Who to Contact at The University of Arizona

Arizona is on Mountain Standard Time all year.

Graduate College
Administration Building, Room 322 ............................................. (520) 621-3471
Admissions ............................................................ (520) 621-3132
Degree Certification ....................................................... (520) 621-3609

Bookstore
UofA Bookstore, west end of the Student Union on the UA Mall .......... (520) 621-2426

Bursar's Office
Administration Building, Room 208 ........................................ (520) 621-3232

Center for Disability Related Resources
Second St. and Cherry Ave. ............................................ (520) 621-3268

Counseling and Psychological Services
Campus Health, second floor, UA Mall and Cherry Ave. .............. (520) 621-3334

Financial Aid
Administration Building, Room 203 .................................... (520) 621-1858

Health Services
Campus Health, UA Mall and Cherry Ave. ............................ (520) 621-6490

Libraries
Main Library, UA Mall and Cherry Ave. ................................. (520) 621-6441
Science-Engineering Library, UA Mall .............................. (520) 621-6384
Arizona Health Sciences Library, AHSC, Room 2140 .......... (520) 626-6241
Law Library, Mountain Ave. and Speedway Blvd. ............... (520) 621-7664

Registrar's Office
Residence Classification, Administration Building, Room 210 ........ (520) 621-3636
Student Information, Administration Building, Room 210 ........ (520) 621-3113

Residence Life (Housing)
Babcock Building, 1717 E. Speedway Blvd. .......................... (520) 621-6500

Student Union
On the UA Mall ......................................................... (520) 621-7755

Summer Session
University Services Building, 888 N. Euclid Ave. ................. (520) 626-8200

Transcripts
Administration Building, Room 210 ................................ (520) 621-3212

Veteran's Certification
Administration Building, Room 210 ............................... (520) 621-9501

Campus Visitors Center
UA Mall and Cherry Ave. ............................................. (520) 621-5130

UA Main Switchboard ................................................... (520) 621-2211

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Announcements in this Catalog concerning regulations, fees, curricula, or other matters are subject to change without notice.
The electronic catalog, found at <http://catalog.arizona.edu>, is the official general catalog of The University of Arizona. Students may access the catalog from any computer connected to the Internet. Please refer to the electronic catalog for the most current information.

Cover photo: Jay Rochlin
UA Alumni Association
Welcome to
The University of Arizona

A Message from the
Interim Dean of the Graduate College

We're glad that you are interested in graduate study at The University of Arizona. Whether you are already enrolled or still considering enrollment, I hope this catalog will give you a sense of the outstanding opportunities for study provided by our university.

You will find in these pages the requirements and course descriptions for each graduate program, and information on Graduate College requirements. More detailed and specific information is available from the Graduate Advisors and Graduate Secretaries in each graduate program. The catalog also contains general information regarding campus services, centers and research units, resources and faculty members.

I encourage you to work closely with faculty in the department of your choice. Explore the many artistic, cultural, scientific, and other creative pursuits at the University and in southern Arizona. Take advantage of this opportunity to learn about yourself, to make lifelong friendships, and to acquire the knowledge and skills that will help you build a satisfying life.

The Graduate College staff is here to assist you—please do not hesitate to call on us for information and help.

Sincerely,

Dennis L. Jones
Interim Dean

THE UNIVERSITY OF ARIZONA RECORD
(USPS 650-800) VOL. XCII NO. 1 May 1999
All colleges and departments establish certain academic requirements which must be met before a degree is granted. These requirements are concerned with such things as curricula and courses, majors and minors, and campus residence. Advisors, directors, department heads, and deans are available to help the student understand and arrange to meet these requirements, but the student is responsible for fulfilling them. At the end of a student's course of study, if all requirements have not been satisfied, the degree will not be granted. For this reason, it is important for each student to become acquainted with and remain currently informed about all regulations and to be responsible for completing requirements. Courses, programs, and requirements described in the Graduate Catalog may be suspended, deleted, restricted, supplemented, or changed in any other manner at any time at the sole discretion of The University of Arizona and the Arizona Board of Regents. The Catalog does not establish a contractual relationship: it summarizes the total requirements which the student must presently meet before qualifying for a faculty recommendation to the Arizona Board of Regents to award a degree.

The determination of acceptability of credit for course work completed at another institution of higher learning, whether the other institution is accredited or not, is made solely at the discretion of The University of Arizona as guided by its academic policy bodies. Students are advised to check with the Graduate Degree Certification Office to determine the acceptability of credit from other institutions and its applicability toward a program of study at The University of Arizona.

Inquiries regarding graduate admission and policies should be addressed to:

Graduate College
Administration 322
P.O. Box 210066
The University of Arizona
Tucson, Arizona 85721-0066
Phone: (520) 621-3132
FAX: (520) 621-7112

Prospective graduate students may receive a complimentary copy of The University of Arizona Graduate Catalog from the Graduate College. In addition, the Graduate Catalog is available on-line at http://grad.admin.arizona.edu.

The University of Arizona's official General Catalog is available electronically at http://catalog.arizona.edu. Students may access the General Catalog from any computer connected to the Internet.

Information regarding the times and locations of scheduled courses is found in the Schedule of Classes, available free in the UofA Bookstore and at the Graduate College Information Counter. Schedules for fall and spring semesters are available in April and October, respectively. The Summer Session Schedule of Classes is available in March. The Schedule of Classes is also available through UAlnfo.
UAInfo

UAInfo is the campus-wide on-line information service. Graduate College policies and procedures and information on financial and support programs offered by the Graduate College are available on-line. Department and course descriptions are linked to the on-line schedule, which offers up-to-the-minute information on the status of course offerings, including additions, cancellations, room changes, and enrollments that are updated as seats are reserved. Students may also see their grades, view their addresses as recorded by the Office of the Registrar, determine their financial award status, and review their class schedules by selecting Student Link.

Connecting to UAInfo

From Computer or Access Point below:

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<thead>
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<th>Command Sequence</th>
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<tr>
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<td>at login prompt: uainfo</td>
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<td>at password prompt: uainfo</td>
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For information or assistance accessing UAInfo, call the Center for Computing and Information Technology (CCIT) Help Desk at (520) 621-HELP, 8 a.m.-5 p.m. Mountain Standard Time.

The University of Arizona Affirmative Action Statement

The University of Arizona is committed to both Equal Employment Opportunity and Affirmative Action and is determined to maintain those principles at all levels of the University for all persons who are employed with and who participate in University-affiliated activities. The University is committed to meeting the provisions of those federal and state laws and University policies which apply to employment and admittance to any University program. The University prohibits discrimination on the basis of age, color, disability, ethnicity, gender, national origin, religion, sexual orientation, or veteran's status, and is also committed to maintaining an environment free from sexual harassment and retaliation.

Equal Opportunity and Affirmative Action Office
University Services Building, Room 219
P.O. Box 210158
The University of Arizona
Tucson, Arizona 85721-0158
(520) 621-9449
TDD Number (520) 626-6768
FAX (520) 621-2095

Accommodation of Religious Observance and Practice

No employee, agent, or institution under the jurisdiction of the Arizona Board of Regents shall discriminate against any student, employee, or other individual because of such individual's religious belief or practice or any absence thereof. Administrators and faculty members are expected to reasonably accommodate individual religious practices. A refusal to accommodate is justified only when undue hardship would result from each available alternative or reasonable accommodation. No administrator or faculty member shall retaliate or otherwise discriminate against any student, employee, or prospective employee because that individual has sought a religious accommodation pursuant to this policy.
## Academic Calendar


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<thead>
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<th>Event</th>
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<tr>
<td>Classes begin</td>
<td>Aug. 23 M</td>
<td>Aug. 21 M</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>Aug. 30 M</td>
<td>Aug. 28 M</td>
</tr>
<tr>
<td>Labor Day - no classes</td>
<td>Sept. 6 M</td>
<td>Sept. 4 M</td>
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<tr>
<td>Last day for dropping courses with deletion of course enrollment form record</td>
<td>Sept. 17 F</td>
<td>Sept. 15 F</td>
</tr>
<tr>
<td>Last day to drop classes with grade of &quot;W&quot;</td>
<td>Oct 15 F</td>
<td>Oct 13 F</td>
</tr>
<tr>
<td>Veterans Day - no classes</td>
<td>Nov. 11 Th</td>
<td>Nov. 10 F</td>
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<tr>
<td>Thanksgiving recess</td>
<td>Nov. 25-28 Th-Su</td>
<td>Nov. 23-26 Th-Su</td>
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<tr>
<td>Classes and laboratory sessions end</td>
<td>Dec. 8 W</td>
<td>Dec. 6 W</td>
</tr>
<tr>
<td>Semester examinations begin</td>
<td>Dec. 10 F</td>
<td>Dec. 8 F</td>
</tr>
<tr>
<td>Semester examinations end</td>
<td>Dec. 17 F</td>
<td>Dec. 15 F</td>
</tr>
<tr>
<td>Winter Commencement</td>
<td>Dec. 18 Sa</td>
<td>Dec. 16 Sa</td>
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<table>
<thead>
<tr>
<th>Event</th>
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<tbody>
<tr>
<td>Classes begin</td>
<td>Jan. 12 W</td>
<td>Jan. 10 W</td>
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<tr>
<td>M. L. King Holiday - no classes</td>
<td>Jan. 17 M</td>
<td>Jan. 15 M</td>
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<tr>
<td>Last day of registration for credit</td>
<td>Jan. 20 Th</td>
<td>Jan. 18 Th</td>
</tr>
<tr>
<td>Last day for dropping courses with deletion of course enrollment form record</td>
<td>Feb. 8 Tu</td>
<td>Feb. 6 Tu</td>
</tr>
<tr>
<td>Last day to drop classes with grade of &quot;W&quot;</td>
<td>Mar. 7 Tu</td>
<td>Mar. 6 Tu</td>
</tr>
<tr>
<td>Spring recess</td>
<td>Mar. 11-19 Sa-Su</td>
<td>Mar. 10-18 Sa-Su</td>
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<tr>
<td>Classes and laboratory sessions end</td>
<td>May 3 W</td>
<td>May 2 W</td>
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<tr>
<td>Semester examinations begin</td>
<td>May 5 F</td>
<td>May 4 F</td>
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<tr>
<td>Semester examinations end</td>
<td>May 12 F</td>
<td>May 11 F</td>
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<tr>
<td>Spring Commencement</td>
<td>May 13 Sa</td>
<td>May 12 Sa</td>
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### Summer Session .................................................. 2000 .................. 2001

#### Presession

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<td>May 15 M</td>
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<td>May 18 Tu</td>
<td>May 15 Tu</td>
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<tr>
<td>Presession classes and examinations end</td>
<td>June 3 Sa</td>
<td>June 2 Sa</td>
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#### First Summer Session

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<td>June 5 M</td>
<td>June 4 M</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>June 7 W</td>
<td>June 6 W</td>
</tr>
<tr>
<td>Independence Day - no classes</td>
<td>July 4 Tu</td>
<td>July 4 W</td>
</tr>
<tr>
<td>First summer session classes and examinations end</td>
<td>July 6 Th</td>
<td>July 5 Th</td>
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#### Second Summer Session

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<td>July 10 M</td>
<td>July 9 M</td>
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<tr>
<td>Last day of registration for credit</td>
<td>July 12 W</td>
<td>July 11 W</td>
</tr>
<tr>
<td>Second summer session classes and examinations end</td>
<td>Aug 9 W</td>
<td>Aug 8 W</td>
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# Abbreviation Guide

The abbreviations listed below refer to the disciplines indicated:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Discipline</th>
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<tbody>
<tr>
<td>ABE</td>
<td>agricultural and biosystems engineering</td>
</tr>
<tr>
<td>ACCT</td>
<td>accounting</td>
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<tr>
<td>AED</td>
<td>agricultural education</td>
</tr>
<tr>
<td>AFAS</td>
<td>African American studies</td>
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<tr>
<td>AGTM</td>
<td>agricultural technology management</td>
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<tr>
<td>AIS</td>
<td>American Indian studies</td>
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<tr>
<td>AER</td>
<td>aerospace and mechanical engineering</td>
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<td>ANES</td>
<td>animal sciences</td>
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<td>ANTH</td>
<td>anthropology</td>
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<tr>
<td>APPL</td>
<td>applied mathematics</td>
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<td>ARB</td>
<td>Arabic</td>
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<tr>
<td>ARCH</td>
<td>architecture</td>
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<tr>
<td>ARE</td>
<td>art education</td>
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<tr>
<td>AREC</td>
<td>agricultural and resource economics</td>
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<tr>
<td>ARH</td>
<td>art history</td>
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<tr>
<td>ARL</td>
<td>arid lands resource sciences</td>
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<td>art</td>
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<tr>
<td>A&amp;S</td>
<td>arts and sciences</td>
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<td>ASTR</td>
<td>astronomy</td>
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<td>ATMO</td>
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<td>B AD</td>
<td>business administration</td>
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<td>CBA</td>
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<td>CBIO</td>
<td>cancer biology</td>
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<td>CCLS</td>
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<td>ECE</td>
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<td>education</td>
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<td>engineering and mines</td>
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<td>exercise and sport sciences</td>
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<td>family and community medicine</td>
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<td>family and consumer resources</td>
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<td>geography and regional development</td>
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<td>geosciences</td>
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<td>German studies</td>
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<td>HWR</td>
<td>hydrology and water resources</td>
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<td>I &amp; S</td>
<td>individuals and societies</td>
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<td>INSC</td>
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<td>INTS</td>
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General Information

The University of Arizona is the flagship institution in the State of Arizona and one of the leading universities in the country. It is both a Research 1 institution and a Land Grant university, and a member the prestigious Association of American Universities. In 1998, the National Science Foundation ranked The University of Arizona 12th among public universities and 17th among all institutions in research expenditures. The UA houses the state’s only colleges of Agriculture, Law, Medicine and Pharmacy, as well as the Arizona Cancer Center. It is also one of few institutions in the country where colleges of Science, Agriculture and Medicine are in the same campus, providing exciting and rigorous opportunities for research and learning, particularly in the sciences. Numerous departments are among the best in the country, including several world-renowned Graduate Interdisciplinary Programs. Graduate students number approximately 7,000 in 83 doctoral and 110 master’s and specialist programs.

A Brief History of the University

In 1885, nearly three decades before Arizona became a state, the territorial legislature approved $25,000 for building The University of Arizona in Tucson. The first classes convened in 1891, when thirty-two students and six teachers met in the original building now known as Old Main.

The University developed in accordance with the Act of Congress of July 2, 1862, known as the Morrill Act, creating land-grant colleges and enabling the institution to obtain federal funds for its original schools of agriculture and mines.

In the early days, there were more students in the preparatory department than in the University proper, and the number of University graduates was never more than ten a year. Then came a decade of rapid expansion. The territory became a state, high schools multiplied, and the preparatory department was closed. In 1915, the University was reorganized into three colleges: the College of Agriculture; the College of Letters, Arts, and Sciences (later Liberal Arts); and the College of Mines and Engineering. The Arizona Bureau of Mines was established the same year.

In 1922, the College of Education was organized and, in 1925, offerings in law, originally established in 1915, were organized under the College of Law. The School of Business and Public Administration, established in 1934, became a separate college in 1944. In 1934, the Department of Home Economics was enlarged to a school within the College of Agriculture, and the College of Fine Arts, including the School of Music, and the Graduate College were established. In 1940, the Board of Regents reorganized the College of Mines and Engineering into two separate colleges, and in 1967 the School of Earth Sciences was organized within the College of Mines, becoming the College of Earth Sciences in 1971. In 1947, the School of Pharmacy was organized, becoming the College of Pharmacy in 1949. The Board of Regents authorized the establishment of the School of Nursing in 1956, which became the College of Nursing in 1963. The Department of Architecture, created in 1958, became the College of Architecture in 1964. In 1961, the College of Medicine was authorized by the Board of Regents. In 1974, the School of Renewable Natural Resources was approved as a new unit of the College of Agriculture. The School of Health Related Professions was authorized by the Board of Regents in 1977. In 1982, the College of Liberal Arts and the College of Fine Arts were reorganized into the College of Arts and Sciences, which included the Faculty of Social and Behavioral Sciences. In 1984, departments under the College of Earth Sciences were reorganized under the College of Arts and Sciences and the College of Engineering, and the School of Home Economics was renamed the School of Family and Consumer Resources. In 1985, the College of Mines combined with the College of Engineering to become the College of Engineering and Mines. In 1993, the Colleges of Medicine, Nursing, Pharmacy, the Department of Medical Technology, and the School of Health Related Professions merged to form the Arizona Health Sciences Center. Arizona International College was founded in 1994 and moved to the UA campus in 1998. In 1995, each of the four Arts and Sciences faculties—Fine Arts, Humanities, Social and Behavioral Sciences, and Science—were given college status. In 1996, the name of the School of Health Related Professions was changed to the School of Health Professions. Two additional colleges have been added since that time: the University College in 1997 and the Honors College in 1999.

The 40-acre campus of the 1890s has grown to 352 acres and 169 buildings. Its purpose remains, in the language of the original law, "to provide the inhabitants of this state with the means of acquiring a thorough knowledge of the various branches of literature, science, and the arts," and, insofar as possible, to provide a technical education adapted to the development of Arizona's resources. The University is maintained by funds appropriated by the State of Arizona and
the United States government, and by
tuition, fees, and collections, including
private grants from many sources.

Current Organization of
the University

The responsibility for administering
Arizona's public universities resides with
the Arizona Board of Regents. The
President of the University is appointed by
the Board and serves as the University's
chief executive officer. The Senior Vice
President for Academic Affairs and
Provost is the University's chief academic
officer. The Senior Vice President for
Business Affairs is the University's chief
fiscal and operations officer. Five vice
presidents: Health Sciences, Research and
Graduate Studies, Undergraduate Educa-
tion, Campus Life, and University
Advancement complete the top manage-
ment team.

Seventeen colleges comprise the
academic divisions of the University. They
are: Agriculture, Architecture, Planning,
and Landscape Architecture, Arizona
International College, Business and Public
Administration, Education, Engineering
and Mines, Fine Arts, Graduate, Honors,
Humanities, Law, Medicine, Nursing,
Pharmacy, Science, Social and Behavioral
Sciences, and the University College. Each
college, except for the University College,
is administered by a dean who has
principal responsibility for academic
programs and procedures for determining
degree requirements. Academic degree
programs are also housed in the Arizona
Prevention Center and the Optical
Sciences Center. Graduate Interdiscipli-
nary Programs are administered by the
Graduate College.

Within colleges are schools, depart-
ments, divisions, and committees, which
have direct responsibility for course
offerings and for the determination of
requirements for majors. The academic
programs offered by the University
through its various units are listed in the
chart which follows in this section of the
Catalog. Course offerings are listed
according to the offering department in
Chapter VIII, Departments and Courses of
Instruction, in this Catalog.

The Graduate College

Graduate studies, in progress continu-
osly since the academic year 1898-1899,
were organized independently in 1934
with the founding of the Graduate
College. Initially, direction was provided
by a dean and a committee composed of
faculty members from graduate-level
disciplines. Administration of the
Graduate College is now provided by the
Dean of the Graduate College and the
Graduate Council, whose members are
appointed by the Faculty Senate and are
broadly representative of areas of graduate
study offered by the University. In
addition, a Committee on Graduate Study
is primarily responsible for maintaining
proper examination standards.

The mission of the Graduate College is
to foster the development of high-quality
graduate education programs which will
attract outstanding faculty, graduate
students, and resources to the University.
It also provides support services to
departments and students through the
Dean's Office, the Graduate Admissions
Office, the Graduate Degree Certification
Office, and other subdivisions. The
Graduate College is further responsible for
administering a variety of special pro-
grams, including those which provide
competitive fellowships, offer research and
travel support, and recruit and retain
minority and international graduate
students.

Building on a well-balanced under-
graduate education, graduate students are
expected to develop a thorough under-
standing of a specific academic discipline.
A fundamental purpose of the Graduate
College is to encourage each graduate
student to demonstrate outstanding
standards of scholarship and to produce
high-quality original research, creative, or
artistic work. Graduate education provides
an opportunity to increase knowledge,
broaden understanding, and develop
research and artistic capability. The
student's academic achievements,
therefore, should reflect a personal
commitment to the discipline and to
scholarly standards.
## Graduate Programs at The University of Arizona

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<td>Women’s Studies</td>
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</table>

1. This program offers a master's degree, but initial admission is to the doctoral program only.
2. PhD minor only
3. Currently not accepting applications.
4. The doctoral program in General Biology is currently inactive.
5. Admission to the master’s degree in Genetics is available only with a concentration in Genetic Counseling.
6. Questions concerning Law and International Trade Law should be referred to the College of Law. Questions concerning Medicine should be referred to the College of Medicine.
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<th>College, Faculty, or School</th>
<th>Department, School, or Committee</th>
<th>Major</th>
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<tr>
<td>Molecular and Cellular Biology</td>
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1. The College of Business Administration offers a Ph.D. in management with majors in accounting, finance, management, management information systems, marketing and public administration.

2. Program offers a master's degree, but initial admission is to the doctoral program only.
I. Admissions

Admission Requirements

To be admitted to a graduate degree program at The University of Arizona, a prospective student needs to apply to both the Graduate College and the academic department in the major that he or she wishes to pursue. Admission is granted only upon the recommendation of the head of the department and the approval of the Dean of the Graduate College.

Admission to the Graduate College is open to qualified individuals who (1) hold a bachelor's degree from The University of Arizona or from a college or university which grants degrees recognized by The University of Arizona, and (2) meet or exceed a grade-point average of 3.00. In addition, applicants must satisfy admission requirements specific to their major academic department, which may include satisfactory scores on standardized examinations such as the Graduate Record Examination (GRE), the Graduate Management Admissions Test (GMAT), or the Miller Analogies Test (MAT). Refer to Departments and Courses of Instruction in this Catalog for specific department requirements. Students may also be able to take a limited number of graduate-level courses before meeting all of the above requirements. Refer to the section on Graduate Non-Degree Admission in this section of the Catalog.

Recognized Degrees

Degrees are recognized based on programs of study that meet or exceed the general educational requirements for comparable majors and degrees at The University of Arizona. A degree cannot ordinarily be recognized if it is based on:

a. Credits awarded by postsecondary institutions in the United States that lack candidate status or accreditation by a regional accreditation association.

b. Credits awarded by postsecondary institutions for life experience unless validated by the institution awarding the credits through the use of standardized or comprehensive examinations (such as the College Level Examination Program or CLEP).

c. Credits awarded by postsecondary institutions for courses taken at non-collegiate institutions (e.g., governmental agencies, corporations, industrial firms, etc.).

d. Credits awarded by postsecondary institutions for noncredit courses, workshops, and seminars offered by other postsecondary institutions as part of continuing education programs.

e. Credits awarded by postsecondary institutions outside the United States that lead to degrees considered not equivalent to the U.S. bachelor's degree, or that lack recognition by the home country's Ministry of Education.

In general, degrees that are recognized should be based on a unit of credit comparable to that defined by the Arizona Board of Regents for institutions under its jurisdiction. A minimum of 45 hours of work by each student is required for each unit of credit. An hour of work is the equivalent of 50 minutes of class time (often called a "contact hour") or 60 minutes of independent study work. For lecture-discussion courses, this requirement equates to at least 15 contact hours and a minimum of 30 hours of work outside of the classroom for each unit of credit. Even though the values of 15 and 30 may vary for different modes of instruction, the minimum total of 45 hours of work for each unit of credit is a constant. Each applicant with an undergraduate academic record containing "pass," "satisfactory," "credit," or similar entries for courses which have a substantial bearing on the field of specialization must also submit (1) a written evaluation by the instructor of each such course, or a letter grade, and (2) scores on the Aptitude Test of the Graduate Record Examination (GRE). Graduates of foreign institutions may be required to enroll in undergraduate-level course work to make up deficiencies in preparation before they can be considered for admission to the Graduate College.
Grade-Point Average

Applicants who apply for admission to the Graduate College are evaluated on the merits of their academic achievements and scholarly potential to complete graduate-level course work and curriculum requirements. A minimum grade-point average of 3.00 based on a 4.00 scale, is required for admission to the Graduate College. Calculation of the grade-point average is based on the final portion of an applicant's undergraduate record (usually 60 credit hours), the graduate record, or a combination of both. Applicants should consult the department to which they are applying regarding that department's grade-point average expectations. Prospective students holding a comparable bachelor's degree but who do not meet the required grade-point average standard may be eligible to enroll in graduate non-degree status. After completion of 12 consecutive semester units of graded (A, B, C) 500 level or higher course work with a minimum grade-point average of 3.25, such students may be considered for admission to a graduate degree program. Refer to the Graduate Non-Degree Admission section of this chapter for additional information.

Graduate Entrance Examinations

The Graduate College does not require standardized examination test scores, but most departments and programs have specific requirements concerning standardized entrance examinations such as the Graduate Record Examination (GRE), the Graduate Management Admissions Test (GMAT), and the Miller Analogies Test (MAT). Some departments may require applicants to take the GRE Subject Test in the appropriate discipline. Refer to Departments and Courses of Instruction for requirements specific to each department.

Normally, applicants must submit examination scores to complete the admission process. These scores are used to supplement other evidence of preparation for graduate work, and are only one component of the credentials used to make admission decisions. It is important that the examination be taken as early as possible in the academic year prior to the application deadline to allow for sufficient processing time. Examinations are administered throughout the country as well as at sites worldwide, and require a registration application accompanied by an examination fee. Information, sample questions, and registration bulletins are available from:

The University of Arizona
Testing Office
Old Main, Room 223
Tucson, Arizona 85721-0001
(520) 621-7589
Internet address: http://w3.arizona.edu/~uco/

GRE, Educational Testing Service
P.O. Box 6000
Princeton, New Jersey 08541-6000
1-800-GRE-CALL
E-mail address: gre-info@ets.org
Internet address: http://www.gre.org

GMAT, Educational Testing Service
P.O. Box 6103
Princeton, New Jersey 08541-6103
1-800-200-7131
E-mail address: gmat@ets.org
Internet address: http://www.gmat.org

Miller Analogies Test
Psychological Corporation
P.O. Box 98215
Chicago, Illinois 60693
1-800-622-3231

Second Graduate Degrees

Applicants to a University of Arizona graduate degree program who previously have earned a degree at the same or higher level in an equivalent discipline, are not routinely admitted by the Graduate College. Exceptions must have the approval of the Dean of the Graduate College.

Additional Admission Information and Requirements for International Students

It is recognized that educational systems in other countries differ from that of the United States. Generally, a four-year, first university degree can be considered comparable to the U.S. bachelor's degree, provided that it was earned at an institution that has official recognition by the Ministry of Education as a university-level academic institution in that country. The comparability of international course work and degrees will be determined solely by the Graduate College.

International applicants who do not meet the necessary academic requirements for admission to a graduate program may wish to apply for admission to an undergraduate degree program, for award of a bachelor's degree. For further information, contact International Student Admissions, P.O. Box 210040, The University of Arizona, Tucson, Arizona 85721-0040, U.S.A.

In addition to the academic requirements for all applicants, international students must satisfy English proficiency, financial guarantee, and health insurance requirements.

Proficiency in English

International students must demonstrate proficiency in English as one of the conditions for admission. Submission of a minimum score of 550 (or a computer-based score of 213) on the Test of English as a Foreign Language (TOEFL) is required of all applicants whose native language is not English. The 550 score is a Graduate College requirement and cannot be waived. Departments may require a score higher but not lower than 550 (213CBT). Exempt from submitting TOEFL scores are applicants who have completed two years of full-time, upper division, academic study in the U.S., or who have received a bachelor's or graduate degree from institutions in the United States, English-speaking Canada, the United Kingdom, Australia, or New Zealand. However, if the student has been residing outside these countries since completing study or earning a degree, he or she may be required to submit current TOEFL scores as part of the admissions process.

When requested by the applicant, an official score report will be sent to The University of Arizona from the Educational Testing Service. Contact TOEFL Services to request the mailing of the student's score report. The University of Arizona institution code is 4832. A student's application is not considered complete until TOEFL scores of 550 (213CBT) or above are received by the Graduate Admissions Office. The test date must be within two years of the intended term of enrollment.

Prospective students who lack college-level English proficiency, or who would like to increase their English ability, can attend full-time English language training on campus at the Center for English as a Second Language (CESL). The full semester and summer term sessions do not carry college credit. However, upon completion of CESL's full-time day program, the student can meet the Graduate College's English proficiency requirement for admission by obtaining written verification from the Director of CESL that satisfactory proficiency in the English language has been attained.
Further information can be requested from the Center for English as a Second Language, The University of Arizona, P.O. Box 210024, Tucson, Arizona 85721-0024, U.S.A. (e-mail: cesl@u.arizona.edu, website: http://www.cesl.arizona.edu)

International students seeking graduate teaching assistantships whose native language is not English, must obtain, in addition to a TOEFL score of 550 (213CBT) or higher, an acceptable score on the Test of Spoken English (TSE) or the Speaking Proficiency English Assessment Kit (SPEAK). Refer to the Employment in Teaching and Research section for further information.

For additional information regarding the Test of English as a Foreign Language, contact:

TOEFL, Educational Testing Service
P.O. Box 6151
Princeton, NJ 08541-6151
1-609-771-7100
E-mail address: toefl@ets.org
Internet address: http://www.toefl.org

Financial Guarantee

Students on non-immigrant visas must certify that they possess adequate financial resources to support themselves while in residence at The University of Arizona. If sponsorship is through an organization or government agency, the sponsor must inform the Graduate Admissions Office, in writing and in advance, of the terms of support. The official letter of sponsorship must include specific information on the amount and duration of the financial award. Financial guarantees must be dated within one year of the term of admission and must be addressed to The University of Arizona. In addition, if the University is to bill a sponsor for the student's tuition and fees, billing must be handled through an embassy or an agency within the United States. Prior to registration, an official letter regarding billing information must be sent to the Center for Global Student Programs, The University of Arizona, 915 N. Tyndall Ave., Tucson, Arizona 85721.

Health Insurance

Students on non-immigrant visas are required by The University of Arizona to carry student accident and sickness insurance coverage for each term of enrollment. The cost of insurance is to be included in the amount of financial guarantee required. Students may be exempted from The University of Arizona's insurance plan only when their government or sponsoring agency has submitted accident and sickness insurance plans deemed acceptable by The University of Arizona. Individual health insurance coverage for Teaching and Research Assistants and Associates is provided by the University; thus, the cost of individual health insurance does not have to be included in the financial guarantee of international students holding such appointments. Additional information about this coverage will be sent to international students who are accepted for admission.

Application Procedures for Admission to a Degree Program

Application for admission to The University of Arizona must be made on forms furnished by the Graduate College. Application packets are available upon request from the Graduate Admissions Office, The University of Arizona, P.O. Box 210066, Tucson, Arizona 85721-0066, (520) 621-7816, e-mail address: gradadm@lorax.admin.arizona.edu. Applicants should also contact the department of their intended major to obtain program application requirements and materials. Prospective students can apply to only one major at a time.

Applicants are responsible for submitting complete application materials as specified in the packet of instructions, both to the Graduate Admissions Office and to the department of their intended major. Official transcripts or yearly mark sheets, including confirmation of degrees awarded, are required for each institution previously attended. If the records are not in English, applicants must provide the official original language document with a certified English translation. Credits which appear as transfer units on another institution's official record will not be accepted in lieu of the original transcript. University of Arizona graduates may need to request their official transcript of record from the Registrar's Office. Refer to individual program information for requirements specific to each major. International applicants should refer to the sections above on English Proficiency, Financial Guarantee, and Health Insurance for additional Graduate College requirements.

Deadlines for Application

Final deadlines for application to the Graduate College are as follows:

U.S. Citizens and Permanent Resident Applicants:
- Fall Semester (August) ............. June 1
- Spring Semester (January) ......... October 1

International Applicants:
- Fall Semester (August) ............. February 1
- Spring Semester (January) ........ August 1

Required credentials can be submitted to the Graduate Admissions Office and the appropriate department as early as one year in advance. Most departments have deadlines earlier than those listed above, often during the month of December for enrollment in the following Fall Semester. Consult individual program information for specific department deadlines. Complete applications, including the application fee, not received by the dates noted above, will not be considered for that term. Instead, they will be automatically considered for the next available term.

Readmission Requirements

Students registered in a program of study must enroll continuously until the completion of the degree.

A student is required to apply for readmission if he or she was previously enrolled in a University of Arizona graduate degree program but has not been officially enrolled for one or more semesters (fall/spring) or received an approved Leave of Absence. Previous admission to the Graduate College does not guarantee readmission at a later date. Financial penalties for violation of continuous registration requirements may also be imposed. A minimum grade-point average of 3.00 on all graduate-level study completed at The University of Arizona is required for readmission. Students who have been enrolled elsewhere since their last attendance at The University of Arizona must submit official transcripts of that study at the time of application for readmission.

International students who have been outside the U.S. for two or more years since their last enrollment at The University of Arizona must submit current TOEFL scores. Additionally, international applicants who need visa documents to be issued by the Graduate Admissions Office are required to submit current financial guarantee statements.

"Summer Only" Attendance

Students who enroll in graduate-level study in the summer terms only are not required to submit an application for readmission for the following summer.
They will receive a Graduate Admissions Office form at their last reported address, instructing them on the process to continue summer-to-summer enrollment.

Students who do not attend consecutive summers must submit an application for readmission. Likewise, those who elect to enroll in a fall or spring term following their summer attendance may be required to apply for readmission. Refer to the Readmission Requirements section above for related information.

Application Fees
The Graduate College's Application for Admission to Graduate Study provides information on current application fees. Acceptable forms of payment include check, money order, or bank draft payable through a U.S. affiliated bank in U.S. dollars to The University of Arizona Graduate College, and U.S. currency. Payments by credit card (Visa or Mastercard) are also accepted. It is recommended that applicants do not send currency through the mail. Applications received without the required, non-refundable application fee will not be reviewed.

Notification of Admission
Each applicant recommended for graduate admission by a department and determined eligible by the Dean of the Graduate College will be issued a Certificate of Graduate Admission for the term for which he or she has applied. The Certificate of Graduate Admission can be issued only by the Dean of the Graduate College and is the sole official verification that graduate admission to The University of Arizona has been approved for a specific term.

Applicants who do not enroll for the term to which they have been admitted, but wish to defer enrollment to another term, must contact their department. They may be required to submit additional documentation for consideration at a later time. Admission to a specific term does not guarantee admission to subsequent terms.

The Certificate of Graduate Admission will specify the status to which the applicant has been admitted, as follows:

Regular Graduate Status: Students who meet all admission requirements may be admitted to Regular Graduate Status to undertake work leading to an advanced degree. Only students in Regular Graduate Status can be awarded a graduate degree.

Admission with Deficiencies: Additional undergraduate courses may be required when previous academic work has not met the general requirements for the corresponding bachelor’s degree at The University of Arizona or the requirements for the field in which the candidate proposes to specialize. With departmental approval, a maximum of 16 semester units of undergraduate course work may be completed after admission to a graduate program to make up deficiencies. No graduate credit will be earned for this course work.

Provisional Admission: Provisional admission indicates some reservation on the part of the Graduate College or major department with regard to the applicant's qualifications to undertake graduate work leading to an advanced degree. This restriction does not impair the student's opportunity to earn graduate credit in properly selected courses. If admitted provisionally, a student can request regular graduate standing upon completion of 9 credit hours of graduate work with a grade-point average of 3.0 or higher, if he or she also meets other requirements established by the major department or academic unit. Students admitted provisionally solely because they lack the GRE or other standardized examination scores may request conversion to Regular Graduate Status immediately upon the receipt of the scores by their department. Students on Provisional Status who wish to be admitted to Regular Graduate Status are responsible for submitting a “Provisional to Regular Graduate Status Request” form available from the Graduate Degree Certification Office.

International Special Status: International students may be admitted initially to International Special Status for a period of enrollment limited to two academic semesters, with the understanding that they may be required to complete a number of units without earning graduate credit to make up deficiencies. Students admitted to this status must enroll full-time, for a minimum of 9 units of credit per semester. At the conclusion of the student's first semester in residence, the Graduate College and the department to which the student seeks admission will evaluate the student's progress. If the department recommends a change to Regular Graduate Status, the student can receive graduate credit for all graduate courses taken during the first semester in residence. If the department does not recommend conversion to Regular Graduate Status, a final evaluation of the student's progress will be conducted following the student's second semester in residence. If the change is approved, the student can receive graduate credit for all graduate courses taken during the one semester immediately preceding the award of Regular Graduate Status. If the department cannot recommend a change to Regular Graduate Status after the second semester, the student will be removed from the degree program. It is the responsibility of the student to initiate the paperwork requesting conversion to Regular Graduate Status, by submitting an
"International Special Student Change of Status" form to the Graduate Degree Certification Office.

"Subject To" Admission: A student who is admitted pending completion of Graduate College requirements (as in the case of a student who applies for fall semester admission while completing a bachelor's degree the previous spring) must submit to the Graduate Admissions Office the required documentation within 30 days of the beginning of the first term of enrollment. Failure to comply will result in the restriction of the student's record at The University of Arizona, prohibiting future registration, receipt of semester grades, disbursement of financial aid funds, and release of the official transcripts and other student records.

Graduate Non-Degree Admission

Individuals holding a bachelor's degree or its equivalent from a college or university which grants degrees recognized by The University of Arizona, may enroll in graduate-level courses without being admitted to a graduate degree program. Such students may enroll in graduate-level course work as their qualifications and performance permit. It is advisable to contact the department(s) offering courses of interest to insure that they are available to non-degree students. Up to 12 units of graduate credit earned in non-degree status and/or transferred from other institutions may be petitioned for application toward an advanced degree once the student obtains regular admission to a degree program. International applicants requiring a student visa are not eligible for graduate non-degree admission.

Applicants who do not meet the minimum required cumulative grade-point average of 3.00 to be admitted to a graduate degree program may enroll in Graduate Non-Degree Status. After completing 12 consecutive semester units of graded (A, B, C) 500 level or higher course work with a minimum grade-point average of 3.25, they may apply for admission consideration to a graduate degree program.

The Graduate College requires that applications for non-degree status, along with the required application fee, be submitted no later than the day before classes begin. However, to avoid late registration penalties assessed by the Bursar's Office, students must submit their application, application fee, and registration payment by the payment deadline, which is approximately one month earlier than the first day of class. Application forms and information on current fees can be obtained from the Graduate Admissions Office.

Students in non-degree status are not eligible for federal financial aid or for any financial assistance offered by The University of Arizona.

Graduate Admissions Office

For further information, please contact:

Graduate Admissions Office
The University of Arizona
P.O. Box 21066
Tucson, Arizona 85721-0066
General Information
(520) 621-3471
Application/Catalog Requests
(520) 621-7816
Admissions Information
(520) 621-3132
Fax (520) 621-4101
E-mail address: gradadm@lorax.admin.arizona.edu
Internet address: http://grad.admin.arizona.edu/gradadm/gradadm.htm

Graduate Study in Summer Session

Graduate study is available during summer session. Many departments allow students to conduct individual research in their special fields. Courses through which a student is able to conduct individual research are listed under the respective department, but students must obtain the consent of the course instructor(s) before registering. Students wishing to enroll in graduate course work during the summer must submit the appropriate application and fee, meet entrance requirements, and be officially admitted by the Graduate College prior to the beginning of the appropriate summer session. Contact the Graduate Admissions Office for additional information.

Graduate credit earned at The University of Arizona Summer School in Guadalajara, Mexico, may be used directly in advanced degree programs where appropriate.

In certain departments provision is made for teachers in service and others who are unable to attend the University during the regular year to complete the requirements for the master's degree by attendance at summer session only.

Extended University

In cooperation with University colleges and departments, the Extended University provides opportunities for graduate study through evening, weekend, and video-based classes. Students wishing to enroll in graduate course work taken through the Extended University must submit an appropriate application and fee, meet entrance requirements, and be officially admitted by the Graduate College.

The Graduate Gerontology Certificate Program and the Certificate Program in Accounting are available through the Evening and Weekend Campus.

Graduate programs through VideoCampus include the Master of Arts degree with a major in Information Resources and Library Science; the Master of Science degree with majors in electrical engineering, emphasizes in communication devices, digital hardware, electronic circuits, electronic packaging, and general purpose; the Master of Science degree with a major in optical sciences, available from The University of Arizona in cooperation with the National Technological University satellite network; and the Professional Certificate in Reliability and Quality Engineering, requiring 15 units of graduate-level course work. The Master's of Engineering (M.Eng), a terminal Master of Engineering degree for professionals already working in industry, will be available in the Fall, 1999.

For further information, contact Extended University, University Services Building, Room 322, 888 N. Euclid Ave., Tucson, Arizona 85721-0139, (520) 621-8630, FAX: (520) 621-3269.

Photo: Margaret Hartshorn, AHSC Biomedical Communications
## II. Expenses, Fees, and Financial Assistance

### Registration and Tuition Fees

Registration and specified fees are paid by all students enrolled at The University of Arizona. In addition, students who are not official residents of the State of Arizona pay non-resident tuition. Conditions determining state residency are established by Arizona state law. A summary of conditions and processes for determining residency status, as well as a copy of the on-line application, is available through The University of Arizona's main web page at www.arizona.edu and through the Office of Residency Classification at (520) 621-3636.

### Summer Session Fees

Registration and fees per unit of credit in the summer are $115.50.* Non-resident tuition is not assessed during summer sessions. Additional charges include an Arizona Financial Aid Trust fee of $5.00 for 1-6 units of credit or $10.00 for 7 or more units of credit; a $12.50 Recreation Center fee for 3 or more units per session, a $1.00 fee supporting campus radio (KAMP); and a $1.00 ASA fee per summer session. Because all fees are subject to change, students should consult the current Summer Session Schedule of Classes for fees in effect for any given year.

* Reflects expenses and fees for the 1999 Summer Session. Expenses and fees for 2000-01 Summer Sessions and beyond were not available at the time of publication of this Catalog.

### Tuition and Fees Per Semester for the 1999-00 Academic Year

#### Arizona Residents

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1. Expenses and fees for 2000-2001 were not available at the time of publication of this Catalog. The Arizona Board of Regents has the legal responsibility to establish fees and reserves the right to change all fees without notice. Current registration and tuition fees are published in the Schedule of Classes for each term and are available from the Bursar's Office, (520) 621-3232.

2. The Arizona Financial Aid Trust (AFAT) was approved by the Arizona Legislature in the 1989-90 academic year to enable currently enrolled students in Arizona universities to receive additional financial aid. It provides for the creation of a long-term endowment to assist future generations of Arizona students. The AFAT fee is assessed to all students who register for any fall, spring, or summer term and is nonrefundable once classes begin.

3. The Recreation Center fee was adopted by a student referendum in 1985 providing for a mandatory $25 per semester fee for all students registering for 4 or more units of credit.

4. A Special Fee of $1.00 for KAMP Campus Radio was approved by the Arizona Board of Regents for 1997-98.

5. A $1.00 refundable fee supports the Arizona Students Association.
Special Course Fees and Deposits

Special course fees and deposits are applicable only under certain specific conditions, and must be approved by the Provost and/or the Arizona Board of Regents. Fees for off-campus field trips, specialized equipment or facilities, private instruction, expendable materials, and refundable deposits for equipment entrusted to the care of students, may be assessed and are payable at the time of registration. Special course fees are identified in the Schedule of Classes for the term in which the course is offered. The following special fees or deposits were approved at the time of the printing of this catalog:

### Special Course Fees Schedule

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</tbody>
</table>

This information is subject to change for compliance with federal and state regulations.

### Arizona Universities Collection of Fees Policy*

The universities shall collect at the time of registration the payment or promise of payment of only those fees which are required for the proper operation of the universities and which are subject to the control of and disbursement by the universities. Each university shall establish procedures to collect outstanding obligations owed by students and former students. Each university shall maintain a system to record all delinquent financial obligations owed to that university by students and former students. Students with delinquent obligations shall not be allowed to register for classes, receive cash refunds, obtain transcripts, diplomas, or a certificate of degree. The university may allow students to register for classes, obtain transcripts, diplomas, or certificate of degree if the delinquent obligation is $25 or less. Unpaid obligations shall remain a matter of record until students and former students satisfy their financial obligations or until satisfactory arrangements for repayment are made with the university. The university may write off delinquent financial obligations for students according to accepted accounting principles and after appropriate collection efforts. No such write-off shall operate to relieve the student for liability for the obligation nor shall such write-off entitle the student to release of any transcript, diploma, or certificate of degree, or to register for further university classes until such obligation is actually paid.

*From the Arizona Board of Regents Policy Manual.*
Minimum Estimated Expenses for Full-Time Off-Campus Students for Academic Year, 1999-2000*

<table>
<thead>
<tr>
<th></th>
<th>Arizona Residents</th>
<th>Non Residents **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuitions and Fees</td>
<td>$2,264</td>
<td>$9,416</td>
</tr>
<tr>
<td>Room/Meals</td>
<td>7,334</td>
<td>7,334</td>
</tr>
<tr>
<td>Books</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td>Travel</td>
<td>1,650</td>
<td>1,650</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>2,660</td>
<td>2,660</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$14,608</td>
<td>$21,760</td>
</tr>
</tbody>
</table>

* Minimum estimated expenses for 2000-2001 were not available at the time of publication of this Catalog.

** Out-of-state and international students.

Additional Miscellaneous Expenses

Music Fee for private lessons, per semester*  
2 hours per week ...................................... $160
1 hour per week ...................................... 100

Late Registration and payment fees  
Late registration penalty ............................ $50
Late payment penalty ................................ $25-500
Late payment for registration on or after the 21st day of class (includes weekends) ............... $250

Degree Certification fees  
Application for degree candidacy .................. $15
Processing fee (thesis or dissertation) .......... $15
Thesis microfilming fee (optional) ............... $65
Dissertation microfilming fee ..................... $65
Copyright fee ........................................ $45

Transcript fees  
Unofficial .............................................. $1
Official, mailed within 9 working days ....... $4
Official, mailed within 5 working days  or for pickup at counter ........................................ $6

* A Graduate Assistant currently on appointment is exempt from music fees in the major field if the student is a music major.

Employment, Scholarships, and Financial Aid

Financial assistance for graduate students is available from diverse sources. The primary sources of information and assistance are the student's department, the Graduate College (Administration Building, Room 322, web address http://grad.admin.arizona.edu, and the Office of Student Financial Aid (Administration Building, Room 203). The University Library Reference Desk is also a source of information regarding external grants, scholarships, and other financial aid. Various types of financial aid are described in the following paragraphs.

Employment in Teaching and Research

Teaching and research assistantships and associateships are available in many departments. Approximately 2,500 of these positions exist and many of them are awarded to first-year graduate students. Salaries vary, but students may expect to receive a salary in the range of $7,900 to $19,300 for half-time (20 hours per week) assistantships and associateships. The benefits associated with the appointment include individual Student Health Insurance provided through Campus Health, an ASUA Bookstore discount, and a waiver of non-resident tuition. Students on appointment are responsible for registration fees.

As a condition of employment, all graduate assistants/associates must be enrolled in a graduate degree program, maintain a minimum grade point average of 3.00 at The University of Arizona, and be enrolled for a minimum of 6 units of graduate credit per semester. Some colleges require their graduate assistants/associates to register for more than 6 units. The maximum number of units per semester which graduate assistants and associates are allowed to take is dependent upon the total number of hours they are employed by the University.

Maximum Enrollment for Graduate Assistants/Associates

<table>
<thead>
<tr>
<th>Full time Equivalency</th>
<th>Hours per pay period</th>
<th>Maximum units</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>33%</td>
<td>26.4</td>
<td>14</td>
</tr>
<tr>
<td>50%</td>
<td>40</td>
<td>12</td>
</tr>
<tr>
<td>66%</td>
<td>52.8</td>
<td>11</td>
</tr>
<tr>
<td>75%</td>
<td>60</td>
<td>10</td>
</tr>
</tbody>
</table>

Graduate assistants/associates are not required to enroll during the summer session to maintain employment status. Interested students should contact the hiring department regarding application procedures.

All graduate teaching assistants/associates who have direct instructional contact with students are required to participate in a two-day University-wide Graduate Teaching Assistant Orientation offered the week prior to the first day of classes. They must also attend their hiring department's orientation, which covers...
specific information relevant to that department and to the course(s) to be taught.

International students who have been awarded a graduate teaching assistantship and whose native language is not English, must submit verification of spoken English proficiency to be able to perform duties that include direct instructional contact. Such students must obtain a score of 550 on the Test of English as a Foreign Language (TOEFL) (213 for computer based score), a score of 230 (in testing prior to 1996) or of 50 (in testing after 1996) on the Test of Spoken English (TSE/SPoK).

Scholarships, Fellowships, Traineeships, Grants, Awards

A limited number of University scholarships, fellowships, traineeships, grants, and awards from diverse sources are available to academically meritorious graduate students. Interested students should contact their departments for information regarding a list of awards, specific guidelines, and availability. Graduate College awards are described below.

Graduate Tuition Scholarships waive non-resident tuition only. Eligibility requires the student to be admitted to regular graduate status in a graduate degree program, have a minimum GPA of 3.2, be in good academic standing, and be enrolled in 3 or more graduate units per semester.

Graduate Registration Scholarships waive registration fees only. Eligibility requires the student to be admitted to regular graduate status in a graduate degree program, have a minimum GPA of 3.5, be in good academic standing, and be enrolled in 3 or more graduate units per semester.

Graduate Fellowships offer a maximum of $10,000 for one academic year. A full fellowship carries one waiver of non-resident tuition. Eligibility requires the student to be admitted to regular graduate status in a graduate degree program, have a minimum GPA of 3.2, be in good academic standing, and be enrolled in 9 or more graduate units each semester during the fellowship period.

Students should contact their departments for availability and application procedures regarding the above three awards. Waivers and fellowships are subject to Graduate College approval.

The Dean's Fellowship Program/Doctoral Competition is available through the Graduate College to support doctoral students in the conduct of dissertation research. The Fellowship provides a one-year stipend of $12,000 plus a waiver of non-resident tuition and registration fees. Applicants must have a minimum cumulative graduate GPA of 3.5, have completed all or nearly all of their course work, passed their oral comprehensive exam, and have a dissertation proposal approved by their dissertation committee.

The Dean's Fellowship Program/Master of Fine Arts Competition is designed to support Master of Fine Arts students in the conduct of their final projects for the degree. Fellowships provide a one-year stipend of $6,000 and waivers of non-resident tuition and registration fees. Applicants must have a minimum GPA of 3.5, have completed all or nearly all of their course work, have a final project proposal approved by their committee, and have an approved master's Application to Candidacy.

The Herbert E. Carter Graduate Fellowship in Interdisciplinary Programs is designed to support a student of outstanding promise, creativity, and scholarship to work in an interdisciplinary area. The fellowship provides a one-year stipend of $12,000 and waivers of non-resident tuition and registration fees. Applicants must be enrolled in a Graduate
Interdisciplinary Program, have a cumulative GPA of 3.5 or higher in their combined undergraduate and graduate studies, be enrolled full-time, and be in residence on campus during the tenure of the fellowship.

The Michael A. Cusanovich Research Fellowship is designed to support an outstanding doctoral student whose dissertation project is judged to exhibit extraordinary creativity and promise. The fellowship provides an annual stipend of $12,000 and waivers of non-resident tuition and registration fees. Applicants must have a minimum cumulative graduate GPA of 3.5, have completed their course work, passed their oral comprehensive exam, and have their dissertation proposal document approved by their dissertation committee.

The Final Project Fund provides up to $1,500 to graduate students engaged in thesis or dissertation research or other creative activities required to complete a graduate degree. Eligible students must be currently enrolled in a graduate degree program, be in good academic standing, and be engaged in thesis or dissertation research under the sponsorship of a faculty member.

The Graduate and Professional Student Travel Fund provides funds to graduate and professional students in academic programs under the aegis of the Graduate College, to present invited papers, posters, or presentations at professional meetings, conferences, and symposia directly related to their educational development.

The Graduate College Thesis/Dissertation Waiver ("900 waiver") provides a waiver of up to 6 units of non-resident tuition for students who are in good academic standing, are enrolled in a minimum of 3 and a maximum of 6 units at the 900-level (thesis or dissertation) and will not be using university resources such as libraries, computer laboratories, and faculty time to any extent during the period covered by the waiver.

Information, applications and deadlines for all programs above are available at the Graduate College Information Counter, Administration Building, Room 322.

Financial and Academic Support for Minority Students

The Graduate College administers several programs designed to provide academic, financial, social, and cultural support to graduate students who are underrepresented in graduate programs: Hispanics, Native Americans, African Americans and Asian Americans/Pacific Islanders.

Financial support offered by the Graduate College includes Graduate Minority Tuition Scholarships, Graduate Minority Registration Scholarships, and Graduate Minority Fellowships. Support to students is also available through the Minority Student Development Fund, the Minority Final Project Fund and the Minority Travel Fund. Minority students must meet the same merit-based eligibility criteria existing in counterpart programs. In addition, Graduate Minority Fellowships require verification of financial need which is determined when the student files a Free Application for Federal Student Aid (FAFSA form). Academic support of up to 12 hours of tutoring or other academic assistance per year is also available to minority students enrolled in a graduate degree program.

Additional information, application forms, and guidelines are available from the Graduate Multicultural Programs Office, Administration Building, Room 302, (520) 621-9192, FAX (520) 621-7112, and from the Graduate College Information Counter, Administration Building, Room 322.

Federal, State, and Institutional Financial Aid

Eligibility for need-based grants, loans, scholarships, and College Work Study programs is determined by completing a Free Application for Federal Student Aid (FAFSA) form available at most universities and community colleges. Most of the financial aid available to graduate students is in the form of loans. However, it is important that graduate students file a FAFSA form if they do not plan to apply for need-based loans but want to be considered for all other financial assistance. The priority service deadline for The University of Arizona is March 1 for the following academic year. Awards are limited by the availability of funds. For most aid, applicants must have been admitted to a degree program before the Office of Student Financial Aid will process the application. Exceptions are made for certain instances under the graduate non-degree status. A separate application is required for the Federal Family Education Loan program. Students are encouraged to complete the FAFSA early as processing time can involve up to 4 months. Contact the Office of Student Financial Aid, Administration Building, Room 203, (520) 621-1858 for more information.
III. Registration, Grading, and Academic Policies

Registration

After the student is admitted to the Graduate College, he or she can register through the Registration System Via Phone (RSVP) by calling (520) 884-7787 from a touch-tone phone anywhere in the world. Each semester and summer term, detailed information, including dates and times graduate students have access to RSVP, and important deadlines for admission, registration, and payment of tuition and fees, is published in that term's Schedule of Classes.

Orientation

New students are encouraged to attend a Graduate College Orientation to become acquainted with university and community resources and assistance. This orientation is usually held in August on the Tuesday before the Fall term begins. Students are expected to attend an orientation in their department, if available, to find out about specific degree requirements and assistance available from their colleges and departments.

Enrollment Policies

Full-Time Status

During the fall and spring semesters, full-time status consists of enrollment for 9 units of graduate credit, or 6 units of graduate credit plus an assistantship or associateship, or 3 or more units of 900-level enrollment. During presession and first and second summer sessions, full-time status consists of enrollment for 6 graduate units or more in any combination of presession, first, and second summer sessions. Some colleges require a greater number of units to maintain full-time graduate status. A student whose financial aid agreement requires enrollment during the summer sessions, should contact the Office of Student Financial Aid to verify specific requirements. International students should check with the University's Center for Global Student Programs to ensure that their registration is in compliance with their visa status.

Minimum Enrollment

The minimum enrollment allowed per semester (fall and spring) for students enrolled in the Graduate College is 3 graduate units. For students holding teaching or research assistantships/associateships, the minimum enrollment required is 6 graduate units. During summer sessions, minimum enrollment is 1 graduate unit. Some colleges and/or departments require additional units for students holding teaching or research assistantships/associateships.

Maximum Enrollment

The maximum enrollment (including graduate, undergraduate, and audited courses) allowed per semester (fall and spring) for students registered in the Graduate College is 16 units. During each summer session the maximum allowed is 6 units. Academic programs may require a greater number of units to maintain full-time status. In these instances, approval from the Graduate College is required.

Schedule Changes

The Schedule of Classes, issued each semester and summer, identifies the last dates for graduate students to drop or add classes, change from credit to audit, withdraw from a class, and make any other schedule changes. Students may make program changes at any time up to the deadlines identified in the Schedule of Classes, by submitting an Add/Drop Form available from departments and at the Graduate College. A student is solely responsible for being enrolled in the appropriate courses. Enrollment can be verified by calling the Registration System Via Phone (RSVP) at 884-7787.

Program Changes

Students who wish to change their major and/or degree objective, who are currently enrolled in a degree program and who have not had a break in their enrollment (summer sessions excepted), can file a Change of Degree Program form available from the Graduate Degree Certification Office. Students who have previously been enrolled in a graduate degree program but who have had a break in their enrollment of at least one semester (summer sessions excepted) are required to apply for readmission to the Graduate Admissions Office. Refer to the Readmission Requirements section in chapter I, Admissions, of this Catalog.

Continuous Enrollment

A student admitted to a graduate degree program must register each fall and spring semester for a minimum of 3 graduate units from original matriculation until all degree requirements, including submission of the final copy of the thesis or dissertation, are completed, unless excused through a Leave of Absence (See Leave of Absence Policy below). Students receiving teaching or research assistantships/associateships must register for a minimum of 6 units. Graduate students do not have to register for graduate units during summer sessions unless they plan to make use of University facilities or faculty time. If they plan to utilize facilities or
Undergraduate students who wish to enroll in 500-level courses for graduate credit, must have a minimum cumulative GPA of 3.00, be within 15 units of completing all requirements for graduation, not apply the 500-level course to fulfill a bachelor's degree requirement, proceed toward graduation as directly as possible, and propose a semester load that does not exceed 16 units of combined undergraduate and graduate work. The student must also obtain approval of the course instructor, the student's department head, and the Dean of the Graduate College. Courses numbered at the 600, 700, and 900-levels are not open to undergraduates.

Use of 400-Level Courses in Graduate Programs
Graduate students may apply, with the approval of their major and minor department heads, up to 6 units of 400-level course work taken at The University of Arizona to fulfill degree requirements in the minor area. These units will not receive graduate credit or be included in the calculation of the student's graduate grade-point average.

Correspondence and Extension Credit
Correspondence courses and courses provided through Extension at other institutions will not be accepted for graduate credit.

Grading Policies
The grading system used by The University of Arizona is as follows:

A ...... Excellent
B ...... Good
C ...... Average
D ...... Poor
E ...... Failure
F ...... Failure (See Pass/Fail Option)
P ...... Passing (See "Special Grades," "Pass-Fail")
S ...... Superior (See "Special Grades")
I ...... Incomplete
K ...... Course in Progress
W ...... Approved Withdrawal
O ...... Audit
CR .... Credit
Y ...... No grade reported

A, B, C, D, E constitute the regular grades used at The University of Arizona, and only courses graded in this fashion are included in the calculation of the grade-point average.

Pass-Fail Option
Graduate credit is not available for Pass/Fail courses. However, graduate students can take courses offered by the College of Law for Pass/Fail with prior approval of the Graduate College. Graduate students who need to complete admission deficiencies or who wish to take undergraduate credit courses available for P/F grading, may take Pass/Fail courses but not earn graduate credit through those courses.

Special Grades
The grades S (superior) or P (passing) are used in place of grades A or B respectively for Individual Studies courses numbered 591, 593, 594, 599, 691, 693, 694, 699, 791, 793, 794, 799, 900, 908, 909, 910, 913, 920, and 925. The only grades available in the courses numbered 599, 699, and 799 are S, P, C, D, E, I, and W. For courses numbered 595, 596, 695, 696, 795, and 796, the instructor may use either these special grades or the regular letter grades as departmental policy dictates as long as all registrants in the course are graded by the same system. Grades available for 900 are S, P, C, D, E, K, and W. The only grades available for 908, 909, 910, 915, 920, and 925 are S, P, E, K, and W. The only grade available for 930 is K. Special grades (S, P) are not used in the computation of the grade-point average.

Incompletes
The grade of "I" for "Incomplete may be awarded only at the end of the semester when all but a minor portion of the course work has been satisfactorily completed. Students should make arrangements with the instructor to receive an incomplete grade before the end of the semester. Graduate students have a maximum of one calendar year to remove an Incomplete. Incomplete grades are not included in the calculation of the grade-point average until one year from the date of the award. A grade of "I" not removed within one year is replaced by a failing grade of "E" and counted as an "E" in determining the grade-point average. The degree will not be awarded if there is a possibility that the student's cumulative grade-point average will fall below 3.00 through the conversion of Incomplete grades to failing grades.
Withdrawal from a Course
Withdrawal from a course within the first four weeks after registration will result in the deletion of the course from the academic record. After the fourth week and through the end of the tenth week of classes, the grade of “W” may be awarded to students earning a passing grade at the time of the official withdrawal. Requests for complete withdrawal from the University are initiated through the Office of the Dean of Students. Students leaving the University without a statement of formal withdrawal will be awarded a failing grade in each course.

Auditing
With the consent of the course instructor and the Dean of the Graduate College, graduate students may audit courses not included in their regular programs of study by filling out a Drop/Add form. Such units are included in the student’s unit load and are charged the same fees as registration for credit. Audit units, however, are not counted in the computation of full- or part-time status. A change from credit to audit will be permitted after the fourth week of classes and until the last day of class only if the student is earning a passing grade in the course and receives the approval of the course instructor and the Dean of the Graduate College. Refer to the Schedule of Classes for the final date for changing a course from audit to credit and vice versa. Changes from audit to credit are not allowed after the end of the semester.

Change of Grade
Within one year of the awarding of a grade, final grades may be changed by the instructor on a Change-of-Grade Form only if there has been an error in computation. The grade change must be approved by the head of the instructor’s department and the Dean of the Graduate College.

Repeating Courses
Graduate students may not repeat a course for graduate credit unless it is marked “Rpt”. Such courses, while retaining the original course number, contain different content each semester they are offered. The Grade Replacement Opportunity program, available to undergraduate students at The University of Arizona, is not available to graduate students. Refer to Chapter VIII, Departments and Courses of Instruction, for specific course information.

Computing Grade-Point Averages
For the purpose of computing grade-point averages, grade points are assigned to each grade as follows: A, 4 points for each unit; B, 3 points; C, 2 points; D, 1 point; and E, 0 points. To calculate the grade-point average, the unit value for each course is multiplied by the number of grade points for that grade. The sum of these products is then divided by the sum of the units of A, B, C, D and E. The grade-point average is based only on credit earned at The University of Arizona.

Grade Appeal
A student may appeal a grade during the first regular semester after the semester or summer term in which the grade was awarded. Grade appeals are not processed during the summer sessions unless the dean of the college in which the course is offered determines that the case warrants immediate review. The appeal involves a stepwise and formal process, progressively involving the instructor, the department head, the dean of the college under which the course is offered, and can involve a committee appointed by the dean to review and make recommendations. Written verification of each step as well as close adherence to a timetable is indispensable. The dean of the college under which the course is offered has the final authority to make a decision regarding the grade appeal. The Graduate College does not process or become involved in such appeals. A copy of the Grade Appeal policy and timetable can be found in The University of Arizona electronic catalog http://catalog.arizona.edu, and at the Graduate College Information Counter.

Academic Policies
A high level of performance is expected of students enrolled for graduate work. To remain enrolled in a degree program, a student must be making satisfactory progress toward completion of the degree.

Minimum Academic Requirements
A student cannot receive an advanced degree unless he or she has achieved a grade-point average of 3.00 or higher on all course work taken for graduate credit, whether or not the courses are offered in satisfaction of specific requirements for an advanced degree. Students who do not
meet the required 3.00 GPA on course work required in their specific degree program may take additional graduate course work.

Satisfactory Academic Progress

In addition to maintaining a minimum 3.00 grade-point average, students enrolled in a graduate degree program are required to demonstrate satisfactory academic progress toward degree completion. Failure to meet satisfactory academic progress requirements is grounds for conversion to graduate non-degree status by the Dean of the Graduate College. Each department has its own criteria for evaluating a student's academic progress, on file in the Office of the Dean of the Graduate College. The Graduate College will apply the appropriate department's criteria when the department requests a student's conversion to graduate non-degree status for failure to demonstrate satisfactory academic progress. Specific department satisfactory academic progress policies are available from departments and from the Office of the Dean of the Graduate College.

Academic Probation

Students who have a cumulative grade-point average of less than 3.00 will be placed on Academic Probation. Students on Probation are required to meet with their graduate advisor, discuss the steps to be taken to remediate the problems that led to the probationary status, and devise a written plan of action to be submitted to the Graduate College. Students who are on Probation for two consecutive semesters will be converted automatically to non-degree status by the Graduate College. Such students may continue to take graduate courses in non-degree status. They can apply for readmission to a degree program as early as the semester after their conversion to non-degree status if they achieve a cumulative grade point average of at least 3.00 through additional graduate course work. Such a request must be supported by the head of the major department and approved by the Dean of the Graduate College.

Petitions

Students may petition the Graduate College if extenuating circumstances have prevented their compliance with any University or Graduate College policies and procedures. Petition forms can be submitted to the Graduate Degree Certification Office explaining all relevant facts. Such petitions must be accompanied by supporting documents (e.g., medical justification) and a letter of support from the graduate advisor and/or department head. Petition forms are available from departments and from the Graduate Degree Certification Office, Administration Building, Room 316.

Problem-Solving Advice

Several avenues exist for students to obtain advice regarding a university-related problem. Graduate students who believe that they have been treated unfairly by a faculty member or department should first try to resolve the problem by seeking advice from the Director of Graduate Studies in their department, or from a trusted faculty member. A second avenue is provided by the campus-wide Ombudsperson Committee established to offer students and employees an option to have disputes resolved. The Ombudsperson Committee is made of students, faculty and staff from all University areas, nominated by their peers and appointed by the President, to provide an informal means of problem resolution.

A third option is available through the Office of the Dean of the Graduate College. The Dean or his/her designee will provide information about graduate students' rights and responsibilities, policies and procedures regulating graduate students and teaching and research assistants and associates, as well as give advice regarding how to approach or diffuse a difficult situation.

Grievance Procedure

A grievance procedure is available to graduate students who have complaints that (1) are not remediable by other University grievance policies and procedures, and (2) are within the decision-making jurisdiction of the Graduate College. Some complaints that cannot be addressed through this procedure are allegations of gender (including sexual harassment), racial, ethnic, religious, and sexual orientation discrimination which must be dealt with by the Affirmative Action Office; grade appeals and graduate examination appeals, procedures for which are set out elsewhere in the Graduate Catalog; and complaints against University
Sexual Harassment and Discrimination

A student who believes he or she has experienced discrimination or sexual harassment should call the Affirmative Action Office at 621-9449 and he or she will be transferred to an individual with expertise in these areas for confidential advice on handling the situation or to file a written complaint. Students with disabilities who would like information on University policies with regard to the Americans with Disabilities Act (ADA) should call the ADA/504 Officer at (520) 626-4133 or [TTY (520) 621-4426].

Students are also encouraged to access the Affirmative Action homepage for information on discrimination, including sexual harassment, and the ADA.

Graduate Examination Appeal Procedure

A student can appeal the decisions of an examining committee for Qualifying, Comprehensive (written and oral), and Final Oral Defense examinations. If no resolution is obtained after appealing to the committee chair and formally meeting with the entire examining committee, the student may request in writing that the head or chair of the department conduct an investigation. Such written request must be initiated during the first regular semester after the term in which the examination was held. If there is still no resolution, the student may then request that the Dean of the Graduate College convene a committee to review the case and report its recommendations in writing. Final action will be taken by the Dean of the Graduate College and may include directing that a new examination or reexamination be held by the student’s department. Specific guidelines regarding the Graduate Examination Appeal Procedure are available from the Graduate College Information Counter and from the Graduate College website at http://grad.admin.arizona.edu/gcgeneral/grievance.html.)

Withdrawal from the University

A withdrawal from the University is defined as leaving the University by dropping all classes after having paid registration fees. Students are allowed seven days to complete the withdrawal process after initiating the procedure in the Dean of Students Office. A withdrawal may not be initiated after the last day of classes of any semester, and must be completed before the beginning of the final examination period. Consult the Schedule of Classes for detailed instructions and deadlines.

Medical Withdrawal: The Dean of Students office requires that students contact Campus Health and provide documentation from their doctors only if a tuition refund is involved. If a student withdraws for medical reasons and is beyond a refund period, medical documentation is not required.

Retroactive Withdrawal

Under appropriate circumstances, a student may petition for withdrawal after completion of classes for a term. If the student has experienced severe physical or psychological stress of such nature as to prevent satisfactory completion of course work in the semester or term in question, the student may petition for retroactive withdrawal for all courses taken that semester or term. This petition must be accompanied by adequate documentation and filed with the Dean of the Graduate College.

Code of Academic Integrity

Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own. Students engaging in academic dishonesty diminish their education and bring discredit to the academic community. Students shall not violate the Code of Academic Integrity and shall avoid situations likely to compromise academic integrity. Students shall observe the provisions of the Code whether or not faculty members establish special rules of academic integrity for particular classes. Failure of faculty to prevent cheating does not excuse students from compliance with the Code.

Conduct prohibited by the Code consists of all forms of academic dishonesty, including, but not limited to: cheating, fabrication, facilitating academic dishonesty, and plagiarism as set out and defined in the Code of Conduct; modifying any academic work to obtain additional credit in the same class unless approved in advance by the faculty member; and failure to observe rules of academic integrity established by a faculty member for a particular course. Any attempt to commit an act prohibited by these rules will be subject to sanctions to the same extent as completed acts. The procedures for reviewing a suspected violation are found in the complete Code of Academic Integrity available in the Dean of Students Office, Old Main, Room 203.
IV. Requirements for Master’s Degree

General Requirements

Master's degrees may be awarded for advanced work to students who have received the bachelor's degree from The University of Arizona or an institution of similar standing. The master's degree implies advanced training gained through intensive study in a special field (or major) supplemented by study in supporting subjects.

Credit Requirements

The total number of units required for a master's program varies by academic discipline, as well as whether a thesis, a substantial research project, a final creative project, or additional course work in lieu of a thesis is required. Except for a limited number of credits that can be transferred from other approved institutions, the remaining credit requirements must be met by graduate-level University of Arizona courses. A total of 12 units of graduate credit earned as an undergraduate senior, in graduate non-degree status, and/or transferred from an accredited institution, can be applied for credit toward a master's degree.

All units of course work for the master's degree must be in 500-level courses or above, (except for up to 6 units with 400-level courses in the minor) and one half of the required units must be in courses in which regular grades (A, B, C) have been earned. In cases in which a thesis is part of the degree program, a limited number of thesis units (910) must be earned. For specific degree requirements, refer to the appropriate department in Chapter VIII Departments and Courses of Instruction in this Catalog.

Residence Requirement

A minimum of 12 units of course work must be completed in residence at The University of Arizona.

Time Limitation

All requirements for the master's degree must be completed within 6 years. Time-to-degree begins with the earliest course to be applied toward the degree, including credits transferred from other institutions. Work more than 6 years old is not accepted toward meeting degree requirements.

Transfer Credit

Twenty percent of the minimum number of units required for a master's degree can be transferred from other accredited institutions. Such transfer credit can be applied to an advanced degree only upon satisfactory completion of deficiencies as prescribed by the head of the major department in which the student seeks a degree. Transfer of credit toward an advanced degree will not be made unless the grade earned was A or B, and unless it was awarded graduate credit at the institution where the work was completed. Grades of transfer work will not be used in computing the student's grade-point average. Credit for correspondence courses or extension work from other institutions will not be accepted for graduate credit.

Second and Third Master's Degrees

Normally, students can earn only one master's degree at The University of Arizona. However, a student may be permitted to enter a second or third master's degree program if the majors are sufficiently different to justify an exception. No student will be permitted to enroll in a second or third master's degree program without specific prior approval of the Dean of the Graduate College.

Major Professor

With the concurrence of the student, the department head or the department's graduate student advisor will designate a major professor (advisor) and, when applicable, a thesis director (who may or may not be the same faculty member as the major advisor) to each student. The major professor will act as the student's mentor and will be responsible for helping the student develop and complete a Plan of Study. The major professor is also responsible for ensuring that the student is making satisfactory progress toward completion of the degree, and for meeting with the student periodically to review the student's progress.

Qualifying Examinations

Many departments require a qualifying (diagnostic) examination in the proposed major field to determine areas of study where further course work is necessary, and to assist in the development of an appropriate Plan of Study. The examination should be taken during the first semester of residence and preferably during the first two weeks of residence.
Plan of Study
In conjunction with his/her major professor, each student is responsible for developing a Plan of Study as early as possible during the first few months in residence, to be submitted to the Graduate College no later than the second semester in residence. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and (3) additional course work to be completed to fulfill degree requirements. The Plan of Study must have the approval of the student's major professor and department head (or chair of the Graduate Committee) before it is submitted to the Graduate College.

Final Examination
Many academic departments require a final examination — oral, written, or both — administered by a committee of faculty members recommended by the major department and approved by the Dean of the Graduate College. A candidate who fails a final oral examination may, upon the recommendation of the major department, be granted a second examination after a lapse of at least four months. A member of the Committee on Graduate Study will be appointed by the Dean of the Graduate College to oversee the second oral examination. The results of the second oral examination are final.

Completion of Master's Degree Requirements
When the student's department determines that he or she has completed all degree requirements, a “Completion of Master's Degree Requirements” form, signed by the three faculty members of the student's committee (two of whom must be tenure-track faculty members in the major field) will be submitted to the Graduate College. Approval of this form by the Dean of the Graduate College will certify completion of degree requirements. For dates that requirements must be met to graduate in a particular semester, refer to the Deadline Sheets, available in departments, in the Graduate Degree Certification Office, and in the Graduate College web page.

Publication of Thesis
Submission of the thesis to the Graduate Degree Certification Office for publication by University Microfilms, Inc. and inclusion in The University of Arizona Library archives, is optional. Consult the Manual for Theses and Dissertations available from the Graduate Degree Certification Office and on the Graduate College home page for format specifications.

Publication by microfilm does not preclude publication by other methods. Successful master's candidates are encouraged to submit thesis material for publication in scholarly or professional journals. Suitable acknowledgment must indicate the publication to be a thesis, or portion of a thesis, submitted in partial fulfillment of the requirements for a master's degree at The University of Arizona.

Master of Arts
The Master of Arts degree is offered in 36 different fields of study. A minimum of 30 units of graduate work, including a thesis where one is appropriate, is required. A minimum of 15 units must be in the major field. Special department requirements, if any, are listed under the appropriate department in Chapter VIII, Departments and Courses of Instruction, of this Catalog.

Master of Science
The Master of Science degree is offered in 64 different fields of study. A minimum of 30 units of graduate work, including the thesis where one is appropriate, is required. Not less than 15 units must be in the major field. Special department requirements, if any, are listed under the appropriate department or committee in Chapter VIII, Departments and Courses of Instruction, of this Catalog.

Major in Fine Arts
The Departments of Art, Theatre Arts, and English offer programs leading to the Master of Fine Arts degree with majors in art, theater arts, and creative writing, respectively. Applicants must have completed appropriate undergraduate majors at this institution or one of similar standing. Deficiencies may be established if the applicant's undergraduate major differs significantly from the corresponding major at The University of Arizona. A thesis is not required, but the departments reserve the right to retain for department collections a selected work, or works, from those submitted in connection with the student's work toward a degree. Final examinations are required. Applicants should contact the appropriate department for instructions regarding submission of examples of creative work directly to the department, in support of their application. Special features and requirements of the three programs are described below.
Major in Creative Writing

Thirty-six units are required for this program. Required course work includes four graduate literature courses in the English Department, two of which must be literature seminars for writing students. Remaining course work can be taken in writing, literature, or in courses of other departments related to the student's field of interest, such as playwriting, film-writing, anthropology, history, or the literature of other languages. The program also requires the writing of an original, book-length work of fiction, poetry, or literary nonfiction. An examination on the craft of modern literature is given at the end of the student's work. There is no foreign language requirement. For specific admission requirements and further information, contact the Department of English, Modern Languages Building, Room 464, (520) 621-3880.

Master of Accounting

The Master of Accounting is a graduate professional program designed to provide advanced specialized training in accounting and related fields. Except as indicated below, the general regulations and requirements for the Master of Science degree apply. To be considered for admission, students must submit scores on the Graduate Management Admissions Test (GMAT) and have obtained a grade-point average of 3.00 or above.

Of the 30 units required for the Master of Accounting degree, no fewer than 15 must be in the field of accounting, and at least 16 must be in courses open only to graduate students. The required courses consist of a 15 unit core. The balance of the 30 units is to be composed of electives. Each candidate must also pass a written Comprehensive Examination.

Master of Agricultural Education

The general regulations and requirements for the Master of Arts and Master of Science degrees apply to this degree. In addition to the bachelor's degree, candidates must have a minimum of one year's successful classroom or extension teaching or education experience. Evidence of acceptability of the candidate's experience is based upon a minimum of two letters from persons who have had administrative authority over the candidate's professional work experience and who can attest to the candidate's professional competence, addressed to the department head in Agricultural Education. A minimum of 32 units of course work is required. The major or field of study is to include a minimum of 20 units of education, agriculture, or agricultural education credits. All candidates are to complete a professional report of approved investigative work.

Master of Business Administration

The goal of the Master of Business Administration (M.B.A.) program is to provide the foundation for a lifetime of development so that each student can maximize his or her potential for success. The curriculum combines the benefits of education based on sound business concepts with the relevance of confronting real business problems. The first year curriculum introduces a management decision-making environment in which students face risk, uncertainty, change, and competition in a controlled setting. Students learn problem solving, communications, team building, and decision-making skills so they can function effectively in such an environment. The second year of the curriculum provides a special blend of theory and project courses in which newly acquired skills can be further developed through interactions with local and national business leaders. Upon completion of the program, students are able to identify and formulate business problems, specify and locate the information needed to solve them, and develop and implement practical solutions.

The Karl Eller School of Management offers both a two-year (four semesters) full-time program, and a four-year (eight semesters and three summers) part-time program. The 60 unit curriculum includes 9 core courses (27 units), 3 communications components (3 units), 9 elective courses (27 units), and a capstone course (3 units) which serves as the final examination for the program. Enrollment in day-sections of all required core courses is restricted to students admitted to the full-time M.B.A. program.

Elective areas of emphasis include: accounting, entrepreneurship, finance, health care administration, international business, management, management of information, operations management, marketing management, marketing research, quality management, interdisciplinary ventures, and reliability and quality engineering. Alternatives include the Juris Doctor/MBA program, which reduces the time to completion of both degree programs from five to four years; the MBA/Master of International Management jointly with the American Graduate School of Management (Thunderbird), which reduces the completion of both programs (if the student is proficient in a foreign language) from four to two-and-a-half years; and the joint degree program combining the Master of Business Administration and the Master of Science Degree with a major in Management Information Systems (MBA/MS, MIS) which reduces the number of units required in each of the programs from 90 to 75 in the dual program. The School plans to propose two additional programs in the near future: MBA/MS in Nursing and a 3/2 MBA/Racetrack Industry program. Detailed information regarding the status of these joint degree programs may be obtained from the Karl Eller Graduate School of Management.

Completion of previous course work in business is not required for admission to the program. Prerequisites, however, include undergraduate courses in finite mathematics and business calculus, which must be completed prior to enrolling in the MBA program. Applicants should also
have a working knowledge of basic word processing, spreadsheet, and database computer software packages. Students who possess prior academic training equivalent to required comprehensive business core courses may elect to sit for waiver examinations scheduled at the beginning of the first and second semesters of the first year. Any student receiving a waiver for the content of a core course is required to substitute an elective to fulfill the unit requirement.

Admission to the program is for the fall semester only. For information on application requirements, contact the Graduate Admissions Office, Karl Eller Graduate School of Management, McClelland Hall, Room 210, (520) 621-3915.

Master of Education

The Master of Education (M.Ed.) program is designed for students who are engaged, or intend to engage, in the profession of education. Majors are available in Bilingual/Bicultural Education and Teaching and Teacher Education. All current or prospective students should check with the College of Education for information regarding the status and degree requirements of all programs and degrees.

Contact the Office of Academic Advising, College of Education, Room 247, (520) 621-7865.

Master of Engineering (M.Eng)/Tri-University Degree

Arizona's three state universities are collaborating to offer a Master of Engineering degree (M.Eng.) primarily intended to serve the advanced technical educational needs of Arizona's practicing engineers. The program provides distributed access to a variety of courses via distance delivery and flexible formats. The M.Eng. degree is intended to be a terminal professional degree, with academic standards equivalent to, but different from, a traditional M.S. degree. The program places emphasis on industrial and/or applied engineering course work, design and experience, and on the integration and synthesis of subject matter. It requires the completion of a minimum of 30 graduate credits. Current information about The University of Arizona M.Eng. program as well as application forms can be found at http://www.engr.arizona.edu

Master of Landscape Architecture

This graduate professional degree program emphasizes landscape ecology and socio-cultural and behavioral factors as well as landscape aesthetics and artistic principles in a variety of design, planning, and management applications. Students have an opportunity to explore broad cross-sections of outdoor environment, types, and scales. The context in which design and planning studios operate simulates the breadth of the profession to include wilderness, rural, urban, and historic landscapes. Special attention is given to the ecology, culture, and history of the arid Southwest. All students are expected to develop computer skills to the current level of use within the profession.

Landscape Architecture offers the Master of Landscape Architecture as both First and Second (advanced) Professional Degrees. Applicants with undergraduate degrees from design or planning disciplines are encouraged to apply for the Second Professional Degree program. All others are encouraged to apply for the First Professional Degree program. While both programs involve the investigation of new thoughts and applications which advance the art and science of landscape architecture, the First Professional Degree program prepares persons to enter the field of landscape architecture and to practice as professional landscape architects. The Second Professional Degree provides opportunities for individual research and advanced study in design, planning, and management of natural resources.

Although the Master of Landscape Architecture requires a minimum of 30 units of credit, students should expect to exceed the minimum and be in residence for 2-3 years of full-time study. The First Professional Degree program consists of a 3-year curriculum which prepares the student for entry into the profession. The Second Professional Degree provides opportunity for an advanced, individualized program of study. All students are expected to complete 6 to 9 units of thesis or master's report. Curriculum information, admission requirements, and application materials are available from the program at (520) 621-1004.

Master of Music

The School of Music and Dance offers programs leading to the Master of Music degree with concentrations in performance, composition, musicology, music education, and music theory. The programs are designed for those students whose professional and artistic goals warrant study beyond the bachelor's degree and who show continued growth in the field of music they have chosen. Applicants must have completed appropriate undergraduate majors. Deficiencies may be established if the applicant's undergraduate preparation is inadequate for graduate study at The University of Arizona.
Composition
Applicants submit a minimum of three reproduced manuscript scores (with tape recordings whenever possible) for evaluation by the composition faculty. If admitted, students must complete a minimum of 30 graduate units including 12 in advanced composition studies. An original composition is required as a thesis. A public recital of original compositions is required to complete the degree.

Music Education
Applicants for a concentration in music education must qualify for teacher certification prior to completion of the degree. The program requires a minimum of 30 graduate units, with no more than 6 units of credit in special workshops. The degree culminates in a major project which demonstrates individual accomplishment of a creative, pedagogical, musical, or scholarly nature.

Musicology
This concentration requires a minimum of 30 graduate units, of which at least 12 must be in musicology. A thesis is required, as is a reading knowledge of French or German.

Music Theory
This concentration requires a minimum of 30 graduate units, of which at least 12 must be in music theory. A thesis is also required.

Performance
Applicants are admitted through a screening process that requires audition by personal interview or tape recording. Emphases are offered in vocal performance, instrumental performance, conducting, and accompanying. The program requires a minimum of 30 graduate units and culminates in the performance of a public recital (two recitals for accompanists).

Master of Public Administration
The Master of Public Administration (M.P.A.) program is designed to prepare individuals for positions of administrative leadership in public sector and nonprofit organizations, as well as private organizations dealing with the public sector. Graduates may expect to pursue management or policy making concerns in a wide variety of settings within organizations at local, state, national, and international levels. The M.P.A. program is a 2-year, 54-unit program, divided into four segments of study. The first segment is a 27-unit public administration core taken by all students. The second segment consists of 9 units in either management or policy courses. The management stream offers additional training for students wishing to pursue managerial or administrative careers. The policy stream offers additional training for those interested in careers in policy and program analysis. The third segment is a 12-unit specialization in a substantive area of study. Specializations include health policy and administration, criminal justice policy and administration, public and nonprofit financial management, social policy, and natural resource policy. The fourth segment is a required 6-unit internship. Applicants must be competent in basic finite mathematics and calculus. Students with a mathematics deficiency must complete PA 400 before the first semester of graduate study. For information regarding application requirements, contact the School of Public Administration and Policy, McClelland Hall, Room 405-JJ, (520) 621-7965.

Master of Public Health
The Master of Public Health (M.P.H.) is a professional degree in public health. Students bring a wide variety of backgrounds to the program, ranging from bachelor's degrees to master's and doctoral degrees in related fields. The M.P.H. degree program prepares graduates to solve public health problems as practitioners who can apply a breadth of understanding as well as expertise in one specific area of public health, and as researchers who can develop new approaches within the field of public health. The degree requires a minimum of 33 units including a minimum of 3 units of internship. Students must complete 15 units of specified core courses and an appropriate number of units in one of ten concentrations. For additional information on degree requirements, see "Public Health" in Chapter VIII, Departments and Courses of Instruction, of this Catalog, or contact the Arizona Graduate Program in Public Health, Arizona Health Sciences Center, Room 1115, (520) 626-3200.
V. Requirements for Specialist Degrees

Educational Specialist

Educational Specialist degrees may be awarded to students who are admitted by the Graduate College upon the recommendation of the College of Education, and who satisfactorily complete program requirements specified by the departments in the College of Education offering this degree. These departments are: Educational Administration and Higher Education; Educational Psychology; Language, Reading and Culture; Special Education and Rehabilitation; and Teaching and Teacher Education.

Admission

All prospective students should check with the appropriate department in the College of Education for information regarding the specific admission requirements of programs leading to the Educational Specialist degree.

Time Limitation

All requirements for the Educational Specialist degree must be completed within 6 years after satisfactory completion of the Qualifying Examination.

Qualifying Examination

Each applicant to an Educational Specialist program must pass a qualifying examination during the first term of course work at The University of Arizona. An applicant's acceptability for work toward the degree will be evaluated on the basis of his or her performance on this examination.

Credit Earned Prior to Admission

Students who are able to demonstrate to the satisfaction of the qualifying examination committee that they have kept abreast of current developments in their areas of study, may be able to apply prior relevant graduate course work to the Educational Specialist program being proposed. A maximum of 12 graduate units taken as an undergraduate senior, in graduate non-degree status, and/or transferred from an accredited institution may be applied toward fulfilling the requirements of the Educational Specialist degree.

Advisory Committee

After successfully passing the qualifying examination, the head of the major department will appoint an advisory committee composed of three faculty members. One committee member may be from another department, with the concurrence of the head of that department. The chairperson of the committee will be the student's Major Advisor.

The committee is responsible for (1) evaluating the student's proposed Plan of Study; (2) making recommendations regarding the student's Plan of Study to the Dean of the Graduate College through the appropriate department head; and (3) being available to the student for advice regarding the program.

Plan of Study

Each student is responsible for designing a Plan of Study to meet his or her needs as determined by previous academic work, experience, interests, and career objectives, with the guidance of the advisory committee and the approval of the department head. This Plan of Study must be submitted to the Graduate College no later than the second term in residence. Contact the appropriate department in the College of Education for information on specific program requirements.

Final Examination

When the student has completed all course work or is in the final semester of course work, and has met the required standards of scholarship, he or she must pass a comprehensive written examination. The department may also require an oral examination. A candidate who fails a final oral examination may be granted a second examination after a lapse of at least four months, upon the recommendation of his or her department. A member of the Committee on Graduate Study will be appointed by the Dean of the Graduate College to oversee the second oral examination. The results of the second oral examination are final.

Professional Experience

With the exception of students in the School Psychology program, candidates must provide evidence of a minimum of two years of successful teaching or education administration experience. Approval from the appropriate department must be obtained before the Specialist degree can be awarded.
VI. Requirements for Doctoral Degrees

The University of Arizona offers three doctoral degrees: the Doctor of Philosophy (Ph.D.), the Doctor of Education (Ed.D.), and the Doctor of Musical Arts (D.M.A.).

Doctor of Philosophy

Attainment of a Doctor of Philosophy (Ph.D.) degree at The University of Arizona requires outstanding scholarship and demonstration of distinguished research leading to a dissertation that contributes significantly to the general fund of knowledge in the discipline.

Credit Requirements

The equivalent of at least six semesters of full-time graduate study is required for the Ph.D. A minimum of 36 units of course work in the area of the major subject, 9 units in the minor subject, and 18 units of dissertation must be completed. Graduate credit earned at other approved institutions, if accepted by the major department and the Graduate College, may be counted toward the requirements of this degree. All required units of credit must be at the 500-level or above at The University of Arizona (or, in the case of transfer units, their equivalent at other institutions). Six units of 400-level credit taken at The University of Arizona may be used in the minor but will not receive graduate credit or be calculated in the graduate grade-point average. At least one-half of the graduate credit must be in courses in which regular grades (A, B, C) have been earned. Credit for correspondence courses or extension work obtained at other institutions will not be accepted for graduate credit.

Residence Requirements

To meet the minimum Graduate College residence requirement, the student must spend two regular semesters of full-time work in residence, and complete a minimum of 30 units of graduate credit at The University of Arizona. Any semester in actual residence while registered for at least 9 units of graduate course work or research will be counted toward meeting the residence requirement. However, if a student proceeds without a break in enrollment from a master's degree to a doctoral degree in the same major, it may be possible to apply one or more semesters of full-time enrollment in the master's program toward the residence requirement for the doctoral degree. If there is a change of major or a break in enrollment between the master's degree and the doctoral degree, the residence requirement must be fulfilled again for the doctoral degree. Students on teaching or research appointments at The University of Arizona can meet the minimum residence requirement by registering for 6 units of graduate credit in each of four semesters.

Major and Minor Subjects

A student must choose a major subject and either one or two supporting minor subjects. Although the minor subject or subjects will usually be taken outside the major department, minors within the major department may be permitted with the approval of the department.

Time Limitation

All requirements for the degree of Doctor of Philosophy, including work done for the master's degree, cannot exceed a period of 10 years. Time-to-degree begins with the earliest course to be applied toward the degree. Work more than 10 years old is not accepted toward meeting degree requirements.

Foreign Language Requirements

Many departments have foreign language requirements for the Ph.D. degree. Doctoral students should ascertain from their major department whether there is a foreign language requirement for the degree they seek, and how the requirements may be satisfied.

Qualifying Examination

To demonstrate acceptability to undertake work leading to candidacy for the doctoral degree, as well as to determine areas of study where further course work is necessary, each prospective candidate must take a qualifying (diagnostic) examination in the proposed major field. The examination should be taken during the first semester of residence and preferably during the first two weeks in residence. Many departments also require a qualifying examination in the minor field, but this requirement may be waived at the option of the minor department.
Major Professor

With the concurrence of the student, the department head or graduate student advisor in the student's major department will designate a major professor (advisor) for each student. The major professor will act as the student's mentor and will be responsible for helping the student develop and complete a Plan of Study. The major professor is also responsible for ensuring that the student makes satisfactory progress toward completion of the degree, and for meeting with the student periodically to review the student's progress.

Plan of Study

In conjunction with their major professor or advisor, students are responsible for developing a Plan of Study during their first year in residence, to be filed with the Graduate College no later than the student's third semester in residence. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona which the student intends to apply toward the doctoral degree; and (3) additional course work to be completed in order to fulfill degree requirements. The Plan of Study must have the approval of the student's major professor and department head (or chair of the Graduate Committee) before it is submitted to the Graduate College.

Comprehensive Examination*

Before admission to degree candidacy, the student must pass a general examination in the chosen fields of study. This examination is intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study, and in depth within the area of specialization. The examination is composed of two parts: (1) a written portion covering the major and minor fields, and (2) an oral portion which is to be conducted before a committee of five faculty members appointed by the Dean of the Graduate College upon the recommendation of the major and minor departments. The written and oral portions of the Comprehensive Examination are to take place within two successive semesters, not including summer sessions. Students must pass the written examination and results must be reported to the Graduate Degree Certification Office before the oral examination is held. Forms and deadlines for the submission of coursework pertaining to the Oral Comprehensive Examination are available in the Graduate Degree Certification Office and posted on the Graduate College web page. The Comprehensive Examination is to be held when essentially all course work has been completed and no later than three months prior to the date of the Final Oral Defense Examination. Students will only be permitted a second attempt to pass the Oral Comprehensive Examination, and only upon the recommendation of the examining committee, the endorsement by the major department, and the approval of the Dean of the Graduate College. The second examination must be conducted by the original committee with faculty members and may not take place until four months after the date of the first examination.

* Also known in previous Graduate Catalogs as the Preliminary Examination.

Advancement to Candidacy

When the student has an approved doctoral Plan of Study on file, has satisfied all course work, language, and residence requirements, and passed the written and oral portions of the Comprehensive Examination, he or she must file an "Application to Advance to Candidacy". This application must be submitted to the Graduate Degree Certification Office no later than six months before the Final Oral Defense Examination is scheduled. "Application to Advance to Candidacy" forms and deadlines for the submission of coursework pertaining to doctoral programs are available in departments, in the Graduate Degree Certification Office, and on the Graduate College web page.

Dissertation

All Ph.D. programs require the completion of a dissertation which meets required standards of scholarship and demonstrates the candidate's ability to conduct original research. Instructions relating to the format of the dissertation and required abstracts are included in the Manual for Theses and Dissertations available in the Graduate Degree Certification Office and on the Graduate College homepage. Guidelines for dissertations which include previously published papers, papers accepted for publication and/or papers with multiple authors, are also available from the Graduate Degree Certification Office and the Graduate College web page.

Final Oral Defense Examination

Upon the completion of the dissertation, the candidate is to submit to a Final Oral Defense Examination. The examination focuses on the dissertation itself but can include general questioning related to the field(s) of study within the scope of the dissertation. The exact time and place of this examination is to be scheduled with the Graduate Degree Certification Office at least three weeks in advance, and announced publicly in Lo Que Pasa at least one week in advance. The examining committee must be composed of at least three faculty members in the candidate's major field and, at the option of the minor department, two members of the minor field(s) appointed by the Dean of the Graduate College upon the recommendation of the heads of the academic departments involved. The examination is closed to the public, except for an initial seminar during which the student presents the dissertation and entertains questions from the audience.
Submission of the Dissertation

Upon successful completion of the Final Oral Defense Examination, the candidate submits two complete and signed copies of the dissertation, dissertation abstract, and supporting documents to the Graduate Degree Certification Office, for forwarding to the Library of The University of Arizona and to University Microfilms, Inc. The major department may require an additional copy for department files. A processing and microfilming fee also must be paid to the University Bursar's Office. If the student elects to have the dissertation copyrighted, a copyright fee must also be paid to the Bursar's Office. Upon receipt of the final copies of the dissertation, the Dean of the Graduate College will recommend conferral of the doctoral degree by the Arizona Board of Regents.

Storage and Publication of the Dissertation

University Microfilms, Inc., Ann Arbor, Michigan catalogs, microfilms, and stores the dissertation's negative in vault storage, and sends catalog information to the Library of Congress for printing and distribution of cards for depository catalogs and libraries. The abstract of the dissertation is printed in Microfilm Abstracts and distributed to leading libraries in the United States and elsewhere, and to a select list of journals and abstracting services. A copy of the dissertation will be archived in the University of Arizona Library, where it serves as the record of the student's research.

Publication by microfilm does not preclude publication by other means. Successful candidates are encouraged to submit dissertation material for publication in a scholarly or professional journal. Suitable acknowledgment must indicate the publication to be a dissertation, or portion of a dissertation, submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at The University of Arizona.

Doctor of Education

Through the Graduate College, the faculty of the College of Education accepts prospective candidates for the degree of Doctor of Education (Ed.D). The degree is granted only to students who demonstrate a high proficiency in education and who present an approved dissertation.

Graduate College requirements for the Doctor of Education degree are the same as those for the Doctor of Philosophy (Ph.D.) degree. Consult with the College of Education or the appropriate department for information regarding the status and requirements of this degree.

Doctor of Musical Arts

The School of Music and Dance, through the Graduate College, accepts prospective candidates for the degree of Doctor of Musical Arts. The degree is granted with concentrations in the fields of composition, conducting, and performance, and requires demonstration of distinguished attainment in the field. Information about the Doctor of Philosophy degree with a concentration in music theory or music education is found under "Music" in Chapter VIII, Departments and Courses of Instruction, in this Catalog.

All requirements for the Doctor of Musical Arts degree are the same as those for the Doctor of Philosophy (Ph.D.) degree, with the exception of a minimum residence requirement of 3 semesters (or the equivalent) of full-time academic work in the Doctor of Musical Arts program at The University of Arizona, and the following specific requirements for each major:

Composition

Approval of a concentration in composition will be based upon evidence of creative talent and a knowledge of craftsmanship in writing music. In lieu of a dissertation, the candidate must compose a major work of approximately 30 minutes duration. Registration for a minimum of 18 units of dissertation credit is required during the preparation of the composition. The candidate is to submit two complete and signed copies of the composition, approved and accepted by the School of Music and Dance and all members of the examining committee, together with approval pages and a special abstract, to the Graduate Degree Certification Office, for delivery to the University Library. A processing fee must be paid to the University Bursar's Office. The abstract addresses the formal, stylistic, and technical elements of the composition. The School of Music and Dance, at its option, may require an additional copy for its files. Regulations governing publication of the composition are the same as those governing publication of a Ph.D. dissertation. In addition to the composition of an extended work, a recital consisting of the candidate's compositions in several forms and a variety of media must be presented.

Performance

In lieu of a dissertation, the candidate must present four recitals: (1) a solo recital during the first semester in residence; (2) a program of vocal and/or instrumental chamber music; (3) a lecture-recital; and (4) a solo recital. No more than one recital is permitted per semester. Registration for 18 units of doctoral recital credit is required during the preparation of the recitals, with a maximum of 9 units during any regular semester. Each recital will be evaluated independently by the student's advisory committee. If the candidate's performance is judged unsatisfactory, an additional recital composed of different literature must be performed. In no case will a candidate be permitted to remain in the program if more than one recital is determined unsatisfactory. The candidate will prepare and submit a formal document in connection with the lecture-recital. This document, based on an aspect of performance or performance practice, must show evidence of the candidate's ability to select and organize data pertinent to the study. The document must be an original contribution to the field of knowledge in the candidate's chosen subject area, and must demonstrate the candidate's ability to communicate effectively in writing. Following a successful Final Oral Defense Examination, the candidate must submit two complete and signed unbound copies of the document (approved and accepted by the School of Music and Dance and all members of the examining committee) to the Graduate Degree Certification Office, for delivery to the University Library. A processing fee must be paid to the University Bursar's Office.

Conducting

Requirements are the same as those for Performance (above), except that conductors generally fulfill each recital requirement (except the lecture recital) through several performances with major university ensembles. Conductors work in a secondary conducting area for the second recital. Following a successful Final Oral Defense Examination, the candidate must submit two complete and signed unbound copies of the lecture document (approved and accepted by the School of Music and Dance and all members of the examining committee) to the Graduate College, for delivery to the University Library. A processing fee must be paid to the University Bursar's Office.
VII. Student Services

Arizona Student Unions
The Arizona Student Unions provide a sense of community and “a home away from home” to thousands of students through its facilities, programs, and services.

At the core is the Memorial Student Union (MSU) which offers dining services, meeting rooms, a computer lab, student programs (Campus Activities, Center for Off-Campus Students, Collegiate Institute for Leadership, Child Care and Family Resources, and Greek Life), art galleries, catering services, a full-service U.S. Post Office, lounge and study areas, locker rental, and professional copy, photo and banking services. Also located within the MSU are the Arizona Student Media (Daily Wildcat, KAMP radio, Desert Yearbook); the Gallagher Theatre which shows current and classic movies at student rates (I.D. required); Sam’s Place which features a video arcade, billiards and table tennis; and the UA CatCard office (photo ID, All Aboard meal plan, Pocket money). Automated teller machines are located in the basement and on the exterior east side of the building. The Park Student Union (PSU) offers dining services, meeting rooms, lounge areas, a computer lab, a convenience store, an automated teller machine, and the Wildcat Gifts etc., store. For more information on the Arizona Student Unions, call 621-7755.

Campus Dining
Students, faculty and staff enjoy the choice and flexibility of over 25 campus eateries.

The Memorial Student Union (MSU) features the “A” Bagel & Rice Bowl Express-bagel sandwiches, rice bowls, yogurt; Café Sonora-homemade, specialized Mexican food and salsa bar; Fiddlee Fig Eatery- breakfast, salad bar, hot lunches and dinners, grilled sandwiches; Louie’s Lower Level-burgers, oriental stir-fry, soups, pastas, potato and salad bar; Java Jive-gourmet coffee bar, pastries and breads; On Deck Deli-gourmet custom sandwiches; Taco Bell Express®; McDonald’s®; Domino’s Pizza®; Smoothie Garage; Union Square Cafe-salads, pastries, gourmet coffee, smoothies, fruit, yogurt, ice cream; Union Club-full service dining and panoramic views; and the U-Mart which sells groceries, grab and go sandwiches, eegee’s, and drinks. The Park Student Union (PSU) features the Commons Food Court-pasta, salads, burgers, a variety of homemade entrees, deli-style sandwiches; Sausage Deli®, Chick-Fil-A®, Domino’s Pizza®, Taco Bell Express®, and Park Place-Egee’s, yogurt, bakery.

Quick meals and snacks are available at the following satellite dining locations: AME Snack Bar in AME building; Corner Cafe in McClelland Hall; Byte to Eat in ECE building; The Juice Bar in the Student Recreation Center; McKale Snack Bar in McKale Center; and the Scoreboard Cafe at The Arizona Stadium. There are also cappuccino and hot dog carts and some 350 vending machines located throughout the campus. For more information, call 621-7038.

Campus Health
Campus Health provides high-quality, primary medical and psychological care to University of Arizona students, as well as a campus resource for counseling on health, nutrition, and addiction problems. Licensed physicians, nurse practitioners, nurses, psychologists, and mental health professionals comprise the staff, in addition to community specialists who conduct clinics in orthopedics, surgery, podiatry, and dermatology. Regularly enrolled students are eligible for services at the beginning of the semester for which registration fees have been paid. Continuing students who were registered during the spring semester but are not registered for summer session may become eligible for summer services by paying a special fee. Medical conditions requiring immediate care can be seen on a walk-in basis. Students are encouraged to call for appointments, available Monday through Friday between 8:30 a.m. and 4:30 p.m., for all non-urgent situations. A pharmacy on the premises provides medicines and over-the-counter drugs at prices competitive with those in the private sector. Every student born after December 31, 1956 must submit proof of one vaccination for rubella given after 12/31/79 and of two measles vaccinations, at least one of which must be administered after 12/31/79. International students must also obtain a tuberculosis skin test at Campus Health before registering for classes for the first time. Many services are free (prepaid by the student’s tuition) after a nominal first visit fee. Charges are incurred for prescriptions, x-rays, laboratory tests, physical therapy, special supplies, and some specialist physician visits. Charges for all services may be paid at the Campus Health Business Office by 5:00 p.m. on the day they are incurred or will be automatically added to the student’s university account. Campus Health Insurance, required for all international graduate students and optional for all other students, is also available at the Health Insurance Office located on the ground floor of Campus Health. For further information contact Campus Health, Cherry Ave. and the UA Mall, (520) 621-6490.
Campus Recreation

Campus Recreation combines programs and facilities offering a wide variety of recreational, fitness, and wellness opportunities. The Student Recreation Center (S.E. corner of Sixth St. and Highland Ave.) is a state-of-the-art, national award-winning, physical fitness and recreation center offering two gymnasia, fourteen racquetball courts, two squash courts, a weight room, an elevated indoor track, two multipurpose dance rooms, two sand volleyball courts, an outdoor Olympic size pool, the Outdoor Adventures Center, a Wellness Center, a juice bar, and short-term child care facilities. Campus Recreation also coordinates more than fifty organized sports events through its Intramural and Recreational Sports Program, and over forty-five active sports clubs including rugby, soccer, water polo, and martial arts. For further information contact the Student Recreation Center, 1400 E. Sixth St., (520) 621-4709.

Career Services

Career Services offers a variety of programs which assist students and alumni to develop and implement career plans, gain work-related experience, seek part-time work, and gain professional employment after graduation. Workshops on resume writing, interviewing, and job-search strategies are offered, as well as CatTraks, a web-based job listing service. Career Services is located on the lower level of Old Main, (520) 621-2588 or check the Career Services web page for more information on all these services. http://w3.arizona.edu/~career/.

Center for Disability Related Resources

The Center for Disability Related Resources (CeDDR) offers services to students, faculty, and staff who have physical, visual, hearing, learning, and hidden disabilities. Major programs and services provided by the Center include academic accommodations, basic services for the learning disabled, physical support and wheelchair maintenance services, computer support, a Disability Resource Clearinghouse, adaptive athletic/recreation programs, counseling advocacy, testing services, interpreting, and referral. Main CeDDR offices are located at the southwest corner of Second St. and Cherry Ave., (520) 621-3268 Voice/TDD, FAX (520) 621-9423.

Center for English As A Second Language

The Center for English as a Second Language (CESL) offers intensive English programs during the academic year as well as during the summer for speakers of languages other than English. Classes meet for 22 hours a week offering course work in oral communication, reading comprehension, writing practice, language laboratory, and special-interest or group practice class. There are seven levels of instruction, ranging from beginning to pre-university. Upon arrival, new students are tested to determine their level of language proficiency to place them in an appropriate course of study. Students are also assigned a CESL faculty advisor to assist them in the transition to life in the United States. CESL also offers an evening program of American pronunciation and other spoken-English skills for 5 hours per week. CESL is a self-supporting unit of The University of Arizona and charges fees not covered by regular University tuition and fees cited in Chapter II Expenses, Fees, and Financial Assistance in this Catalog. For further information, contact the Center for English as a Second Language, CESL, Room 100, Building #24, Tucson, Arizona 85721, U.S.A. (520) 621-3637; FAX (520) 621-9180; E-mail address cesl@u.arizona.edu.

Center for Global Student Programs

The Center for Global Student Programs (CGSP) serves both the incoming international student population and University of Arizona students studying abroad. CGSP assists international students in complying with existing federal, state, and local regulations, provides information and authorization on visa and immigration matters, and offers personalized counseling and advisory services to students in all phases of the adjustment to the University and to the United States. The Center also sponsors an International Student Orientation and Registration Program each semester for newly arrived international students, and cross-cultural workshops and seminars on issues affecting the international student population. Over 30 international student clubs are supported by the Center. CGSP is located adjacent to the campus, at 915 N. Tyndall Ave., Tucson, AZ 85721, (520) 621-4627, FAX (520) 621-4069.

Child Care

The Office of Child Care Initiatives offers students, faculty, and staff assistance with locating and selecting child-care arrangements, including referrals to centers and family child-care providers, and to facilities that offer sliding fees and state-funded subsidies. A limited subsidy program and a sick-child care program are available to help students finance childcare. Students must pre-register for both the subsidy and sick-child care programs by calling (520) 621-5848, (520) 626-7227, or by stopping by the Student Union, Room 300. Forms and additional information can be obtained from the office's web page at: http://life/work.arizona.edu

Counseling and Psychological Services

A unit of Campus Health, Counseling and Psychological Services (CAPS) offers crisis intervention, brief individual, couple, and group psychotherapy; and medication evaluation and prescriptions to University of Arizona students. Other services include biofeedback training and HIV counseling and testing. Services are confidential. The first visit is free; there is a minimal charge for subsequent visits. Students can be seen on a walk-in basis the same day they seek services, and by appointment after the first visit. CAPS is located on the second floor of Campus Health, Cherry Ave. and the UA Mall, (520) 621-3334.

Cultural Events

The College of Fine Arts exhibits the talents of both faculty and students in a variety of exhibits, shows, and recitals. University facilities for cultural events are extensive and include Crowder Hall, the Holsclaw Hall, the Lightsong Gallery, the Joseph Gross Gallery, and the Dance Studies Theatre. The School of Music and Dance offers students numerous performance opportunities to participate in student recitals, large and small ensembles, chamber music groups, and contemporary and early music groups. Advanced and graduate students may audition for membership in the Tucson Symphony and the Arizona Opera Company orchestra.

UApresents offers a diverse program of acclaimed performing artists at historic Centennial Hall, including world-renowned stars such as Yo-Yo Ma, Alvin Ailey Dance Theatre, and the Peking Acrobats, as well as Broadway musicals and other shows. Many events offer master classes, and pre- and post-performance activities. Ticket discounts are available for students.

Additional cultural and entertainment opportunities are offered by the Arizona Historical Society Tucson Museum, The Arizona State Museum, the world renowned Center for Creative Photography, the Flandrau Science Center and Planetarium, the Poetry Center, the Kitt Peak National Observatory, and The University of Arizona Museum of Art.

Dean of Students

The Dean of Students office is committed to student learning and success at The University of Arizona. In addition to ensuring community standards and high-quality student life programs, the office is responsible for withdrawals from the University, Code of Conduct, Code of
Academic Integrity, Policy on the Use of Campus and First Amendment Rights, and other types of policy interpretation and dissemination. The office provides campus-wide leadership in managing student crisis situations. The office also sponsors several student advisory groups which include graduate student participation. The Dean of Students office is located in Old Main 203, (520) 621-7060.

Graduate and Professional Student Council
The award-winning Graduate and Professional Student Council (GPSC) was formed in 1991 to advance the interests of graduate and professional students at The University of Arizona. GPSC’s mission is to promote the academic, economic, and social goals of graduate and professional students, to establish effective communication among them, and to facilitate communication with the University and other organizations. GPSC representatives are elected proportionately from each college or academic unit of the University. GPSC sponsors the Professional Opportunities Development Fund to bring speakers and events on campus; coordinates the Graduate and Professional Student Travel Fund; sponsors the annual Student Showcase which highlights the achievement of students in research, outreach, and performance; co-sponsors Graduate Orientation; and holds Graduate/Professional Student Appreciation Week to recognize the contributions that graduate and professional students make to the University, among other activities.

Housing
The University of Arizona operates Christopher City Apartments for students with families and single students. Approximately seventy percent of student residents are married with children and a similar percentage are students working toward an advanced degree. Over half of the residents are international students. The 358 apartments of Christopher City are located about 15 minutes from the campus, many offering views of the nearby Catalina Mountains. Furnished and unfurnished apartments are available. There is a direct bus line between the campus and Christopher City, with frequent service. Bus passes are available through the University by the month or by the semester at discounted rates. There are nearby parks, grocery stores, postal services, a YMCA, and an elementary school. A state-licensed preschool operates on the premises. Christopher City also provides on site staff, 24-hour laundry facilities, and a community center which includes study rooms, a weight room, a full-size swimming pool, and a wading pool. Plans exist to build additional married-student housing adjacent to the campus. For current rates, application forms, or further information, contact Christopher City Apartments, 3401 N. Columbus Blvd., Tucson, AZ 85712, (520) 327-5918, FAX (520) 322-5881.

The Renter’s Guide is available at no cost in the Center for Off-Campus Students. This publication assists in locating housing and gives tips on how to be a wise rental consumer. Off-campus housing listings as well as roommate listings are available weekly in the Center for Off-Campus Students, Memorial Student Union Building, Room 353, (520) 621-7397.

International Students: See Center for Global Student Programs

Minority Cultural Resource Centers
The University of Arizona supports cultural centers designed to provide academic, social, and cultural support to ethnic minority students.

Centers offer a meeting place and support programs including academic counseling, advisement, emergency loans, computer laboratories, and social and community activities with undergraduate and graduate students, the University and the Tucson community.

The Chicano/Hispano Student Affairs and Resource Center is located in the Economics Building, Room 217, (520) 621-5627. http://w3.arizona.edu/~chsa/
The African American Cultural Resource Center is located in the Martin Luther King, Jr. Building, Room 209, (520) 621-3419. http://w3.arizona.edu/~mlhc
The Asian American Cultural Resource Center is located in the Martin Luther King, Jr. Building, Room 320, (520) 621-3481. http://w3.arizona.edu/~apasc
The American Indian Graduate Center can be accessed by calling (520) 621-7989, FAX (520) 623-3233. http://grad.admin.arizona.edu/aigc/

Speech-Language and Hearing Clinics
The Speech-Language Clinics offer a full range of services to individuals with communication difficulties, including evaluation and remediation of articulation, language, voice, and fluency disorders, and accent and dialect reduction. Individual and group therapy sessions are offered as well as specialized instrumental testing. Services in the Hearing Clinic include assessment of hearing, selection of hearing aids, training in the use of amplification, counseling relative to alternative communication devices, procurement of earmolds, and maintenance of amplification systems. Services are available to University students, staff, and faculty, and to children and adults in the community. The Clinics are located in the Speech and Hearing Sciences Building, Room 110, Speech Clinic: (520) 621-1826, Hearing Clinic: (520) 621-7070, FAX (520) 621-9901.

Testing Office
The Testing Office offers the GRE, LSAT, MCAT and GMAT. It also offers a credit by examination program (CLEP). For additional information, contact the Testing Office, Old Main, Room 223, (520) 621-7589.

University Learning Center
The University Learning Center (ULC) provides direct learning assistance workshops and courses at no cost to students, in areas such as Learning Styles, Memory Techniques, Time Management, Reading and Note-taking Strategies, Examination Preparation, and Interactive Computer Software. It also offers preparation courses for the GRE and the LSAT. The Center maintains a Private Tutoring Index to help students identify other students working as private tutors for a fee, and publishes a Guide to Free Tutoring. For information, contact the University Learning Center, Nugent Building, Room 9, (520) 621-4548.

UofA Bookstores
The UofA Bookstores provide students, faculty and staff with books and supplies needed to make their educational experience successful. The UofA Bookstores provide new and used textbooks, class supplies and electronics, UA clothing and souvenirs, computer hardware and software, and general books through the main UofA Bookstore and C.A.T.S. (Computing and Technology Store) located in the Memorial Student Union; Wildcat Gifts, Etc. . . located in the Park Student Union; the McKale Sports Stop, located in McKale Stadium; and the UA Sierra Vista Campus Bookstore. The UofA Bookstores fund various student programs and provide scholarships and academic internships to students, while remaining financially self-supporting.
VIII. Departments and Courses of Instruction

Course Listing Information

Curricular Changes
Course listings are subject to change without notice. For the most up-to-date information about course offerings, consult The University of Arizona General Catalog, found at http://catalog.arizona.edu.

Class Schedules
To confirm or identify the semester of offering for any course, consult the Schedule of Classes for each term. Schedules for fall and spring classes are available in April and October, respectively. The Summer Session Schedule of Classes is available in February.

Prerequisites
Students must meet the course prerequisites or otherwise satisfy the instructor of having the necessary preparation to take the course. Prerequisites can be waived only at the discretion of the instructor or department involved.

Cancellation of Courses
The University reserves the right to cancel courses not selected by an adequate number of students.

Course Numbering Classification System
The number by which a course is designated indicates the level of the course. Courses are numbered as follows:

- 500-599: Graduate courses. Open to exceptionally well-qualified seniors with prior written approval of the course instructor and the Graduate College.
- 600-699: Graduate courses. Not open to undergraduate students.
- 700-799: Graduate courses limited to doctoral students.
- 800-899: Courses limited to students working toward degrees offered by the College of Medicine or the College of Pharmacy. Not available for credit toward other degrees.

Semester Course (Single Numbers)
A course designated by a single number (e.g. ECON 560) is one semester in length.

Year Courses (Double Numbers)
A course designated by a double number (e.g. POL 610a-610b) is continued through two successive semesters, the work of the first semester being prerequisite to that of the second unless otherwise indicated in the statement of prerequisites.

University-Wide “House-Numbered” Courses
Most University of Arizona courses use a combination of lectures, discussions, and laboratories as their basic teaching format. University-wide house-numbered courses comprise two categories of courses using alternative teaching formats: (1) courses offered in small group settings, and (2) courses taught on an individual basis.

Small group courses are identified by numbers ending in 95, 96, and 97. The study area of such courses is indicated through a subscript and subtitle.

- 595, 695, 795. Colloquium (Credit varies). The exchange of scholarly information and/or secondary research, usually in a small group setting. Instruction often includes lectures by several different persons. Research projects may or may not be required. Grades available: A, B, C, D, E, I, S/P*, W.
- 596, 696, 796. Seminar (Credit varies). The development and exchange of scholarly information, usually in a small group setting. The scope of work consists of research by course registrants, with the exchange of the results of such research through discussion, reports and/or papers. Grades available: A, B, C, D, E, I, S/P*, W.

* Special (i.e., S, P, C, D, E) or regular grades may be used as departmental policy dictates; however, in any single course offering, all registrants must be graded by the same system.

- 597, 697, 797. Workshop (Credit varies). The practical application of theoretical learning within a group setting, involving an exchange of ideas, practical methods, skills, and principles. Grades Available: A, B, C, D, E, I, W.
Individual-studies courses are those with numbers ending in 91, 93, 94, and 99, as well as all 900-level courses. Under their generic numbers and titles, these courses may be selected by a student in any department even though the courses are not listed in the departmental course offering section, with prior approval of the responsible faculty member.

591, 691, 791. Preceptorship (Credit varies). Specialized work consisting of individual instruction and practice in actual service in a department, program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work, and patient study. Grades Available: S/P, C, D, E, I, W.

593, 693, 793. Internship (Credit varies). Specialized work consisting of individual training and practice in actual service in a technical, business, or governmental establishment. Grades Available: S/P, C, D, E, I, W.

5931. Legislative Internship [493 (12 units of credit), 593 (9 units of credit)] Working experience at the Arizona State Legislature. Responsibilities draw upon student's area of major expertise and include preparing written and oral reports, summarizing legislative proposals, and providing information to legislators and legislative committees. Participating programs include but are not limited to: architecture, economics, English, geography and regional development, history, hydrology, journalism, management, management information systems, marketing, political science, psychology, public administration secondary education, sociology, statistics, and urban planning. Students in other programs are eligible and should consult the department head or, in the case of the College of Law, the dean, for appropriate arrangements. Grades Available: A, B, C, D, E, I, W.

594, 694, 794. Practicum (Credit varies). The practical application, on an individual basis, of previously studied theory and data collection for future theoretical interpretation. Grades Available: S/P, C, D, E, I, W.

599, 699, 799. Independent Study (Credit varies) Qualified students working on an individual basis with professors who have agreed to supervise such work. Grades Available: S/P, C, D, E, I, W.

Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

900. Research (Credit varies). Individual research, not related to thesis or dissertation preparation, performed by graduate students. Grades Available: S/P, C, D, E, K, W.


910. Thesis (Credit varies). Research for the master's thesis (includes library research, laboratory or field observation research, artistic creation, and thesis writing). Maximum total credit permitted varies with the major department. Grades Available: S/P, E, K, W.


920. Dissertation (1 to 9 units of credit) Research for the doctoral dissertation (library research, laboratory or field observation or research, artistic creation, or dissertation writing). Grades Available: S/P, E, K, W.

925. Doctoral Recitals (1 to 9 units of credit) For doctoral students in music performance. Grades Available: S/P, E, K, W.

930. Supplementary Registration (1 to 9 units of credit) For students who have completed all course requirements for their advanced degree programs. May be used concurrently with other courses to bring the total number of units to the required minimum. Grades Available: S/P, E, K, W.

Symbols: How to Read Course Descriptions

**Sample Course Listing:**

506.* Social Structure in Modern Societies (3) [Rpt] Critical review of modern theory and research on social structure and social organization in modern societies. 2R, 3L. P, 6 units of sociology or CR. (Identical with HIST 506). Fee.

**Explanation:**

506 - Course number.

* - The asterisk denotes 400- and 500-level courses with the same number and title which may be convened jointly. Students may receive credit for such courses only once, whether jointly convened or separately, unless designated [Rpt.] or unless special approval is granted by the student's major advisor. The 500-level listing designates additional requirements for graduate credit.

Social Structure in Modern Societies - Course title.

(3) - Number of units.

[Rpt.] - May be repeated for credit. A restriction regarding the number of times a course may be repeated for credit (beyond the student's first enrollment) or the total number of units of credit permitted for a course may be designated. [Rpt.] indicates that the course may be repeated for credit once, for a total of two enrollments. [Rpt./2] indicates that the course may be repeated for credit twice, for a maximum of three enrollments; [Rpt./6units] means that the course may be repeated until the student has received a total of 6 units of credit. It is the student's responsibility to ensure that course content is not duplicated.

I - Semester in which a course is usually offered. I indicates fall semester; II, spring; and S, summer. If no semester designation is present, the course is usually offered each term. Courses are sometimes offered during a term other than that indicated in the Catalog. For offerings in a particular term, consult the Schedule of Classes for that term.

Critical review of modern . . . societies: - Course description.

2R, 3L - Class structure. R, L, S, and D indicate "recitation", "laboratory", "studio", and "discussion". 2R, 3L indicates that the class meets for two hours of recitation and three hours of laboratory per week (based upon a 15 week semester). For courses consisting of recitation (lecture) periods only, the number of class hours per week is the same as the unit value and is not specified in the course listing.

In addition to the above abbreviations for class structure, the College of Engineering and Mines uses the abbreviations ED and ES to designate the number of units in the areas of "engineering design" and "engineering science". Thus 1Ed, 2ES signifies that the course meets the requirements for 1 unit of engineering design and 2 units of engineering science.

P - Prerequisites. Identifies courses or other experiences which must be completed prior to enrolling in the course listed.

CR - Concurrent registration. Identifies courses which must be taken during the same term as the course listed.

(Ide ntical with HIST 506) - Cross listing. Identifies other departments which give credit for the same course. The complete course listing is shown in the course list of the "home" department which has instructional responsibility for the course. An abbreviated listing appears in the course list of the "cross listing" department.

Exceptions are house-numbered courses, which do not have course descriptions.

Fee - Special course fees apply.

GRD/CDT - GRD indicates that the course is available for a grade and credit, whereas CDT indicates that the course is available for credit only. These options, however, are not available for graduate credit.

Note: Not all of the above information may be noted in each course.

**Faculty Lists**

The listing of faculty which precedes departmental course offerings on the following pages identifies tenured and tenure-track faculty members holding appointments in May, 1999, as well as emeritus faculty and academic professionals involved in teaching and research. A department designation in parentheses following a faculty member's name identifies the department in which the primary appointment is held. These designations appear only in cases of faculty who hold multiple appointments. For identification of Regents' Professors as well as a complete listing of the faculty of The University of Arizona, consult the last section of this catalog.
Courses by Department

Permanent graduate-level courses offered by The University of Arizona are listed on the following pages by department or committee in alphabetical order. For a complete listing of all courses offered at The University of Arizona, see the General Catalog at: http://catalog.arizona.edu.

Accounting (ACCT)
McClelland Hall, Room 301
Phone: (520) 621-2620
FAX: (520) 621-3742
WWW: http://www.bpa.arizona.edu/depts/acct

Application Questions:
(520) 621-4455, accounting@bpa.arizona.edu

Advising Questions:
Dan S. Dhalwal, (520) 621-2620

Degrees Offered: M.Ac.

Professors: Dan S. Dhalwal, Head, William L. Felix, Jr., William S. Waller
Associate Professors: Ashiq Ali, Leslie G. Eldenburg, Jeffrey W. Schatzberg, Mark A. Trombley
Assistant Professors: Cristi A. Gleason, Dee L. Kleespie (Emeritus), Edward S. Lynn (Emeritus), Lyle H. Mciff (Emeritus), Lillian Mills, Kay Newberry, Hong Xie
Lectures: Phillip A. Blanchard, Leslie A. Cheon, Judith G. Doing, Richard W. Metcalf
Adjunct Instructors: Gregory A. Pivrotto, Carol E. Plagman
Visiting Professor: Douglas E. Stevens

The department offers a program leading to the Master of Accounting degree. The department also participates in programs leading to the Master of Business Administration (major in business administration), Master of Public Administration (major in public administration), and Doctor of Philosophy (major in management) degrees. For information concerning these degrees, see Requirements for Master's Degrees/Master of Business Administration, Master of Public Administration and see also Business Administration and Management and Policy headnotes elsewhere in this catalog. 500a-500b. * Intermediate Financial Accounting (3-3) I II Theory and methodology involved in contemporary accounting for assets, liabilities, stockholders' equity, net income and funds, analysis and interpretation of financial statements. P, ACCT 210. Credit allowed for this course or for ACCT 400a-400b, but not for both.

501. * Advanced Accounting (3) I II Theory and methodology involved in the preparation of consolidated financial statements and in accounting for partnerships. P, ACCT 400b, advanced standing in the College of Business and Public Administration. Credit allowed for this course or for ACCT 410, but not for both.

510. * Principles of Profit Planning and Control (3) I II Examination of the value of managerial accounting in organizational decision-making and control, addressing specific managerial accounting problems and their solutions. P, ACCT 310, advanced standing in the College of Business and Public Administration. Credit allowed for this course or for ACCT 410, but not for both.

520. * Introduction to Federal Taxation (3) I II Principles of federal income taxation, with emphasis on how individuals are taxed; additional topics. P, ACCT 210, advanced standing in the College of Business and Public Administration. Credit allowed for this course or for ACCT 410, but not for both.

522. * Advanced Federal Taxation (3) I II Introduction to advanced topics: taxation of corporations and stockholders' transactions in stocks, taxation of partnerships and fiduciaries, gift and estate taxation. P, ACCT 420, advanced standing in the College of Business and Public Administration. Credit allowed for this course or for ACCT 420, but not for both.

525. * Accounting Theory and Institutions (3) I Theoretical analysis of the role of accounting and taxation in society. Examines existing accounting and taxing institutions involved in policy making and standard setting. International issues are included. P, ACCT 420, advanced standing in the College of Business and Public Administration. Credit allowed for this course or for ACCT 425, but not for both.

529. * International Accounting and Taxation (3) I Accounting and taxation viewed from an international perspective, including comparison of various national standards, laws, and business practices. Also includes examination of standards issued by worldwide accounting organizations. P, ACCT 422 or consent of instructor; advanced standing in the College of Business and Public Administration. Credit allowed for this course or for ACCT 429, but not for both.

531. * Principles of Auditing (3) I II The opinion formulation process of the professional auditor, the auditor's reports, professional standards, internal and operational auditing. P, ACCT 305, ACCT 400b. Graduate-level requirements include a special project. P, ACCT 500b, MBA candidates only. Credit allowed for this course or for ACCT 431, but not for both.


551. * Analysis of Financial Statements (3) Examination of demand and supply forces underlying the provision of financial statements, the properties of financial statement information. P, ACCT 400b, advanced standing in the College of Business and Public Administration. Graduate-level requirements include a special project. P, ACCT 500b. Credit allowed for this course or for ACCT 451, but not for both.

569. Managerial Accounting (3) I II Concepts and analytic procedures necessary for the generation and use of accounting data in management planning and control. P, ACCT 550, MBA candidates only.

599. Independent Study (1-3) [Rpt./]


696. Seminar
a. Auditing (1-3) I II
b. Managerial Accounting (1-3) I II
c. Taxation (1-3) I II (Identical with FIN 696c).
d. Accounting Theory (1-3) I II (Identical with FIN 696d).
e. Behavioral Research in Accounting (1-3) I II

699. Independent Study (1-5) [Rpt./]

797A. Research Design (1-3) [Rpt./ 6 units] I II P, open only to Ph.D. students in accounting.

799. Independent Study (1-3) [Rpt./]

900. Research (1-3) [Rpt./]

930. Supplementary Registration (1-4) [Rpt./]
Aerospace and Mechanical Engineering (A ME/NEE)
Aerospace and Mechanical Engineering
Building, Room N-310
Phone: (520) 621-2235
FAX: (520) 621-8191
WWW: http://www.ame.arizona.edu

Application Questions:  Graduate Secretary, (520) 621-4692
Advising Questions:  Thomas Balsa, (520) 621-2208

Degrees Offered: M.S., Ph.D.

Concentrations: Aeronautics and space technology; fluid mechanics, solid mechanics, dynamics/computational mechanics, control systems; thermosciences; reliability engineering; biomechanical engineering; reactors, dynamics of nuclear systems and energy.


Associate Professors: Ara Arabyan, Cho Lik Chan, Morris Farr (Emeritus), Rocco Fazzolari (Emeritus), Jeffrey W. Jacobs, Alfonso Ortega, K.R. Sridhar

Assistant Professors: Weitong (Wayne) Chen, Ernest Fasse, Matthew R. Jones, Jeffrey Weiss

Adjunct Professor: Rudolph A. Eisentraut

Adjunct Associate Professors: Ahmed A. Hassan, John Peck, John A. Szivek

Research Professor: Ming De Zhou

Visiting Research Associate Professor: Oleg A. Likhtatev

Research Associate Professor: Sergey Shkarayev

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in aerospace engineering, mechanical engineering, or nuclear engineering. Close relation with the Applied Mathematics program is maintained.

A Bachelor of Science degree from an aerospace, mechanical, or nuclear engineering curriculum of a recognized institution of higher education is required of applicants to the graduate program. In general, a grade average of "B+" or better in previous academic work is expected. Graduates from other engineering, mathematics, and physical sciences curricula may be admitted provisionally. All applicants must submit scores from the Graduate Record Examination general test.

Master of Science: Students are required to complete 32 units of graduate work, including two units of 696g. All students are required to complete 300a and 500b and core courses in one fundamental area. These areas include: dynamics and control systems, fluid mechanics, solid mechanics and dynamics, thermal sciences and nuclear systems. A student may elect to present a master's thesis (6 units of 910), a master's report (3 units of 909), or complete a course work option. No more than 3 units of independent study are allowed for the course work option. No independent study units are allowed for the thesis or report options. All students are expected to attend a weekly graduate seminar. A final examination is required. Specific departmental M.S. degree requirements and examination procedures are described in the department's Graduate Program booklet.

Doctor of Philosophy: All students are required to complete a minimum of 54 units of graduate course work (including 30 units earned for the M.S. degree), 18 units of dissertation (920), and 3 units of 696g. Each student must pass a qualifying examination. After completing all or nearly all the required course work, the comprehensive examination may be scheduled. The comprehensive examination on the major field is taken after the student has passed the examination on the minor field. Minor fields may be chosen from other engineering, physical sciences, or mathematics departments. A final oral examination including defense of the dissertation is required. Doctoral students are expected to attend a weekly graduate seminar. All degree candidates are required to present a department seminar on their research during their last year in residence. Specific requirements and examination procedures for the Ph.D. are described in the department Graduate Program booklet.

Aerospace and Mechanical Engineering (A ME)


520. * Aircraft Conceptual Design (3) II Student groups develop conceptual designs for aircraft with specified performance and figures of merit. Design issues include program organization, configuration, aerodynamics, weights, and performance. Design groups develop computer flight simulators to evaluate performance. 3ED. P, A ME 320, A ME 321, A ME 323. Graduate-level requirements include the development of a three-degree-of-freedom flight simulator with active stability augmentation.


522. * Aerospace Engineering Design (3) Application of engineering fundamentals, including structural analysis, structural vibrations, aero-elasticity and finite element methods to aerospace vehicle design project. P, A ME 420, A ME 428. Graduate students will be responsible for simulation software development or laboratory tests.

523. Advanced Aerospace Propulsion (3) I Interior ballistics of rocket motors; ramjets, turbojets, turboprops, scramjets; detonation wave theory; combustion chamber instability analysis; nozzle design. P, A ME 425.

524. * Introduction to Space Technologies (3) I The space environment: vacuum, microgravity, radiation(s), free molecule flow and drag on bodies. Resource utilization in deep space. Introduction to orbital mechanics. Space transportation, spacecraft thermal design, automation and robotics, communications, space power, space structures. 1.5 ES. P, A ME 323. Graduate-level requirements include additional term papers and extra questions on exams. May be convened with A ME 424.


528. * Space Mission Conceptual Design (3) II Introduction to space mission design and modern tools available to aid the designer.
Includes brief case histories of some of the more successful space missions and design of a mission. 3ED. P, A ME 424. Graduate-level requirements include an additional design project and report.


531. *Numerical Methods in Fluid Mechanics and Heat Transfer (3) II Development of numerical techniques for the solution of ordinary and partial differential equations that arise in heat transfer and fluid mechanics; classification of equations, methods of solutions, examples. 3ES. P, A ME 302, A ME 331. Graduate-level requirements include three additional projects.

532. Convective Transport Phenomena (3) II Convective energy, mass and momentum transfer; internal and external flow; exact, approximate and numerical solutions; application to current problems. P, A ME 432, computer programming ability; CR, A ME 500a.


534. Radiative Heat Transfer (3) I Fundamentals of radiative heat transfer; radiative properties of materials; gray-body and spectral exchange between surfaces; participating media; radiation combined with conduction and convection. Intended for students with strong interests in heat transfer, combustion, and applications such as energy conversion systems, materials processing, and space technology. P, A ME 432.

536a-536b. Fundamentals of Fluid Mechanics (3-3) I-III 536a: Fundamental equations of motions; surface tension; kinematics of vorticity; integral solutions; irrotational flows; simple viscous flows. 536b: Small-disturbance inviscid theory; low Reynolds number flow; vorticity dynamics; boundary layers. P, A ME 500a-500b.

537. Fluid Mechanics of Viscous Flows (3) I Behavior of viscous fluids over a range of Reynolds numbers; Navier-Stokes equations; boundary layer equations; slow flow; compressible boundary layers. P, A ME 536b.

538. Nature of Turbulent Shear Flow (3) I Physical phenomena in turbulent shear flows; experimental techniques; observations and physical consequences; prediction methods; recent advances. P, A ME 500b, A ME 536a, A ME 536b.


540. * Energy Utilization and Management (3) I Methods for evaluating the technical and economic aspects of energy conversion and usage directed toward the effective utilization of resources, including economics, HVAC systems, electric power, lighting and industrial processes. 1ED. Graduate-level requirements include an in-depth research paper. (Identical with NEE 540).
566. Biomechanical Engineering (3) II Graduate-level requirements include a project and additional reading assignments.

567. Computer Graphics and Geometric Modeling (3) I (Identical with ECE 567, which is home).

572. * Reliability Engineering (3) I Time-to-failure, failure-rate, and reliability determination for early, useful and wear-out lives; equipment reliability prediction; spare parts provisioning; reliability growth; reliability allocation. 1.5 ED. P, or CR, A ME 474 or SIE 408 and SIE 572. Graduate-level requirements include a special report of 30 pages on a specific reliability engineering topic.

573. * Probabilistic Mechanical Design (3) I Application of probability theory and statistics to mechanical and structural design; modern mechanical reliability methods; design philosophy. 1.5 ED. P, C E 217; CR, A ME 410. Graduate-level requirements include additional homework with focus on theoretical considerations, and a research project.

574. * Reliability and Quality Analysis (3) I Probability and statistics with applications to reliability engineering, discrete and continuous statistical models for engineering variables, fundamentals of statistics. 1.5 ED. P, MATH 223. Graduate-level requirements include additional assignments and independent study, Monte Carlo simulation.

575. Reliability Testing (3) II Mean-time-between-failure and reliability confidence limits; sequential testing; sampling; accelerated, sudden-death, suspended-items, non-parametric, and Bayesian testing. P, A ME 472.

576. Advance Probabilistic Design (3) II Advanced methods for mechanical and structural reliability analysis, system reliability analysis, random loading models, applications to fatigue, fracture, buckling, creep, etc. P, A ME 472.

577. Maintainability Engineering (3) II Extension of 572; complex systems reliability; maintainability engineering; reliability and availability of maintained systems; operational readiness; system effectiveness; maintainability demonstration. P, A ME 472.

599. Independent Study (1-6) [Rpt./]


603. Boundary Element Method (3) I Introduction to BEM, applications to Laplace equation, conduction-convection problems, transient problems, problems involving material nonlinearities, large strain problems, and design sensitivity-analyses through BEM. P, A ME 461 or A ME 561.

606. Wave Propagation in Solids (3) II P, EM 603 or A ME 564a-564b. (Identical with C E 606, which is home).


632. Advanced Topics in Heat Transfer (3) II Topics will depend on instructor(s). Possible topics include linear and non-linear convective stability, turbulent convective heat transfer, advanced analytical and numerical methods in heat transfer, boiling and condensation, multiphase flow and heat transfer phenomena. P, A ME 500a, A ME 500b, A ME 532, A ME 536a, A ME 536b.

635. Hydrodynamic Stability (3) I Introduction to linear stability theory in fluid mechanics, the Orr-Sommerfeld equation, behavior of eigen-solutions, stability limits, extensions to problems in two component systems. P, A ME 500a, A ME 500b, A ME 536a, A ME 536b.


695. Colloquium

696. Seminar

g. Graduate Seminar (1) [Rpt./] I II

699. Independent Study (1-6) [Rpt./]

799. Independent Study (1-6) [Rpt./]

900. Research (1-16) [Rpt./]

908. Case Studies (3) [Rpt./]

909. Master's Report (1-16) [Rpt./]

910. Thesis (1-16) [Rpt./]

Agricultural and Biosystems Engineering (ABE)

Shantz Building, Room 403
Phone: (520) 621-1607
FAX: (520) 621-3963
WWW: http://ag.arizona.edu/ABE

Application Questions: Graduate Secretary, Stephanie Wang,
(520) 621-1753, swang@ag.arizona.edu

Advising Questions: Dennis Larson,
(520) 621-1248, larson@ag.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: Donald C. Slack, Head, Delmar D. Fangmeier (Emeritus), Kenneth A. Jordann, Gerald W. Matlock (Emeritus), Gene M. Nordby (Emeritus), Stephen E. Poe, Robert L. Roth, William T. Welchert (Emeritus)
Associate Professors: Kathryn L. Farrell-Poe, Dennis L. Larson, William O. Rasmussen, Muluneh Yitayew
Assistant Professors: Christopher Choi, Joel Cuello, Mark R. Riley. Peter Waller
Associate Specialist: Edward C. Martin
Research Professor: Theodor Strelkoff
Adjunct Associate Professor: Albert J. Clemens
Adjunct Assistant Professor: Jeffy Stone, Diana Yakowitz

The department offers graduate work leading to the Master of Science and Doctor of Philosophy degrees with a major in agricultural and biosystems engineering.

Opportunities for study and research exist in several areas of concentration. The include: irrigation and water resources management and development, biosystems and biochemical engineering with emphasis on biotechnology developments, energy issues and alternatives, biosystems analysis and design, waste management and water quality control, soil-water-plant relationships, microporogation, environmental control, materials handling in agri-biosystems production, applications of sensors, control systems, computer applications, artificial intelligence, multispectral analysis, robotics, and emerging technologies in these areas.

Students with adequate undergraduate preparation in engineering will be considered for admission to a degree program.

A thesis is normally required of students in the Master of Science program, but the requirement may be waived for a student who is the senior author of a manuscript published or accepted for publication in a refereed professional journal.

504. * Irrigation Principles and Management (3) II Principles of operating farm irrigation systems, evaluation of systems, selection of systems, basic irrigation scheduling, measurements of water flow, soil moisture, pump and system efficiencies. Not for ABE majors. 2R, 3L. Field Trips. P, MATH 121, SWES 200. (Identical with SWES 504).
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506. * Applied Hydraulics (3) I Fundamentals of hydraulics applicable to the irrigation of agricultural lands, including fluid properties, hydrostatics, irrigation flow characteristics, open channel and pipeline applications, and measurement of flowing water. P, MATH 111 or MATH 113 or MATH 125, PHYS 102 (Identical with WS M 506).

508. * Environmental Simulation (3) I Introduction to the usage of mathematical tools and techniques to analyze physical, chemical and biological components of the environment. P, MATH 113 or MATH 124.


515. * Engineering of Biological Processes (3) II Application of design and fundamental engineering principles such as kinetics, heat, and mass transfer, thermodynamics, material separation, control and reactor theory to animal/mammalian and plant systems. P, A ME 230.

516. * Simulation of Biological Systems (3) S Fundamental differential equations of plant systems are solved using analog computer methodology. Analysis of soil temperature and moisture, mulched systems, plant growth, and greenhouse environments are simulated using dynamic digital programs, CSMP and ACSL. Parameters of radiation, heat, and moisture transfer, CO2 and unique soil properties are utilized to provide realistic simulation of cyclic conditions. P, knowledge of computer programming.

519. * Engineering Properties of Biological Materials (3) I Physical properties — including mechanical, thermodynamic, electrical, magnetic, acoustic, etc. — of biological materials — including human, animal, plant, agricultural and food materials — that are necessary in the engineering analysis, evaluation, synthesis, and design of biological systems. This course is temporary, and will be offered during the Fall of 1999 only. 3L. 2R.

523. * Agricultural Systems Analysis and Design (3) II Application of systems analysis to agricultural and biologically related problems; computer modeling and use of simulations, optimization methods, decision support systems. 1ED. P, familiarity with statistics.

526. * Soil and Water Conservation Engineering (3) II S Methods for estimating runoff from croplands, Universal Soil Loss Equation, design of terraces, waterways, small earth dams, erosion control structures. 1.5 ES. P, ABE 406 or C E 321 or A ME 331. (Identical with WS M 526).


555. * Irrigation Engineering (3) II Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs. 1ED. P, C E 321 or A ME 331. (Identical with C E 553).

556. * Irrigation Systems Design (3) I Design and operation of surface, sprinkler, and trickle irrigation systems. 2ED. Field Trips. P, ABE 455.

557. * Irrigation Engineering Laboratory (1) II Data acquisition and analysis pertinent to design and evaluation of irrigation systems. 1ES. Field Trips. P, CR, ABE 455.

558. * Agricultural Drainage and Effluent Treatment (3) II Water quality and system design for agricultural drainage and wastewater systems. 1.5 ED. P, C E 321 or A ME 331. (Identical with C E 558).

563. * Energy from Biomass (3) II Biomass energy sources; collection and processing methods; thermal, anaerobic digestion and fermentation conversion processes; energetic, economic and environmental issues. P, A ME 230. Graduate-level requirements include a special project. (Identical with NEE 563).

567. * Advanced Watershed Hydrology (3) I I (Identical with WS M 567, which is home).

593. Internship (1-6) [Rpt./ 1 II

599. Independent Study (1-3) [Rpt./

605. Soil-Water Dynamics (3) II P, MATH 254. (Identical with SWES 605, which is home).

650. Advanced Irrigation Management (3) II Irrigation scheduling using Jensen-Haise and Penman equations for predicting evapotranspiration, determination of crop coefficients, production functions, economics, and energy considerations. P, SWES 520 or ABE 455; ABE 404.

655. Surface Irrigation Analysis (3) I Analysis of design and operating criteria for basin, border and furrow irrigation systems, and effect of field parameters on system design. Evaluation criteria for existing systems. P, ABE 456.

656. Pressurized Irrigation Systems (3) II Analysis of design and operating criteria for sprinkler and trickle or drip irrigation systems, hydraulics of sprinklers and emitters, hydraulics of pipe systems. P, ABE 456.

693. Internship (1-6) [Rpt./ 1 II

696. Seminar a. Agricultural and Biosystems Engineering (1) [Rpt./ 1 II

699. Independent Study (1-3) [Rpt./ 1 II

900. Research (1-16) [Rpt./

908. Case Studies (1-5) I II

909. Master's Report (1-8) [Rpt./ 1 II

910. Thesis (1-16) [Rpt./

920. Dissertation (1-16) [Rpt./

930. Supplementary Registration (1-16) [Rpt./

Agricultural and Resource Economics (AREC)

Economics Building, Room 319
Phone: (520) 621-6421
FAX: (520) 621-6250
WWW: http://ag.arizona.edu/AREC/arechome.html

Application Questions:
Connie McKay, (520) 621-2421,
garec@ag.arizona.edu,
Advising Questions:
Satheesh Aradhyula,
satheesh@ag.arizona.edu, Eric Monke,
emonke@ag.arizona.edu, Gary Thompson,
gary@ag.arizona.edu

Degrees Offered: M.S.
Concentrations: theoretical and applied graduate training in agricultural economics, agribusiness management, international economic development, and environmental and natural resource economics.


Associate Professors: Satheesh V. Aradhyula, Roger A. Dahlgren, Gary D. Thompson

Assistant Professor: Alan P. Ker

Instructor and Assistant Research Scientist: Mark W. Langworthy
Senior Lecturer: William J. Haneck

Research Scientists: Edwin H. Carpenter

Extension Specialist: Harry W. Ayer

Associate Extension Specialists: George B. Frisvold, Russell E. Tronstad

Research Specialist: Trent L. Teegerstrom

The department offers a program leading to the Master of Science degree with a major in agricultural and resource economics. A broad spectrum of agricultural economics subject matter is presented, with emphasis on natural resources, international business, and agribusiness. In cooperation with the Department of Economics, work is also offered leading to the Doctor of Philosophy with a major in economics, with emphases in international agricultural economic development and natural resource economics.
Students in the Master of Science degree program have a choice between thesis and non-thesis programs. Students completing a thesis are required to complete a minimum of 30 units which may include up to 6 units of credit for thesis research, while those selecting the technical paper option take 33 units of graduate coursework and 3 units of research credit. Students choosing the non-research option must complete 33 units.

504. Production Economics (3) [Rpt/ 6 units] I Theory of the firm and industry; single and multiple products; risk and uncertainty. P, ECON 300 or ECON 361; MATH 113. (Identical with ECON 504).

512. Economic Policy in Developing Countries (3) II The role of policies in economic growth and development. The impact of commodity, factor market and macroeconomic policies on economic incentives. (Identical with ECON 512, ARL 512).


514. Cost-Benefit Analysis (3) I Theoretical bases and empirical techniques. Consumer-producer surplus; social and private costs; macroeconomic distortions; non-market goods; uses in policy analysis. (Identical with ECON 514).


516. Agricultural Development (3) I Microeconomic analysis of agriculture in developing economies, focusing on factors affecting production decisions of small farmers, including adoption of new technologies. Interrelationships between agricultural activities and household consumption patterns are also discussed. P, ECON 361 or ECON 300. (Identical with ECON 516).

548. Applied Econometric Analysis (3) II P, ECON 549. (Identical with ECON 549, which is home).

550. * Financial Management for Agribusiness (3) Application of financial management principals and tools to challenges and opportunities facing agribusiness firms. Emphasis is placed on the acquisition, allocation, control and transfer of capital resources. P, ECON 300 or ECON 361; 3 units of accounting. Graduate-level requirements include a research paper of publishable quality, which analyzes a current financial issue or problem in the agricultural sector and selected readings in professional journals.

571. * Problems in Regional Development (3) I-II (Identical with GEOG 571, which is home).

575. Economics of Natural Resource Policy (3) I Theory and application of economic concepts needed to evaluate resource laws and policies, including welfare economics, externalities, public goods and valuation methodologies. Case studies focus on the American West and include federal and state environmental, water, and land policies. P, ECON 300 or ECON 361. (Identical with ARL 575, ECON 575, RNR 575).


577. Advanced Topics In the Economics of Environmental Regulation (3) II Advanced econometric theory of environmental policy. Topics include regulation of air and water pollution under imperfect competition, imperfect information, costly enforcement, uncertainty, and the use of alternative regulatory instruments. P, MATH 113, ECON 361. (Identical with HWR 577, ECON 577, WS M 577).


593. Internship (1-6) [Rpt/] I II I Legislative Internship (1-12) [Rpt/] I II

596. Seminar a. Agricultural and Resource Economics (1) [Rpt/ 6 units] I II

599. Independent Study (1-6) [Rpt/]

676. Economic Dynamics and Natural Resources (3) II Covers three topic areas: mathematical structure of dynamic optimization problems, economics of exhaustible resource use, and economics of renewable resource use. The methods part of the course treats both discrete and continuous time as well as deterministic and uncertain environments. Relationships between the methods of Lagrange, dynamic programming, optimal control, the calculus of variations, and the Ito calculus are developed. The sections on natural resource apply these tools to the classical economic problems of natural resource allocation and exploitation. P, graduate students only with one year graduate microeconomic theory. (Identical with ECON 676).

693. Internship (1-8) I II

696. Seminar a. Interstate Conflict Resolution (3) [Rpt/] I II (Identical with SIE 696G, which is home).

699. Independent Study (1-3) [Rpt/]

900. Research (1-8) [Rpt/]

909. Master's Report (1-8)

910. Thesis (1-8) [Rpt/]

920. Dissertation (1-9)

930. Supplementary Registration (1-9) [Rpt/]

Agricultural Education (A ED / AGTM)

Forbes Building, Room 224
Phone: (520) 621-1523
FAX: (520) 621-9889
WWW: http://ag.arizona.edu/aed/aedhome.html

Application Questions: Glen Miller, (520) 621-7170, uamiller@ag.arizona.edu

Advising Questions: Glen Miller, (520) 621-7170, uamiller@ag.arizona.edu

Degrees Offered: M.S., M.Ag.Ed.

Professors: Roger T. Huber, Head, David E. Cox, Clinton O. Jacobs (Emeritus), Floyd G. McCormick, Jr. (Emeritus), Glen M. Miller

Associate Professors: John F. Elliot, Nancy S. Huber, James A. Knight, Jr.

Assistant Professor: Billye B. Foster

Senior Lecturer: William J. Hanekamp

Adjunct Associate Professor: Kathryn L. Hollenback

Master of Science: The program requires the completion of at least 20 units in agriculture and agricultural education. Supporting course work can be in plant sciences, animal sciences, entomology, soil and water sciences, environmental sciences, agricultural and resource economics, renewable natural resources, agricultural and biosystems engineering, educational administration, higher education, teaching and teacher education, or in other disciplines appropriate to teaching, extension, or similar educational work. Thirty units including a thesis (for which a maximum of 6 units may be earned) must be completed.

Master of Agricultural Education: For information concerning this degree see.

- Requirements for Masters' Degrees/Master of Agricultural Education elsewhere in this Catalog.

507. * Principles of Vocational Education (2) Social and economic values of vocational education, federal laws, state policies and administration; theories and principles with special reference to programs in the secondary school. (Identical with TTE 507).

521. * Communicating Knowledge in Agriculture and the Life Sciences (3) I Principles and processes of knowledge diffusion and methods of transferring appropriate technology to user/clientele groups. Communicating effectively within organizations. (Identical with AGTM 522).


539. * Non-Formal Education (3) I An experiential course which explores the nature and scope of non-formal education, the process of facilitating and evaluating non-formal education, and a framework for developing a working philosophy of non-formal education practice. (Identical with FS 539).

540. International Extension Education (3) II Critical evaluation of case histories of international extension education models, and integration of successful components into composite models based on cultural, political and educational situations typically encountered in developing countries.

542. * Transformation of Agrarian Societies in the Middle East (3) II (Identical with NES 542, which is home).


562. * Curriculum Development (2-3) II S Analysis, design, construction and evaluation of resources appropriate for a competency based agriculture education curriculum.

585. * Teaching Psychomotor Skills in Laboratory Sciences (1-2) I II Methods and procedures in teaching psychomotor operational skills, conducting demonstrations, providing for student and teacher safety, sequencing skills activities, providing and organizing facilities, including micro-teaching demonstrations. 1R, 3L.

593. Internship (1-3) I II

596. Seminar a. Leading and Learning Across the Disciplines (3) II Seminar participants will explore philosophy and practice regarding the integration of leading and learning across the disciplines.

597. Seminars a. Instructional Advances in Experiential Education (1-3) [Rpt./ 12 units] b. Advances in Youth Leadership (1-3) [Rpt./ 12 units]

d. Instructional Advances in Applied Biological Systems (1-3)
e. Continuing Education in Agriculture (1-3) [Rpt./ 12 units] I II
f. Program Development in Vocational and Technical Education (1-3) [Rpt./ 12 units]
g. Instructional Advances in Vocational/Technical Education (1-3) [Rpt./ 12 units] (Identical with FS 597g).
h. Instructional Advances in Environmental Education (1-3) [Rpt./ 12 units] (Identical with FS 597g).

599. Independent Study (1-5) [Rpt./]


615. Investigations and Studies in Applied Research (3) I Study and analysis of research literature, methods, techniques and procedures for conducting investigations, selecting a problem and developing plans for a study.

616. Research Project Design and Implementation (3) II Principles and practices of selecting, developing and analyzing research instruments, analyzing and interpreting both quantitative and qualitative data research in agricultural and extension education, including the use of the computer. P, A ED 615.

621. Program Planning and Evaluation (3) II Developing and evaluating programs in teaching and extension; situation analysis, objectives, policies, content, procedures, and evaluative criteria.

693. Internship (1-3) I II

695. Colloquium a. Teaching College Level Agriculture and Life Sciences (1-3) I II

699. Independent Study (1-3) [Rpt./] I II

900. Research (2-4) [Rpt./]

909. Master's Report (1-3) [Rpt./] I II

910. Thesis (2-6) [Rpt./]

920. Dissertation (1-9)

930. Supplementary Registration (1-9) [Rpt./]

Agriculture
Forbes Building, Room 201
Phone: (520) 621-3612
FAX: (520) 621-8662

Within the College of Agriculture, programs are offered leading to the Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) degrees as indicated in the following list of departments and majors or concentrations:

Agricultural and Resource Economics
agricultural and resource economics .................................. M.S.

Agricultural Education
agricultural education ................................................. M.S./M.Ag.Ed.

Agricultural and Biosystems Engineering
agricultural and biosystems engineering ......................... M.S./Ph.D.

Animal Sciences
animal sciences ....................................................... M.S./Ph.D.

Entomology
entomology ............................................................ M.S./Ph.D.

Family and Consumer Resources
retailing and consumer studies ..................................... M.S./Ph.D.

Nutrition and Food Science
nutritional sciences ..................................................... M.S.

Plant Pathology
plant pathology ........................................................ M.S./Ph.D.

Plant Sciences
plant sciences .......................................................... M.S./Ph.D.

Renewable Natural Resources
range management ..................................................... M.S./Ph.D.

Soil, Water and Environmental Science
soil and water science .............................................. M.S./Ph.D.

Veterinary Science and Microbiology
pathobiology ............................................................. M.S./Ph.D.

In special cases, an undergraduate field of concentration different from but related to the intended graduate major may be admissible.

Students with a special interest in genetics are referred to the program in Genetics elsewhere in this Catalog. For further information concerning any of the programs listed above, see the appropriate department headnotes and see Requirements for Graduate Degrees.

The Agricultural Experiment Station offers the graduate student in agriculture an opportunity to participate in current research programs. The student may be assigned to a staff member of the Agricultural Experiment Station, under whose direction the research necessary to the writing of a thesis or dissertation is conducted. Residence credit may be earned for certain graduate courses offered at University facilities away from the Tucson campus.
American Indian Studies
(AIS)
Harvill Building, Room 430
Phone: (520) 621-7108
FAX: (520) 621-7952
WWW: http://w3.arizona.edu/~aisp/index.htm

Application Questions:
AISP Secretary, aisp@u.arizona.edu
Advising Questions:
Marie Madeiski, madeiski@u.arizona.edu
Degrees Offered: M.A., Ph.D., Joint J.D./M.A.
Concentrations: American Indian law and policy, American Indian cultures, American Indian languages and literature, and American Indian education.

Professors: Joseph (Jay) H. Stauss
(Family and Consumer Resources), Chair, Barbara A. Babcock (English), Stephen Cornell (Sociology), Lawrence J. Evers (English), Thomas M. Holm, K. Tsiainina Lomawaima, N. Scott Momaday (English), Nancy J. Parezo (Anthropology), J. Jefferson Reid (Anthropology), Robert Williams, Jr. (Law)
Associate Professors: Jennie R. Joe (Family and Community Medicine), Teresa L. McCarty (Language, Reading and Culture), Alice S. Paul (Teaching and Teacher Education), Ofelia Zepeda (Linguistics)
Assistant Professors: Eileen M. Luna, Irvin Morris (English), Mary Willie (Linguistics)
Adjunct Lecturers: Mary Jo Fox, Robert Hershey
Research Anthropologist: Emory Sekaquaptewa (Anthropology)

Further opportunities for study are provided by related programs. The AISP Community Development Office provides assistance in economic and educational development and resource identification to Arizona Indian tribes. Internship opportunities are available to students through this office. REDINK, a biannual publication, allows students to work on a nationally-distributed publication of poetry, short stories, creative non-fiction, original artwork, and book and film reviews concerning American Indians. The American Indian Language Development Institute provides opportunities for study and practice in American Indian linguistics and bilingual curriculum development.

The Master of Arts (with a major in American Indian studies) consists of 30 units plus a 6 unit thesis report or research project. Each student works closely with three faculty advisors to develop an individual program. In addition to the thesis, a final master's examination is required. Graduates of the program have assumed leadership and policy-making roles in tribal governments and in state and federal government agencies. They have also obtained academic and research positions, and pursued Ph.D. or J.D. degrees.

Concurrent Juris Doctor/Master of Arts in American Indian Studies degrees can be obtained in four years. Typically, students in this program take one year of graduate coursework work in American Indian Studies after the first year of classes required for the J.D. degree. In the J.D. program, students may take a wide range of courses including many with a substantial concentration on Indian legal issues. Among them: Federal Indian Law I and II, Indigenous Human Rights Law, Advanced Indian Law seminars, Tribal Law Clinic, Energy and Natural Resources Law, Water Law, and Federal Courts. In American Indian Studies students can pursue course work in the regular concentrations offered by the program. Graduates of the Concurrent J.D./M.A. program are qualified to provide legal representation to Indian tribes, tribal organizations, and Indian individuals in cases involving civil rights, land and water rights litigation, fishing, hunting, treaty rights, religious-cultural resource protection, and taxation on Indian lands. Graduates are also qualified to assist tribal governments and businesses in their efforts to build strong communities governed through self-determination.

The Doctor of Philosophy with a major in American Indian Studies is an interdisciplinary degree program designed to prepare individuals for academic careers, conduct basic and applied scholarly research from a cross-cultural perspective; develop innovative theories, methodologies, and research tools appropriate for and useful to sovereign tribes; and educate students to assume leadership and policy-making roles in higher education, tribal communities, the state, and the nation. The Ph.D. in American Indian Studies is designed to be completed in 3-4 years (beyond the master's degree). A master's degree from an accredited institution (or its equivalent) is required for admission. At the discretion of the Admissions Committee, exceptionally qualified applicants who do not hold a Master's degree may be considered for admission.

Applicants for M.A. or Ph.D. degrees must submit an application, statement of purpose, a resume or curriculum vitae, three letters of recommendation, two writing samples, and the personal and academic data called for on the Graduate College application form. In addition to the above, Ph.D. applicants must submit GRE scores and a copy of their Master's thesis (if one has been completed) as one of the two required writing samples. All applicants are also invited to submit vitae, published articles, or other materials relevant to admission.

502. Dynamics of Indian Societies (3) I Historic overview of philosophies, institutions, and characteristics of Indian societies, and indigenous constructions of historic knowledge. (Identical with ANTH 502).
513. * Ethnology of the Southwest (3) II (Identical with ANTH 513, which is home).
516. * Contemporary Indian America (3) (Identical with ANTH 516, which is home).
523. Anthropology of Rural Mexico (3) II (Identical with ANTH 523, which is home).
524. * Studies in Southwest Literature (3) I II (Identical with ENGL 524, which is home).
530. * The Anthropology of Visual Art (3) II (Identical with ANTH 530, which is home).
545a-545b. * Structures of Non-Western Languages (3-3) [Rpt./ 2] I-II (Identical with LING 545a-545b, which is home).
549a-549b. Folklore (3-3) I-II (Identical with ENGL 549a-549b, which is home).
576. Creative Writing for Native American Communities (3) I S For members of Native American communities and individuals working within such communities who are interested in producing new and authentic works in various genres including biography, autobiography, poetry, essay, and translation...
and interpretation of collected tribal texts. Writing in the native language will be strongly encouraged.

577. Studies in American Indian Literature (3) I II (Identical with ENGL 577, which is home).

578. * American Indians and the Supreme Court (3) (Identical with POL 578, which is home).

582. * Hopi Language in Culture (3) II (Identical with ANTH 582, which is home).

584. Development of Federal Indian Policy (3) I II (Identical with POL 584, which is home).

587a-587b. * Race and Public Policy (3-3) I-II (Identical with POL 587a-587b, which is home.)

589. * Areal Survey of Native North American Languages (3) I II P, ANTH 276 or LING 101. (Identical with ANTH 589, which is home).

590. * Indian Religions and Spirituality (3) Examines the positive (curing, harmony with the natural world, etc.) aspects of Indian religions. Indian medicine men may participate in the course at various junctures. Graduate-level requirements include an additional research paper based on past research and personal experience with related topic. (Identical with RELI 590).

591. Preceptorship (1-6) I II

593. Internship (1-6) [Rpt.] I II

595. Colloquium
a. American Indian Studies (3) [Rpt./ 15 units] I II

596. Seminar
f. American Indian Studies (1-2) [Rpt./ 8 units] I II
g. American Indian Law and Policy (3) I II (Identical with POL 596, which is home).

m. Studies in the Oral Tradition (3) [Rpt./ 2] I II (Identical with ENGL 596m, which is home).

599. Independent Study (1-5) [Rpt./]

602. Interdisciplinary Research: Theory and Methods (3) I II Survey of important theoretical perspectives and their associated qualitative methodologies in American Indian Studies. Overview of selected disciplinary frameworks of inquiry, discussions of case studies, and student exercises in choosing and implementing appropriate qualitative research methods.

631a-631b. Federal Indian Law I-II (3) I II (Identical with LAWS 631a-631b, which is home). P, LAWS 631a

646. Ancient and Contemporary Voices (3) I II The connections between ancient and contemporary native literature of North and South America. (Identical with ENGL 646).

660. Ecology, Demography, and Disease (3) I II Linked issues of environmental change, demographic change, epidemic/endemic diseases, and health in the Americas after 1492.

670. Colonization and Native Peoples (3) I II Examination of colonialism as theoretical model and as political-economic phenomenon. Case studies of indigenous groups' reactions to colonizing agents from the Americas, the Pacific Rim, and other countries. (Identical with POL 670).

677. History of American Indian Education (3) I II Educational philosophies, policies, and practices of native people, European missions, and federal schools. Historic overview of Indian education to early 1900s. (Identical with LRC 677).

678. Contemporary American Indian Education and Research (3) I II Contemporary American Indian/Alaskan native education in two parts: (1) the current state of native education and its effectiveness in meeting the needs of native students; (2) current research in the area of American Indian/Alaskan native education and its implications for future research. (Identical with LRC 678).

679. American Indian Higher Education (3) I II Development of higher education for American Indians/Alaskan natives from the earliest efforts to contemporary times. Issues and their implications for the education of American Indians in institutions and agencies of higher education. Emphasis on tribally controlled colleges and universities, and the development of American Indian Studies programs in higher education institutions. (Identical with ED 679).

688. Energy and Natural Resources (3) GRD (Identical with LAWS 688, which is home).

691. Preceptorship (3) I II

693. Internship (1-6)

694. Practicum (3-6) [Rpt./ 2]

695. Colloquium
a. Special Topics in American Indian Studies (3-6) [Rpt./ 3] I II

696. Seminar
a. American Indian Policy (3) [Rpt./ 1] I II
b. Languages and Literature (3) [Rpt./ 6 units] I II
c. Societies and Culture (3) [Rpt./ 1] I II
d. Tribal Law Clinic (4) (Identical with LAWS 696d, which is home).

697 Workshop
a. College Teaching Methods (3) I II
b. Globalization and Preservation of Culture (1-3) I II (Identical with LAWS 697b, which is home).

697C. Research Design for American Indian Communities (3) I II

699. Independent Study (1-3) [Rpt./]

791. Preceptorship (1-6) [Rpt./]

900. Research (1-6) [Rpt./]

909. Master's Report (1-6) [Rpt./] I II

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) I II

930. Supplementary Registration (1-9) [Rpt./]

Anatomy

(See Cell Biology and Anatomy)

Animal Sciences (AN S)

Shantz Building, Room 205
Phone: (520) 621-7623
FAX: (520) 621-9435
WWW: http://ag.arizona.edu/ANS/anshome.html

Application Questions:
Alberta Rettig, Admin Secretary, (520) 621-7623, arettig@ag.arizona.edu
Advising Questions:
Donato Romagnolo, (520) 626-9108, donato@ag.arizona.edu

Degrees Offered: M.S., Ph.D.
Concentrations: reproduction and breeding, genetics, stress protein biochemistry, mammary gland biology, meat science, effects of heat on animal performance and nutrition of beef and dairy cattle.

Professors: R. L. Ax, Head, Ronisue K. DeNise, John A. Marchello, Richard W. Rice, William A. Schurg, Mark E. Wise
Associate Professors: Vincent Guerriero, Jr.
Assistant Professors: Richard M. Enns, Donato Romagnolo
Adjunct Professors: Patricia B. Hoyer, Colin Kaltenbach, Rita C. Manak
Adjunct Associate Professors: Thomas Fuhrmann, DVM
Adjunct Associate Professors: David Karabinus, Adele M. Turzillo
Adjunct Lecturers: Wendy Davis, F. Doug Reed, John Walzak
Extension Specialists: Robert M. Kattmig
Research Specialist: S. Peder Cuneo

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in animal sciences. Areas of study include reproductive biology, nutritional and mammary gland biology, molecular genetics and heat stress physiology.
Department faculty also participate in interdisciplinary graduate committees on genetics, nutritional sciences, physiological sciences and cancer biology in offering the Ph.D. degree.

Applicants are expected to submit a detailed statement of professional goals, three letters of recommendation from persons who are in a position to predict the applicant's potential as a graduate student, and scores from the Graduate Record Examination. In addition to the regular portion of the examination (quantitative, analytical, and verbal), advanced examinations in either biology or chemistry are recommended but not required.

Master of Science: Admission to the M.S. program depends on completion of a bachelor's degree with a major in animal, biological, chemical, or physical sciences. Undergraduate preparation must include 3 units of college-level algebra (MATH 117R/S or equivalent; calculus recommended); one year each of general biology and organic chemistry (laboratories in each recommended); and one upper-division course in animal behavior, animal biotechnology, animal growth, animal physiology, animal nutrition, meat science and muscle biology, animal production/management, or meat/dairy products. In addition, depending on the selected area of study, at least one course from the following will be required: anatomy, physiology, advanced animal breeding and genetics, advanced cellular and molecular biology, animal endocrinology and physiology, analytical chemistry, biochemistry, calculus, organic chemistry laboratories, physics, or statistics. Students transferring to The University of Arizona with graduate credits from other universities can petition to apply those graduate credits to the major in this program; however, only graded courses are acceptable.

A minimum of 30 graduate units are required for the degree. At least one-half of the required units must be in courses in which regular grades (A, B, C) have been earned. Students must complete 3 units of statistics, 3 units of biochemistry, 3 units of physiology, and 2 units of seminar (AN S 596). Additional requirements for completion of the degree will be determined by the major professor and graduate committee.

Doctor of Philosophy: Students are usually admitted to the Ph.D. program after completing the master's degree. Either a B.S. or B.A. degree with a Master's degree (major in animal, biological, chemical, or physical sciences) is recommended. The M.S. requirement may be waived for unusually well-qualified candidates.

Courses required for admission include: one semester (3 units) each of biochemistry, general physiology, and statistical methods; one year (8 units) each of organic chemistry with laboratory. An applicant may have a limited number of deficiencies which must be completed in the first year of study. Students with M.S. degrees from other universities are encouraged to apply.

At least 36 units of graduate credit exclusive of dissertation credits are required for the major. Students must meet the minimum requirements established for the master's degree with a major in animal sciences. Additional required graduate credit units are 3 units of statistical design; 3 units of biochemistry; 2 units of animal growth, endocrinology, or physiology; and 2 units of seminar (AN S 596). At least 9 units of graduate courses, depending upon the requirements of the minor department, are required for the minor. A minimum of 18 units of dissertation credit is required. A maximum of 10 units of individual studies (599, 699, 900) plus seminar credits will be allowed toward the Ph.D. requirements. Additional requirements for completion of the degree will be determined by the major professor and student's graduate committee, but must include a minimum of 6 units from at least two of the following: AN S 513, 535, 585, 637, 684, 687.

512. Biological Electron Microscopy (4) I II P, one college level course in each of physics, chemistry, and biology. (Identical with MCB 512, which is home).

513. Quantitative Genetics (3) I Theory of quantitative genetics including idealized populations, forces that change gene frequency, breeding systems, and estimation of genetic parameters in a population. P, 6 units of genetics. (Identical with GENE 513).

535. Biotechnology in Animal Science (3) II Survey of current recombinant DNA technology and principles. Topics include: vectors and hosts, enzymes used in molecular cloning, DNA sequencing, site-directed mutagenesis, expression systems and polymerase chain reaction. P, BIOC 460 or BIOC 462a.

43. * Research Animal Methods (3) I (Identical with V SC 543, which is home).

566. Topics in Developmental Biology (2) I II Readings and discussions of primary literature concerning embryonic development of vertebrate and invertebrate organisms. P,
Anatomy of Religion (ANTH 510) An introductory course on the history of religious thought, thematic analysis, and basic concepts in the study of religion. (Identical with MAS 510, which is home).

Prehistoric Archeology (ANTH 511) A survey of the development of human societies from prehistoric times to the present. (Identical with MAS 511, which is home).

Anthropology of Religion (ANTH 512) An advanced seminar in the study of religious phenomena, focusing on specific religious systems or traditions. (Identical with MAS 512, which is home).

Paleoarchaeology (ANTH 513) An introduction to the methods and techniques of paleoarchaeology, including bone and artifact analysis. (Identical with MAS 513, which is home).

Evolutionary Ecology (ANTH 514) An examination of the relationships between ecology and evolution, with an emphasis on the evolution of human societies. (Identical with MAS 514, which is home).

Prehistoric Archeology (ANTH 515) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological sites or regions. (Identical with MAS 515, which is home).

Evolutionary Pedology (ANTH 516) An introduction to the study of soil evolution and its relationship to human societies. (Identical with MAS 516, which is home).

Prehistoric Archeology (ANTH 517) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological studies or methods. (Identical with MAS 517, which is home).

Evolutionary Pedology (ANTH 518) An introduction to the study of soil evolution and its relationship to human societies, with an emphasis on archeological pedology. (Identical with MAS 518, which is home).

Prehistoric Archeology (ANTH 519) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological issues or topics. (Identical with MAS 519, which is home).

Evolutionary Pedology (ANTH 520) An introduction to the study of soil evolution and its relationship to human societies, with an emphasis on archeological pedology. (Identical with MAS 520, which is home).

Prehistoric Archeology (ANTH 521) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological issues or topics, with an emphasis on the evolution of human societies. (Identical with MAS 521, which is home).

Evolutionary Pedology (ANTH 522) An introduction to the study of soil evolution and its relationship to human societies, with an emphasis on archeological pedology. (Identical with MAS 522, which is home).

Prehistoric Archeology (ANTH 523) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological issues or topics, with an emphasis on the evolution of human societies. (Identical with MAS 523, which is home).

Evolutionary Pedology (ANTH 524) An introduction to the study of soil evolution and its relationship to human societies, with an emphasis on archeological pedology. (Identical with MAS 524, which is home).

Prehistoric Archeology (ANTH 525) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological issues or topics, with an emphasis on the evolution of human societies. (Identical with MAS 525, which is home).

Evolutionary Pedology (ANTH 526) An introduction to the study of soil evolution and its relationship to human societies, with an emphasis on archeological pedology. (Identical with MAS 526, which is home).

Prehistoric Archeology (ANTH 527) An advanced seminar in the study of prehistoric archeology, focusing on specific archeological issues or topics, with an emphasis on the evolution of human societies. (Identical with MAS 527, which is home).

Evolutionary Pedology (ANTH 528) An introduction to the study of soil evolution and its relationship to human societies, with an emphasis on archeological pedology. (Identical with MAS 528, which is home).
in the modern world. (Identical with RELI 511). Graduate-level requirements include a major term paper.

512. * Peasants and Peasant Societies (3) Comparison of approaches to analyzing the peasantry. Special concern with peasant political mobilization and consciousness. (Identical with SOC 512) Graduate-level requirements include an additional research paper.

513. * Ethnology of the Southwest (3) II Culture, history and economic, social, and religious institutions of the living people of the Southwest. P. ANTH 200. Graduate-level requirements include a research paper. (Identical with AIS 513).

514. Late Quaternary Geology (3) I P, GEOS 102, GEOS 104. (Identical with GEOS 514, which is home).

515. Cultural Ecology of Agrarian Societies in the Middle East (3) II Emphasis is on land tenure, Islamic law, irrigation and agricultural development in the central Middle East, Nile valley, North Africa, and the Sahel from the Middle Ages to the present.

516. * Contemporary Indian America (3) The historical development and contemporary significance of the life of the Native American of the United States. Graduate-level requirements include a term paper based on original archival or field research. (Identical with AIS 516).

517. * Cultures of Ancient Mexico (3) S Archaeological and ethnohistoric survey of the civilizations of ancient Mexico from earliest times to the period of the Spanish Conquest. Field Trips. Graduate-level requirements include a term paper. (Identical with LA S 517).

519. * Psychological Anthropology (3) Cultural emphasis and experiences as basic shaping forces in personal development and emotion. Topics include psychoanalysis and anthropology, gender and sexuality, childhood, grief and mourning, dreaming, psychopathology. P, ANTH 102 or ANTH 200. Graduate-level requirements include a term paper.

520. * Contemporary American Culture (3) II Diverse perspectives on American values as expressed in organization of kinship, space, bureaucracies, media, social classes, ethnic groups, religious sects and movements. Graduate-level requirements include a major term paper.

521. * Ethnology of North America (3) Origin and distribution of native populations of North America; historical development and interrelations of cultures. P, ANTH 200. Graduate-level requirements include an oral presentation and a research paper.

522a-522b-552c. * Pre-Hispanic Art (3-3-3) 1-1-1 & II (Identical with ARH 522a-552b-552c, which is home).

523. Anthropology of Rural Mexico (3) II Historical and cultural background, and contemporary economic, political and social organization of indigenous and non-indigenous groups in rural Mexico. Primarily concerned with the people of the countryside and the Mexican revolution. Graduate-level requirements include a term paper based on original library, archival or field research. (Identical with LA S 523, AIS 523).

524. * Theoretical Population Genetics (3) I (Identical with ECOL 524, which is home).

525. * Language Variation (3) II (Identical with LING 525, which is home).

526. * Archaeology of Africa (3) I Survey of the prehistory and early history of Africa, with emphasis on sub-Saharan Africa and on the last ten thousand years. P, 3 units of archaeology. Graduate-level requirements include a 30 page term paper. (Identical with AFAS 526).

527a. * The Prehistory of East Asia (3) The origins and subsequent development of prehistoric cultures in China, Japan, Korea, Mongolia, Siberia and Southeast Asia. Broad concepts such as cultural change and environmental adaptation are stressed in order to draw parallels among these geographically and culturally diverse regions. P, ANTH 101. Graduate-level requirements include a 20 to 30 page research paper. (Identical with EAS 527a).

527b. * The Archaeology of Pre-Han China (3) The origin and florescence of Chinese culture and civilization from an archaeological perspective. An in-depth survey of Chinese prehistory and early history from the early Pleistocene to the third century BC. P, ANTH 101, consent of department. Graduate-level requirements include a 20 to 30 page research paper. (Identical with CHN 527b).

528. Near East Pastoral Nomads and Arid Lands Hunter-Gatherers (3) I A rigorous introduction to pastoral nomads and hunter-gatherers with a focus on arid lands.

530. * The Anthropology of Visual Art (3) An introduction to the anthropology of visual art and the interdisciplinary methodologies and techniques of studying art and aesthetics cross-culturally as sociocultural phenomena. P, ANTH 200. Graduate-level requirements include a research paper or project. (Identical with AIS 530).

532. * Peoples of the Pacific (3) Populations and cultures of Polynesia, Micronesia, and Melanesia; variability of these "natural laboratory" settings in an ecological framework. Graduate-level requirements include a research project and paper.

534. * Reproduction, Politics, and Household Economics (3) Principles in the comparative study of social systems, types of social structure. Graduate-level requirements include additional readings and a detailed term paper.

535. * Principles of Archaeological Fieldwork (3) Introduction to the principles of archaeological fieldwork, with emphasis on method and theory of survey and excavation. 2R, 3L, P, ANTH 235. Graduate students are expected to perform at a higher level of sophistication.

536a. * Medical Anthropology (3) I Anthropology of illness and health. Lay perceptions of health, ethnophysiology and pathology; pluralistic ideas about illness experiences; indigenous ideas about preventative and promotive health; folk dietetics; social labeling; and illness responsibility attribution. Emphasis on the study of health culture and how the subjective experience of illness and health is influenced by cultural variables. Draws upon cross-cultural ethnographic research and consideration of American health culture. P, ANTH 536a is not prerequisite to ANTH 536b.

536b. * Ethnomedicine (3) II Comparative medical systems and healing traditions, regional health arenas, and health care seeking. Topics include folk medicine, traditional medical systems, distinctive illness and public health problems, patterns of resort in the use of pluralistic medical resources, and the way in which the practice of biomedicine has been adapted to regional cultures. Explores the medical cultures of Mexico and Latin America, Native America, Africa and Asia. P, ANTH 536a is not prerequisite to ANTH 536b.

540. * Engendering The Past (3) I II Primatological, ethnographic, archaeological, and historical evidence are reviewed and critically evaluated to develop an empirically well-rounded view of engendered statuses, roles, and duties in prehistory and in selected early historic periods. Graduate-level requirements include more advanced course work and a book review. (Identical with W S 540).

541. * Organization of Museums (3) An intensive introduction to museum studies, with emphasis on the history, philosophy, structure, and functions of museums. Graduate-level requirements include a volunteer project in a local museum providing practical, hands-on experience in museum work.

543a-543b. Archaeology of Neolithic and Bronze Age Greece (3-3) Rpt./ 1 I II (Identical with CLAS 543a-543b, which is home).


547. * Anasazi Archaeology (3) II Detailed review of the archaeology of the Colorado Plateau emphasizing its agriculturally-based occupants, the Anasazi, and their descendents, the Pueblo Indians. Graduate-level requirements include a longer term paper.

548. * Writing Culture (3) Rpt./ 1 I The development of anthropological writing as it has moved toward cultural critique: the use of knowledge of other cultures to examine the assumptions of our own. Comparison of ethnographic examples. Graduate-level requirements include a major term paper.
Graduate-level requirements include an additional research paper. (Identical with MSE 579).

580. * Historical Comparative Linguistics (3) Types and mechanisms of linguistic change; language and dialect formation; determination of prehistoric connections; reconstruction of proto-languages and their origins in time and space. Graduate-level requirements include a research paper. (Identical with LING 580).

581. * Quaternary Palynology and Plant Macrophytes (2-4) II (Identical with GEOS 581, which is home). ANTH 481.

582. * Hopi Language in Culture (3) II A conversational introduction to Third Mesa dialect of Hopi, with emphasis on cultural context and covering essentials of Hopi language structure. Graduate-level requirements include a research paper. (Identical with AIS 582).

588. Healing Systems in the Southwest (3) I II P, 9 units of behavioral science. (Identical with NURS 588, which is home).

589. * Areal Survey of Native North American Languages (3) II The field of native North American linguistics; areal and genetic classifications; how the study of particular languages provides insights into theories of linguistic anthropology and general linguistics. P, ANTH 276 or LING 101. Graduate-level requirements include additional readings and longer term papers. P, ANTH 276 or LING 101. (Identical with AIS 589).

590. * Women in Middle Eastern Society (3) I II Middle Eastern society viewed from the perspective of women. Examines the extent to which formal definitions of women's nature and roles coincide with women's self-images and activities. Graduate-level requirements include an additional paper. (Identical with NES 590, W S 590).

595. Colloquium e. Anthropology and Education (3) I (Identical with LRC 595e, which is home).

596. Seminar a. Paleoanthropology and Paleolithic Archaeology of Africa (3) II P, introductory or upper-division archaeology and biological anthropology courses.

605. Professional Ethics and Skills (3) II Treatment of a series of ethical issues that can arise in the acquisition and dissemination of anthropological data; design and implementation of research through the construction of fundable research proposals; professional self-presentation. Course materials will represent the four sub-disciplines of anthropology.

606. Women's Health in the United States (3) II An examination of social, cultural and political-economic factors affecting women's health in historical and contemporary contexts in the U.S. Focus on anthropological and feminist perspectives. (Identical with W S 606).

607. Anthropological Research Methods and Design (3) I Survey of research designs, data collection methods, and data analysis used in ethnographic field research by sociocultural and medical anthropologists. Focus on practical skill acquisition.

608. History of Anthropological Theory (3) I Survey of the foundations of contemporary theory in the field of cultural anthropology.


b. Biological and Forensic Anthropology (2) II P, consent of department.

c. *Dendrochronology (1-4) II (Identical with GEOS 597c, which is home).

599. Independent Study (1-6) I [Rpt/]

600. Survey of Cultural Anthropology (3) I Intensive introduction, overview, and synthesis of cultural anthropology.

605. * Areal Survey of Native North American Languages (3) II The field of native North American linguistics; areal and genetic classifications; how the study of particular languages provides insights into theories of linguistic anthropology and general linguistics. P, ANTH 276 or LING 101. Graduate-level requirements include additional readings and longer term papers. P, ANTH 276 or LING 101. (Identical with AIS 589).

607. Anthropological Research Methods and Design (3) I Survey of research designs, data collection methods, and data analysis used in ethnographic field research by sociocultural and medical anthropologists. Focus on practical skill acquisition.

613. Policy Making and Organizational Culture (3) I II Examine the development, goals, techniques and practices of anthropology as a policy science.

620. Linguistic Field Techniques (3) I II Practice in asking linguistically informed and ethnographically sensitive questions in face-to-face interaction with a linguistic consultant; techniques of language data analysis and description.

631. * Anthropology and Development (3) II The role of anthropology in interdisciplinary projects involving economic development and planned change on the national and international levels. (Identical with ARL 631, LA S 631).

636. Foundations of Archaeological Interpretation (3) I Surveys the history of archaeological interpretation. Central concepts in archaeological method and theory are presented.

637. Archaeological Methodology (3) II Surveys the fundamental principles, methods, and techniques of archaeological analysis and inference from a multidisciplinary perspective.

642a-642b. Advanced Field Course in Archaeology (3-3) SArchaeological methods, theory, and field techniques. Three-week field excavation and survey. P, application returned to department no later than April 1st.

645. Early Civilizations (3) I II Comparative analysis of early civilizations from both the Old World and the New World, with emphasis on regularities in cultural development. P, ANTH 457 or ANTH 456a or ANTH 456b or ANTH 454.

665. Survey of Biological Anthropology (3) II Modern biological anthropology including evolutionary theory, genetics, skeletal biology, primatology, paleoanthropology, human growth, adaptability and demography.


674. The Impact of Modernization on the Third World (3) I II Intensive study of specific theories and varieties of culture change. P, 6 units of cultural anthropology or consent of instructor.

675a-675b. Anthropology and International Health (3-3) I II 675a: An intensive overview of the field of international health and anthropologists' contributions to it. Responses to biotechnology, primary health care and child survival, diseases and development; health care utilization patterns; world systems and multinational pharmaceutical industry; health care bureaucracies; interaction between traditional medicine and public health. 675b: Health transitions and the household production of health within a broader development context. P, ANTH 536a.

679. Language and Ethnography (3) I I Training in the use of ethnographic method in linguistic and cultural research where naturally occurring speech is data. Analysis of data from observation, tape recording and videotaping. (Identical with SLAT 679).

680. Survey of Linguistic Anthropology (3) II Major theoretical and methodological issues in linguistic analysis. Language as a cultural code, biological foundations, universals and typology, language and social reality, textual analysis.

693. Internship (1-6) [Rpt/]

694. Practicum (1-4) [Rpt/]

695. Colloquium a. Forensic Anthropology (2) [Rpt/ 2] II P, ANTH 597b; P or CR, ANTH 468.

696. Seminar a. Archaeology (1-3) [Rpt/ 12 units] I II
Anthropology and Linguistics
(See separate listings for Anthropology and for Linguistics)

Applied Mathematics (APPL)
Mathematics Building, Room 410
Phone: (520) 621-2016
FAX: (520) 621-8322
WWW: http://www.arizona.edu/applmath

Graduate Interdisciplinary Program in Applied Mathematics

Application Questions:
Graduate Secretary, (520) 621-2016, applmath@u.arizona.edu
Advising Questions:
Michael Tabor, (520) 621-4664, applmath@u.arizona.edu
Degrees Offered: M.S. Ph.D.
Concentrations: applied mathematics with emphasis on interdisciplinary research.


Associate Professors: J.C. Baygents (Chemical and Environmental Engineering), M. Brio (Mathematics), A.C. Cangellaris (Electrical and Computer Engineering), P.J. Downey (Computer Science), L. Friedlander (Mathematics), J.B. Goldberg (Systems and Industrial Engineering), E.J. Kerschen (Aerospace and Mechanical Engineering), Z.S. She (Mathematics)

Assistant Professors: G. L. Eyink (Mathematics), J.X. Xin (Mathematics)

A list of affiliate members is available upon request.

The Program in Applied Mathematics offers courses of study leading to the Master of Science and Doctor of Philosophy degrees. It supports and encourages research in many areas of mathematical, physical, biological, and engineering sciences in which the use and development of mathematical methods and modeling techniques play a central role.

Students entering the program are expected to have a strong background in mathematics, including advanced calculus, complex variables, and differential equations. However, entry into the program is not restricted to students who have an undergraduate mathematics major. Courses of study in the program are flexible and individually designed. In the first year students take a sequence of core courses offered in conjunction with the Department of Mathematics, which includes numerical analysis, principles of analysis, and methods of applied mathematics. In addition, students participate in Research Tutorial Groups, which provide the opportunity to become involved in small-scale research projects. In subsequent years students are able to choose from a broad variety of courses suited to their evolving research interests.

For the Doctor of Philosophy degree a dissertation is required. This dissertation is expected to contain original contributions by the student to the solution of a mathematical problem in a scientific discipline or to the development of applicable mathematical methods and/or modeling techniques.

The listed members of the program are actively involved in the supervision and/or teaching of program graduate students. The departmental affiliations of the faculty in this list give an indication of the breadth of research activities. In addition, the program has a substantial body of affiliate members who are involved in research with a strong applied mathematics component and who are potential research advisors. The combined network of members and affiliate members creates an unusually broad base of interdisciplinary research opportunities in applied mathematics.

Arabic
(See Near Eastern Studies)

Architecture (ARCH)
Architecture Building, Room 104
Phone: (520) 621-6751
FAX: (520) 621-8700
WWW: http://architecture.arizona.edu

Application Questions:
(520) 621-9819, matter@u.arizona.edu

Advising Questions:
Fred S. Matter, (520) 621-4688, matter@u.arizona.edu

Degrees Offered: M.Arch.
Concentrations: Desert architecture and design communication

Professors: Richard Eribes, Dean, Architecture, Planning and Landscape Architecture, Charles A. Albanese, Nader V. Chalfoun, Robert G. Hershberger, William Kirby Lockard (Emeritus), Alvaro Malo (Director of Architecture), Fred S. Matter, Richard L. Medlin, Robert L. Nevins, Gary Pivo (Associate Dean), Sandra Rosenbloom, Harris Sobin (Emeritus), William P. Stamm

Associate Professors: Harry der Boghossian, Dennis C. Doxtater, Robert W. Dvorak, Mary Hardin, Charles Poster, Abigail Van Slyck

Assistant Professors: Richard Brittain (Research), Renée Cheng, Susan K. E. Moody (Assistant Dean), C.C. Raid (Research)

The School of Architecture offers a program leading to the second professional degree, Master of Architecture. For information concerning this degree
program, see Requirements for Master's Degrees/Master of Architecture elsewhere in this Catalog.

501. * Systems Approach in Architectural Design (6) Design and programming of built form which changes and grows with systematic clarity; emphasis on the interface with contextual systems of activity and integrated choices of structural and environmental control systems. P, ARCH 270, ARCH 302. Graduate-level requirements include additional documentation demonstrating theoretical understanding of design.

502. * Topics in Architectural Design (6) Studio work emphasizing design of large buildings or building complexes in one of the following: building design, urban design, campus design, design competitions, computer-aided design. Offerings are determined by faculty availability, and all topics may not be offered each year. Other topics may be introduced. P, ARCH 401. Graduate-level requirements include additional documentation of the understanding of the impact of complex buildings on human experience.

503. * Solar Utilization in the Built Environment (3) Survey of solar energy utilization principles, methods and case studies focused upon building and site planning design. Graduate-level requirements include an in-depth research paper focusing on appropriate design applications of a particular solar strategy.

504. * Architecture and Planning in Mexico (3) Study of architectural development in Mexico during the prehispanic, Spanish colonial and contemporary periods, with emphasis on design ideas from each period. Graduate-level requirements include an additional research paper on a particular aspect of Mexican architecture. (Identical with LA S 504).

512. * Publication Graphics (3) [Rpt./2] I Designing compositions of text and graphics, and preparing them for publication. P, ARCH 222, ARCH 301. Graduate-level requirements include a research paper on one aspect of state-of-the-art design communication techniques.

513. * Architecture and the Arid Region (2) Studies of the relationship between architecture and the climatic characteristics of arid regions with emphasis on passive cooling techniques. P, ARCH 302. Graduate-level requirements include a research paper focusing on a particular passive cooling strategy.

514. * History of American Architecture (3) Developments in American architecture from the colonial to the early modern period. P, ARCH 334 or consent of instructor. Graduate-level requirements include an additional research project that focuses on and develops one of the major topics of the course.

522. * Urban Open Space (3) [Rpt./1] II The study of urban open space, its use as a path, meeting place, amphitheater or plaza. Analysis of how fountains, sculpture and way finding systems may enhance public space. Graduate-level requirements include an in-depth research paper or project.

524. * Modern Architecture (3) I Study of recent architectural developments throughout the world, focusing on the personalities, theories and issues influencing built form since 1945. P, ARCH 334 or consent of instructor. Graduate-level requirements include an additional in-depth research paper.

532. * Video and Media in Design Communication (3) [Rpt./1] I Introduction to video and other media in architectural design communication with emphasis on photographic reproduction, graphic design, desktop publishing, slide photography, slide presentations, and video production. Personal presentations based upon communication psychology and theory. Graduate-level requirements include an in-depth research paper or project.

533. * Lightweight Construction Techniques (3) II Survey of lightweight construction techniques, including pneumatics, tensile membranes, three-dimensional cable nets, grid shells and Baxure stiff plates. Graduate-level requirements include an additional project demonstrating a comprehensive grasp of one lightweight construction technique.

534. * History of the American House (3) Survey of American domestic buildings from European settlement to the present including social, political, and economic forces affecting architectural change. P, ARCH 334, consent of instructor. Graduate-level requirements include an additional research project. (Identical with ARH 534).

539. * Construction Documents (3) Content, intent, functions and practice of preparing documents needed for various construction delivery systems. P, ARCH 302. Graduate-level requirements include an in-depth research paper focusing on one particular aspect of developing new techniques in the field.

542. * Architectural Photography (3) Theory and practical techniques for the varied uses of photography in the field. Emphasis on the "daily use" of 35mm equipment and color slide films for self expression, documentation (exteriors/interiors), c o p y w o r k , s c a l e m o d e l s and simulation. Introductory hands-on exploration of large format photography with Polaroid film. Graduate-level requirements include a research project.

543. * Architecture in the Mediterranean (3) Summer study tour of the Mediterranean focusing on architecture. Includes Greece and the Greek islands. Seminars and graphic and written projects and assignments. Emphasis on field investigation. Graduate-level requirements include a research paper.

544. * Site Planning (3) [I (Identical with PLN 544, which is home).

551. * Option Areas in Architecture (6) I Studio work emphasizing one of the following: desert architecture, community
design, historic preservation, design communication, computer aided design, entrepreneurial design, architectural programming and evaluation. Offerings are limited by faculty availability and all topics may not be offered each year. Other topics may be introduced. P, ARCH 334, ARCH 335, ARCH 336, ARCH 402, ARCH 428. Graduate-level requirements include additional project development focusing on a particular aspect of the topic under study.

559. * Ethics and Practice (3) Standards and values of architectural services and professional project and practice management. P, ARCH 270, ARCH 402. Graduate-level requirements include an in-depth research paper focusing on a particular aspect of contemporary professional practice.

560. Introduction to Architecture Graduate Computing (3) I II Study and use of computing applied to the architecture graduate program including architectural graphics, desktop publishing, CAD, and computer presentations. Previous experience required with word processing, spreadsheets and the DOS and Macintosh operating systems. P, graduate admission.

562. * Readings and Research in Design Communication (3) Reading and discussion of design communication theory and research. Generating, developing and defending a research proposal in design communication. P, ARCH 402. Graduate-level requirements include an in-depth research paper or project.


564. * Women in American Architecture (3) Women as users, patrons, and architects of American buildings with emphasis on understanding the relationship between gender and architecture in the history of the United States. Graduate-level requirements include an in-depth research paper or project. P, consent of instructor. (Identical with ARH 564, W S 564).

566. Art and Archaeology of Le Corbusier (3) I Graduate-level requirements include an additional research paper or project. (Identical with ARH 566).

570. * Computer Graphics in Architecture (3) Introduction to the theory, techniques, and applications of computer-aided design, Focusing on modeling buildings using 3D CAD strategies and techniques on DOS and Macintosh platforms. Lectures on technical topics, with intensive experience on computers. P, ARCH 270, ARCH 202. Graduate-level requirements include a special project demonstrating in-depth understanding of one particular theory or technique covered in the course.
572. *Freehand Perspective (3) I Freehand perspective including shadow casting and entourage through 19 draw-along videos/overview tapes prepared by Prof. Kirby Lockard. Tapes are 60 minutes, divided into 3 segments. Students produce drawings for each segment. Base underlay drawings provided with videotapes. Drawings returned with constructive criticism. Graduate-level requirements include self-critical evaluations and the generation/development of alternative graphic options not required of 400-level students. This course is temporary, and will be offered during the Fall of 1999 only.

573. *Introduction to Conservation of Cultural Resources (3) I An overview of the Historic Preservation movement in America, including discussion of concepts, rationale for and methods of resource utilization, implementation of plans, legislation, etc. Graduate-level requirements include an in-depth research paper focusing on a particular concept or methodology utilized in preservation practice.

574. Field Methods in Environmental Psychology (3) II (Identical with PSYC 574, which is home).

580. *Computer Presentations in Architecture (3) II Introduction to the theory, techniques, and applications of computer-based presentations. Focusing on generating realistic architectural images and fly-throughs that are assembled in a finished multimedia presentation. In-class experience on computers. P, ARCH 470. Graduate-level requirements include additional project development demonstrating in-depth comprehension of the potential of the application under study.


584. *Planning the Built Environment (2) A lecture survey dealing with the origins and implications of the physical manifestations of communal ordering systems. An analytic vocabulary is developed with which current and historic settlement patterns are visually compared to discover spatial attributes as a dimension of human experience. P, ARCH 302, ARCH 334. Graduate-level requirements include an additional research paper that focuses on and develops one of the major themes of the course. (Identical with PLN 584).

587. *Space: A Social Cultural View (3) Human, socio-cultural use of space including processes of symbolic expression. Investigation of the role of space through ethnographic readings describing both ritual and architectural examples. P, consent of department. Graduate-level requirements include an additional research paper that focuses on and develops one of the major topics of the course.

591. Preceptoryship (1-3) [Rpt./]

593. Internship (1-4) [Rpt./]

596. Seminar
   a. *Readings in Architectural Theory (2-4) [Rpt./ 8 units] I II P, open to majors only.
   c. *Mediterranean Cities in 15th-16th Centuries: Cairo, Istanbul, Florence & Venice (3) II (Identical with NES 596d, which is home).
   d. Issues in Architectural History (3) I II P, graduate standing, ARCH 414 or ARCH 514 or consent of instructor. (Identical with ARH 590h, which is home).
   e. *Interdisciplinary Environment-Behavior-Design (3) [Rpt./ 6 units] II P, consult College before enrolling. (Identical with PSYC 596u, which is home).

597. Workshops
   a. Issues in Architecture (3-8) [Rpt./ 16 units] I II P, open to majors only. (Identical with PLN 597a).
   b. *Special Projects in Architecture (1-3) [Rpt./ 6 units] P, consent of department.
   c. *Design Development for Architectural Interiors (3) [Rpt./ 6 units] II For a description of course topics see ARCH 497d. Graduate-level requirements include producing individual projects for assignments and responsibility for broader solutions to assigned projects.
   d. *Interdisciplinary Studio for Community Design (3-6) P, open to non-majors only. (Identical with LAR 597f, PLN 597l).

599. Independent Study (1-5) [Rpt./]

696. Seminar
   b. Financing Public Services (3) I (Identical with PLN 696b, which is home).

900. Research (1-8) [Rpt./]

909. Master's Report (1-8) [Rpt./]

910. Thesis (1-8) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Arid Lands Resource Sciences (AR L)
1955 E. Sixth St., Suite 205-D
Phone: (520) 626-9111
FAX: (520) 621-3618
WWW: http://ag.arizona.edu/OALS/oals/arlsgp/contents.html

Application Questions:
Olivia A. Mendoza, (520) 626-9111, omendoza@ag.arizona.edu

Advising Questions:
Steven P. McLaughlin, (520) 741-1697, smclaughlin@arizona.edu

Degrees Offered: Ph.D.

Professors: Steven P. McLaughlin, Chair, Robert B. Bechtel (Psychology), Michael E. Bonine (Near Eastern Studies), Wayne E. Coates (Arid Lands Studies), Bonnie G. Colby (Agricultural and Resource Economics), Dennis C. Cory (Agricultural and Resource Economics), Owen K. Davis (Geosciences), Peter F. Ffolliott (Renewable Natural Resources), Martin M. Fogel (Emeritus), Kenneth E. Foster (Arid Lands Studies), Roger W. Fox (Agricultural and Resource Economics), Lay J. Gibson (Geography and Regional Development), C. Vance Haynes (Anthropology and Geosciences), Joseph J. Hoffman (Arid Lands Studies), Charles F. Hutchinson (Arid Lands Studies) Fred S. Matter (Architecture), Eric A. Monke (Agricultural and Resource Economics), James W. O'Leary (Plant Sciences), John W. Olsen (Anthropology), Richard W. Reeves (Geography and Regional Development), Michael B. Schiffer (Anthropology), Donald C. Slack (Agricultural and Biosystems Engineering), Barbara N. Timmermann (Pharmaceutical Sciences), Thomas Weaver (Anthropology)

Associate Professors: Lisa J. Graumlich (Laboratory of Tree-Ring Research), Phillip D. Guertin (Renewable Natural Resources), Leslie Gunatilaka (Arid Lands Studies), Katherine K. Hirschboeck (Laboratory of Tree-Ring Research), Vicente L. Lopes (Renewable Natural Resources), Mitchell P. McClaran (Renewable Natural Resources), Stuart E. Marsh (Geography and Regional Development), Thomas K. Park (Anthropology), Dennis T. Ray (Plant Sciences), Robert H. Robichaux (Ecology and Evolutionary Biology), Steven E. Smith (Plant Sciences), Robert G. Varady (Arid Lands Studies and Udall Center for Studies in Public Policy), Donovan C. Wilkin (Renewable Natural Resources)

Assistant Professors: Andrew C. Comrie (Geography and Regional Development), Joel Cuello (Agricultural and Biosystems Engineering), Suzanne K. Fish (Anthropology), Thomas L. Thompson (Soil, Water and Environmental Science), Stephen R. Yool (Geography and Regional Development)

The program offers graduate study leading to the Doctor of Philosophy degree with a major in arid lands resource sciences. The program is interdisciplinary and provides an academic environment in which to examine the ecological, economic, and social factors which influence
the sustainable use of arid and semi-arid lands. It is structured around four general areas of study, or tracks:

Developmental studies focus on determining strategies for resource development and management that can be sustained locally without external support. Tools upon which the track draws come from many disciplines including agricultural economics, agronomy, applied anthropology, applied ecology, range science, and watershed management.

Economic Botany studies focus on the development of natural products with potential economic uses for sustainable agriculture in arid and semi-arid lands. The field of research and study draws on the disciplines of botany, natural products chemistry, pharmacology, taxonomy, horticulture, agronomy, genetics, anthropology, and archaeology.

Ethnoecological studies focus on the interaction between people and their physical and biological environment. The ethnoecological track draws heavily on several disciplines or traditions within disciplines, including anthropology (ethnology, archaeology, ethnobotany), geography (human ecology), ecology (botany), and plant sciences (economic botany).

Physical studies focus on the interaction of two or more of the physical elements of the environment. Climate is usually one of those elements. The physical studies track draws on the allied earth sciences, including atmospheric sciences, geosciences, hydrology, watershed management, and those parts of engineering, economics, and architecture that are concerned with large and enduring transformations of the arid landscape.

Application materials are available from the department. All applicants must provide the following directly to the department: General Graduate Record Examination scores, three letters of recommendation, a list of publications and special papers, curriculum vitae, personal resume, proposed study program, and a brief statement of long range professional plans. Interested students should request additional information from the program chair. Doctoral students with majors in other fields may use arid lands resource sciences as a minor field.

512. Economic Policy in Developing Countries (3) II (Identical with AREC 512, which is home).
521. Physical Climatology (3) II (Identical with ATMO 521, which is home).
523. Hydrology (3) I (Identical with C E 523, which is home).
530. The Climate System (3) I
535. Water Management in Dryland Ecosystems (3) I (Identical with WS M 535, which is home).
541. Economic Botany of Arid Lands (3) I II P, PL S 360. (Identical with PL S 541, which is home).
542. * Transformation of Agrarian Societies in the Middle East (3) II (Identical with NES 542, which is home).
550. Geomorphology (4) I (Identical with GEOS 550, which is home).
564. The Arid and Semi-arid Lands (3) I (Identical with GEOG 564, which is home).
565. Physical Aspects of Arid Lands (3) II (Identical with GEOG 565, which is home).
566. * Population and Development in the Middle East (3) I (Identical with NES 567, which is home).
569. Ethnobotany (3) II (Identical with ANTH 569, which is home).
575. Economics of Natural Resource Policy (3) II P, ECON 300 or ECON 361. (Identical with AREC 375, which is home).
580. * Medicinal Plants (3) I (Identical with PL S 580, which is home).
590. Remote Sensing for the Study of Planet Earth (3) II (Identical with REM 590, which is home).
592. Hydrology (3) I II
593. Internship (1-3) [Rpt./] I II
595. Colloquium
   a. Current Research (1) [Rpt./] 6 units] I II
   b. Cultural Anthropology (1-3) [Rpt./ 12 units] I II (Identical with ANTH 696b, which is home).
599. Independent Study (1-3) [Rpt./] I II
600. Research (1-4) [Rpt./]
609. Master's Report (1-3) [Rpt./] I II
900. Thesis (1-8) [Rpt./]
910. Thesis (1-8) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-6) [Rpt./]

Art (ART / ARE / ARH)
Art Building, Room 101-D
Phone: (520) 621-7570
FAX: (520) 621-2955
WWW: http://www.arts.music.arizona.edu

Application Questions:
Graduate Secretary, (520) 621-8518
Degrees Offered: M.A., M.F.A.
Concentrations: Painting, drawing, sculpture, print processes, ceramics, visual communications, photography, new genre, fibers, art history, studio art, and education.

Professors: Warren H. Anderson (Emeritus), Jackson Boeils, Aurore Chabot, Robert Colescott (Emeritus), Michael F. Croft, Douglas Denniston (Emeritus), Margaret B. Doogan, Moira Geoffrion, Judith Golden (Emeritus), Dwaine Greer, Maurice K. Grossman (Emeritus), Harmony Hammond, Charles V. Hintner, Harold Jones, Dennis Jones, Bruce E. McGrew, Ellwood C. Parry, III, Robert M. Quinn (Emeritus), Alfred Quirroz, Sheldon Reich (Emeritus), Barbara Rogers, Jean Rush (Emeritus), Lynn Schroeder (Emeritus), Gayle Wimmer

Associate Professors: Andrew Polk, Head, Rosemarie T. Bernardi, Jerold Bishop, David Christiana, Pia Cuneo, Elizabeth Garber, Lynn Galbraith, John F. Heric, Paul Ivey, D. Keith McElroy, Ellen McMahon, Bart J. Morse, Mikelle...
OMAR, BARBARA PENN, SHEILA PITT, JULIE FLAX, JOYAN SAUNDERS, KENNETH SHORY, SUTCLE WIDDIFIELD
ASSISTANT PROFESSORS: CAROL FLAX, SARAH MOORE, KAREN WHITE

MASTER OF FINE ARTS: CONCENTRATIONS ARE AVAILABLE IN PAINTING, DRAWING, SCULPTURE, THE PRINT PROCESSES, CERAMICS, VISUAL COMMUNICATIONS, PHOTOGRAPHY, NEW GENRE, AND FIBERS. FOR FURTHER INFORMATION CONCERNING THIS DEGREE SEE REQUIREMENTS FOR MASTER'S DEGREES/MASTER OF FINE ARTS ELSEWHERE IN THIS CATALOG.

MASTER OF ARTS (WITH A MAJOR IN ART EDUCATION): A 30-UNIT PROGRAM WHICH ENCOURAGES STUDENTS TO INDIVIDUALIZE THEIR STUDIES WITH COURSES FROM OTHER SUBJECT DISCIPLINES SUCH AS ART HISTORY, STUDIO ART, EDUCATION, AND OTHER RELATED FIELDS.

ALL STUDENTS MUST COMPLETE AT LEAST 15 UNITS IN ART EDUCATION COURSE WORK, INCLUDING COURSES IN RESEARCH METHODS AND CURRENT ISSUES, UPON APPROVAL OF THEIR ART EDUCATION ADVISOR. OTHER GRADUATE-LEVEL COURSES ON SELECTED ART EDUCATION TOPICS WILL BE OFFERED EACH SEMESTER.

REQUIREMENTS FOR ENTRY INTO THE GRADUATE ART EDUCATION PROGRAM INCLUDE: AN UNDERGRADUATE DEGREE IN ART, ART EDUCATION, OR OTHER RELATED FIELD; THREE LETTERS OF RECOMMENDATION SENT DIRECTLY TO THE ART EDUCATION OFFICE; A WRITTEN AUTOBIOGRAPHICAL STATEMENT; A CURRENT RESUME; AND EVIDENCE OF SCHOLARSHIP AND/OR STUDIO WORK. FURTHER DOCUMENTATION MAY BE REQUESTED.

SPECIAL FACILITIES FOR GRADUATE WORK INCLUDE THE WORKS DEVOTED TO ART WITHIN THE T. E. HANLEY COLLECTION OF 37,000 VOLUMES; THE SAMUEL H. KRESS COLLECTION OF 14TH TO 19TH CENTURY EUROPEAN ART, INCLUDING THE SURVIVING PANELS OF THE RETALBO OF CIUDAD RODRIGO BY FERNANDO GALLEGRO; THE CHARLES LEONARD PFIEFFER COLLECTION OF AMERICAN ART, CONSISTING OF MORE THAN 100 CONTEMPORARY AMERICAN PAINTINGS; THE EDWARD JOSEPH GALLAGHER III MEMORIAL COLLECTION OF CONTEMPORARY AMERICAN PAINTINGS AND EUROPEAN, LATIN AMERICAN, AND ORIENTAL OBJECTS OF ART; AND MISCELLANEOUS COLLECTIONS, INCLUDING THE UNIVERSITY PRINT COLLECTION OF NOTABLE EXAMPLES OF THE VARIOUS GRAPHIC ARTS. THE CENTER FOR CREATIVE PHOTOGRAPHY HOUSES 50,000 PHOTOGRAPHIC PRINTS, ARCHIVES OF NEGATIVES, CORRESPONDENCE AND MEMORABILIA AS WELL AS A SPECIALIZED LIBRARY OF OVER 12,000 VOLUMES. THE UNIVERSITY OF ARIZONA MUSEUM OF ART SCHEDULES EXHIBITIONS FROM THESE COLLECTIONS AND, FROM TIME TO TIME, OTHER EXHIBITIONS OF GENERAL OR SPECIAL INTEREST.

MASTER OF ARTS (WITH A MAJOR IN ART HISTORY): APPLICANTS MAY BE ADMITTED WITH 18 UNITS OF UNDERGRADUATE CREDIT IN ART HISTORY OR WITH 12 SUCH UNITS PLUS A SUBSTANTIAL AMOUNT OF CREDIT IN RELATED AREAS OF STUDY.

THE MASTER OF ARTS WITH A MAJOR IN ART HISTORY REQUIRE A MINIMUM OF 30 UNITS IN ART HISTORY, INCLUDING 3 UNITS OF 511, 6 UNITS OF 596, AND 3 TO 6 UNITS OF 910. WITH THE APPROVAL OF THE ADVISOR, OTHER COURSES MAY BE SUBSTITUTED FOR A PORTION OF THE 24-UNIT ART HISTORY REQUIREMENT. A MAXIMUM OF 9 UNITS MAY BE IN INDIVIDUAL STUDIES INCLUDING 900 AND 910. A READING KNOWLEDGE OF FRENCH OR GERMAN OR OTHER APPROVED LANGUAGE MUST BE DEMONSTRATED BEFORE THE THIRD SEMESTER. THE COMPREHENSIVE EXAMINATION MUST BE PASSED PRIOR TO UNDERTAKING THESIS WORK. THE COMPREHENSIVE EXAMINATION MAY BE TAKEN NO MORE THAN TWICE. A THESIS IS REQUIRED.

STUDIO ART (ART)


505. GRADUATE FIGURE DRAWING (3) [RPT./ 5] I II SPECIAL PROBLEMS IN DRAWING, USING THE CLASSROOM MODEL AND OUTSIDE SOURCES AS REFERENCES FOR PERSONAL EXPRESSION.

509. GRADUATE DRAWING CRITIQUE (3) [RPT./ 5] I II INDIVIDUAL EXPLORATION IN DRAWING MEDIA AND VISUAL CONCEPTS. CLASSROOM AND INDIVIDUAL CRITIQUES.

522. * PERFORMANCE: LIVE/PHOTO/VIDEO (3) I AN OVERVIEW OF DIVERSE APPROACHES WITHIN PERFORMANCE ART IN AN INTERDISCIPLINARY CONTEXT. COMBINES LIVE PERFORMANCE WITH VIDEO AND PHOTOGRAPHY. GRADUATE STUDENTS ARE REQUIRED TO PRODUCE PROJECTS THAT ARE QUALITATIVELY SUPERIOR IN TERMS OF FORM, CONCEPT AND TECHNIQUE.

523. * NEW GENRE CONCEPT DEVELOPMENT (3) [RPT./ 1] I II STUDIO COURSE TO ASSIST STUDENTS WITH DEFINING INTENTIONS, REFINING PROJECT IDEAS AND CLARIFYING THE CONTENT OF THEIR ARTMAKING. OPEN TO STUDENTS WORKING IN ANY MEDIUM. GRADUATE STUDENTS ARE REQUIRED TO PRODUCE PROJECTS WHICH ARE QUALITATIVELY SUPERIOR IN TERMS OF FORM, CONCEPT AND TECHNIQUE.


541. * ADVANCED PHOTOGRAPHY (3) [RPT./ 1] I CURRENT TRENDS, PHILOSOPHIES AND EXPERIMENTATION IN PHOTOGRAPHY. P, ART 341, ACCEPTANCE OF PORTFOLIO. GRADUATE-LEVEL REQUIREMENTS INCLUDE AN IN-DEPTH RESEARCH PROJECT ON A SINGLE ASPECT OF A CURRENT SCHOLARLY INTEREST.

544. * ADVANCED DIGITAL PHOTOGRAPHY (3) [RPT./ 2] I EXPLORATION OF CONCEPTS, THEORIES, ETHICS, CREDIBILITY, AND PRACTICE OF ELECTRONIC DIGITAL IMAGING AND ITS ROLE IN THE EVOLUTION OF A BODY OF CONTEMPORARY PHOTOGRAPHIC INQUIRY. EXPLORATION OF CONCEPTS, THEORIES, ETHICS, CREDIBILITY, AND PRACTICE OF ELECTRONIC DIGITAL IMAGING AND ITS ROLE IN THE EVOLUTION OF A BODY OF CONTEMPORARY PHOTOGRAPHIC INQUIRY. 2R, 2S.

546. * EXPERIMENTAL COLOR PHOTOGRAPHY (3) [RPT./ 1] I NONTRADITIONAL APPROACHES TO COLOR PHOTOGRAPHY INCLUDING THE USE OF BLACK-AND-WHITE AND COLOR NEGATIVES, MANIPULATION OF THE NEGATIVE, DYES AND PAINTS ADDED TO THE PRINT. DEVELOPMENT OF PERSONAL VISION ENCOURAGED. P, ART 341b OR ART 341c; ART 241, ART 341a, ART 346, ACCEPTANCE OF PORTFOLIO. GRADUATE-LEVEL REQUIREMENTS INCLUDE MORE RIGOROUS GRADING AND EXPECTATIONS.

547. * MIXED MEDIA BOOK (3) [RPT./ 1] I II INVESTIGATION OF THE BOOK AS A FORMAT FOR PRESENTING VISUAL MATERIAL; THE PROCESS OF MAKING SIMPLE BOOKS. CONTEMPORARY BOOKMAKERS WILL BE PRESENTED. FIELD TRIPS. GRADUATE-LEVEL REQUIREMENTS INCLUDE AN IN-DEPTH RESEARCH PROJECT ON A SINGLE ASPECT OF A CURRENT SCHOLARLY INTEREST.

548. * VIDEO FOR ARTISTS (3) I II SENIORS AND GRADUATE STUDENTS UTILIZE SMALL FORMAT VIDEO Camera AND EDITING TO EXTEND/AMPLIFY CONCEPTS THAT HAVE DEVELOPED IN THEIR ARTISTIC INQUIRY. P, ACCEPTANCE OF PORTFOLIO. GRADUATE-LEVEL REQUIREMENTS INCLUDE AN IN-DEPTH RESEARCH PROJECT ON A SINGLE ASPECT OF A CURRENT SCHOLARLY INTEREST.

549. * ADVANCED ARTISTS' VIDEO (3) [RPT./ 6 UNITS] I II STUDENTS WILL PRODUCE INDIVIDUAL VIDEO PROJECTS WITH AN EXPERIMENTAL, SELF-EXPRESSIVE ORIENTATION. THERE IS ALSO AN OPTION TO COMBINE VIDEO WITH PERFORMANCE OR TO INCORPORATE IT WITHIN AN INSTALLATION CONTEXT. P, ART 349 OR MAR 314; ACCEPTANCE OF PORTFOLIO. GRADUATE-LEVEL REQUIREMENTS INCLUDE PROJECTS THAT DEMONSTRATE CONCEPTUAL AND TECHNICAL ACCOMPLISHMENT.

550. GRADUATE RELIEF PRINTMAKING (3) I II RELIEF PRINTMAKING WITH EMPHASIS ON INDIVIDUAL RESEARCH, PERSONAL DIRECTION AND PROFESSIONAL STANDARDS.

551. GRADUATE INTAGLIO (3) I II INTAGLIO PRINTMAKING WITH EMPHASIS ON INDIVIDUAL RESEARCH, PERSONAL DIRECTION AND PROFESSIONAL STANDARDS.
553. Graduate Alternative Methods in Printmaking (3) I II Nontraditional approaches to printmaking with emphasis on individual research, personal direction and professional standards.

555. Graduate Lithography (3) I II Lithography with emphasis on individual research, personal aesthetic, and professional standards.

556. * Advanced Illustrated Anatomy (3) [Rpt./3] S Anatomic art studies from cadaver and body parts collection in anatomy lab at the medical center. Drawing from live models and cadavers. P, ART 205, upper-division status, acceptance of portfolio.

561. Graduate Advanced Computer Graphics (3) I II S Interactive multi-media and computer graphic technologies explored in visual communication context. Includes historical and theoretical information through project development. 3R, 3S, P, ART 261, ART 265, ART 363.

565. Graduate Graphic Design Problems (3) [Rpt./1] I II Two- and three-dimensional design considerations with emphasis on conceptualization and presentation. Field Trips. P, acceptance of portfolio.

566. * Editorial Illustration (3) [Rpt./1] Problems in editorial and book illustration. P, acceptance of portfolio. 9 units of illustration courses. Graduate-level requirements include an in-depth research project on a single aspect of a current scholarly interest.

567. Graduate Illustration (3) [Rpt./1] I II Exploration of any optical material or phenomenon as a possible solution to illustration problems. P, ART 466, acceptance of portfolio.

569. * Portfolio Preparation (3) [Rpt./1] Final approach to completion of portfolio. Student's portfolio is critiqued in areas of order, style, and degree of presentation to bring it to a professional level. P, acceptance of portfolio. 9 units of graphic design courses. Graduate-level requirements include an in-depth research project on a single aspect of a current scholarly interest.

573. * Advanced Practices in Ceramics (3) [Rpt./18 units] I Individual studio research and instruction with emphasis on personal creative development. P, ART 473, acceptance of portfolio. Graduate-level requirements include an in-depth studio research project.

574. * Ceramic Surface and Color (3) [Rpt./1] Conduct sophisticated and complex investigations of surface possibilities and color interactions specific to ceramic fired techniques through experiments with slips, engobes, stains and glazes. Emphasis on creative exploration of ceramic and related materials, and diverse firing methods. Paper and sketchbook required. Final project also required. Field Trips.

575. * Ceramics Within a Public Art Context (3) [Rpt./1] For students who are interested in exploring original ceramic art work in a public art context. Students will be expected to work both individually and in groups to identify public art sites, research and design public art works, seek approval, make scale drawings and models for the sites, and when feasible, complete actual public art works. Includes all aspects of working with clay, visiting artist lectures, field trips, discussions, critiques and sketchbooks. Graduate-level requirements include one more public art proposal or internship in a ceramic public art project. A higher level of professionalism and sophistication will be expected. Field Trips.

576. * Advanced Fibers (3) [Rpt./1] I II Individual interpretations of concept into finished fiber works. P, 9 units of fiber courses. Graduate-level requirements include an in-depth studio research project.

578. Graduate Two-Dimensional Fiber Technique (3) I II Advanced fiber technique course for graduate students who wish to develop further their strengths in special technical areas. Stresses two-dimensional work.

579. Graduate Three-Dimensional Fiber Technique (3) I II Advanced fiber technique course for graduate students who wish to develop further their strengths in special technical areas. Stresses three-dimensional work.

580. Graduate Painting (3) [Rpt./1] I II Graduate study in painting with an emphasis on the development of a personal imagery and body of work.

583. * Combining Media (3) [Rpt./1] I Individual and group projects, including collages, constructions, image sequences, and elements from other art forms (sound, language, movement, etc.). Graduate-level requirements include an in-depth studio research project.

585. Graduate Watercolor Painting (3) [Rpt./1] I II High level experimentation in personal expression with watercolor and related media. Demonstration and critique.

586. * Sculpture Materials/Experimental and Combined Media (3) I II For a description of course topics see ART 486. In-depth advanced-level exploration of concepts, processes and personal direction through combining media and experimental sculpture processes.

587. * Sculpture Casting (3) I II An in-depth exploration of the techniques and concepts of casting. Advanced process of mold making as applied to individual directions.

588. * Sculpture Materials/ Metal and Wood Fabrication (3) I II An in-depth exploration of advanced processes and concepts of sculpture through metal and wood fabrication.

589. * Advanced Modeling with Emphasis on the Figure (3) [Rpt./3] Advanced modeling techniques in clay and casting wax emphasizing figure modeling. Work primarily from the model, perfecting modeling techniques, utilizing figure proportions, muscle and skeletal structures, gesture, texture, scale, and composition in creating sculptural ideas. P, ART 101, ART 102, ART 104, ART 287, ART 289, ART 389.

Graduate-level requirements include work which exemplifies graduate-level knowledge, background, and skills. Size-life figures for the final project also required.

591. Preceptorship (1-5) [Rpt./3] I II

593. Internship (1-6) [Rpt./1]

596. Seminar

f. *Critical Issues in Design (3) [Rpt./6 units] P, senior or graduate standing, acceptance of portfolio, consent of instructor.

j. *Writing Art Criticism (3) I Field Trips.

s. 3-D Concepts (3) [Rpt./3] I II

x. *Digital Illustration/Painting (3) I Advanced level course in digital painting/illustration which incorporates hands-on painting, drawing including the 3rd dimension in relation to digital imaging. Studio projects will focus on integrating traditional visual art principles with digital imaging and then working back into these images with traditional media. 3R, 3S, P, ART 261, ART 266, and portfolio. Graduate-level requirements are listed in the syllabus. This is a temporary course, and will be offered during the Fall of 1999 only.

597. Workshop

a. Gallery Management (1-3) I II
b. *Professional Experiences in Art (3) [Rpt./9 units] P, 12 units of studio or art history.

599. Independent Study (1-5) [Rpt./3]

600. Painting Concepts (3) [Rpt./2] I II Presentation of one's painting concepts and the concepts of others, citing parallel influences, research, related ideas and implications for highly concentrated student and faculty discussion.

642. Studio Photography Critique (3) [Rpt./5] I II Investigation of practical methods of critique and their influence on an artist's developing body of work. Limited to art majors with photography concentration. P, open to majors only.

656. Graduate Printmaking (3) [Rpt./5] I II Printmaking with emphasis on aesthetics, conceptualization, technical competency, artistic literacy, and personal direction. P, consent of department.
64 / Art

539. Art, Symbolism, and Psychopathology (3) [Rpt./1] II (Identical with F CM 539, which is home).

558. Theories of Curriculum and Instruction in Art (3) I II Recent theories in the fields of curriculum and art education. Review and evaluation of extant art curricula and development of skills for presentation, monitoring and evaluation of instruction. P, ARE 338.

566. * Feminist Practices in Art (3) II Practices and theories of U.S. feminism in visual art making, art writing and art exhibition, explored through lectures, presentations, discussions, reflective activities and problem solving situations. Graduate-level requirements include a greater degree of theoretical and historical understanding and scholarship; graduates have defined leadership roles and make presentations. 2D, 2R. (Identical with W 566).

576. * Teaching Aesthetics and Art Criticism (3) Practices and theories of U.S. feminism in visual art making, art writing and art exhibition, explored through lectures, presentations, discussions, reflective activities and problem solving situations. Graduate-level requirements include a greater degree of theoretical and historical understanding and scholarship; graduates have defined leadership roles and make presentations. 2D, 2R. (Identical with W 566).

577. * Teaching Studio and Art History (3) Theory, content, curriculum and methods of teaching studio art and art history. Graduate-level requirements include additional reading materials and opportunities for class leadership. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

588. Seminar I II

599. Independent Study (1-5) [Rpt./]

600. Research (1-4) [Rpt./]

691. Preceptorship (1-5) [Rpt./] I II

693. Internship (1-6) [Rpt./]

694. Practicum (1-4) [Rpt./]

699. Independent Study (1-5) [Rpt./]

791. Preceptorship (1-5) [Rpt./] I II

900. Research (1-4) [Rpt./]

909. Master's Report (1-5) [Rpt./]

910. Thesis (1-6) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Art Education (ARE)

500. * Art for Exceptional Learners (3) Adaptation of structured art curricula to exceptional learner populations. P, previous course work in art and/or special education. Graduate-level requirements include an in-depth research report.

530. Introduction to Theory in Art Education (3) I II Development of competency in application of language, methods, and diverse research procedures used in the visual arts and education as demonstrated by a scholarly written research report.

531. * The Teaching of Art (3) II Exploration of art education curricula and instructional methodology in the elementary school. P, TTE 300, EDUC 350; CR, ARE 338L, ARE 400. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.


534. * Cross-Cultural Issues in Art Education (3) Multicultural and cross-cultural issues within visual arts education (e.g., in studio art, art criticism, art history, and aesthetics). Graduate-level requirements include a choice of either developing a curriculum unit/project based on some aspect of multicultural art education, research and writing a ten-page paper related to a multicultural topic, or conducting a small multicultural research project.

593. Internship (1-6) [Rpt./]

594. Practicum (1-6) I II

596. Seminar I

h. *Current Issues in Art Education Theory and Practice (3) [Rpt./3] I II For a description of course topics see ARE 496H.

599. Independent Study (1-5) [Rpt./]

630. History and Philosophy in Art Education (3) [Rpt./2] I II Critical analysis of objectives, current theories, and texts that are shaped by the visual arts, history, philosophy, aesthetics and the behavioral sciences.

633. Issues and Recent Research in Art Education (3) [Rpt./2] I The identification of problems in art education at various curricular levels; examination of related research with possible implications for practice.

693. Internship (1-6) [Rpt./]

694. Practicum (1-4) [Rpt./]

699. Independent Study (1-5) [Rpt./]

900. Research (1-4) [Rpt./]

909. Master's Report (1-5) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) I II

930. Supplementary Registration (1-9) [Rpt./]

Art History (ARH)

511. Methods of Art History (3) I Major intellectual approaches to the visual arts developed within the past 150 years. Field Trips.

512a-512b-512c-512d. * Medieval Art (3) II The history of art and architecture in Western Europe and Byzantium between ca. 300 and ca. 1300. P, ARH 512a is not prerequisite to ARH 512b, etc. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

513a-513b-513c. * Renaissance Art in Italy: 13th and 14th Century (3) Painting, sculpture and architecture in Italy: 13th and 14th century. P, ARH 513a is not prerequisite to ARH 513b, etc.

514a-514b. * Northern Renaissance Art (3) I-1 I II *Current Issues in Art Education Theory and Practice (3) [Rpt./3] I II For a description of course topics see ARE 496H.

514a-514b. * Northern Renaissance Art (3) I I II The history of art and architecture in Western Europe and Byzantium between ca. 300 and ca. 1300. P, ARH 512a is not prerequisite to ARH 512b, etc. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

515a. * Southern Baroque Art (3) I The painting, sculpture, and architecture of 17th century Italy and Spain. Graduate-level requirements include supplemental readings, additional assignments, and an oral presentation.

515b. * Northern Baroque Art (3) II The art and architecture of 17th century Holland, France, and England. Graduate-level requirements include supplemental readings, additional assignments, and an oral presentation.

516a. * Eighteenth Century Art (3) Survey of art and architecture of 18th-century England and Italy within the context of the grand tour. Graduate-level requirements include supplemental reading, discussion, additional writing assignments and oral presentations.

516b. * Eighteenth Century Art (3) II The history and philosophy of art education in Western Europe and Byzantium between ca. 300 and ca. 1300. P, ARH 512a is not prerequisite to ARH 512b, etc. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

517. * 19th Century European Art (3) I Painting and sculpture from the French Revolution through Impressionism. P, 6 units of history or art history. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

518a-518b. * 20th Century Art (3) I Painting and sculpture in Europe. 518a: 1886 to World War I. 518b: Between the World Wars. P, 6 units of history or art
history. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

522a-522b-522c. * Pre-Hispanic Art (3-3-3) 1-II-11II 522a: Art of the high cultures of Mesoamerica, with the focus on architecture, sculpture, painting and crafts. 522b: Pre-Columbian art of Central and South America with particular attention to the Andean area. 522c: Social history of art in pre-hispanic Mesoamerica from the pre-classic through the post-classic period. P, ARH 422a is not prerequisite to ARH 422b, etc. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest. (Identical with ANTH 522a-522b-522c, LA S 522a-522b-522c).

523a-523b. * The Art of Mexico (3-3) 1-II 523a: The art of Colonial Mexico, from the early 16th century to the late 18th century. The effects of the Spanish conquest on native traditions; public, private and sacred patronage; the effects of the Bourbon reforms. 523b: The art of Modern Mexico, from the late 18th century to the early 20th century. The Independence Period, the National Period, and the Revolutionary Period. Painting, sculpture, architecture, graphic and minor arts. P, ARH 423a is not prerequisite to ARH 423b. Graduate-level requirements include a critical bibliography as well as a research paper.

524a-524b. * History of Photography (3-3) I-II 524a: From its invention to 1893; impact of photography on the art and culture of the 19th century. 524b: As an art medium from 1893 to 1965. P, 6 units of art history. ARH 424a is not prerequisite to ARH 424b. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest.

529a-529b-529c-529d. * American Art (3-3) I-II Art in the United States. 529a: Colonial art. 529b: 19th Century Art. 529c: from 1900 through 1940. 529d: Twentieth century American art from the 1930s to recent times. P, 6 units of history or art history. Graduate-level requirements include an in-depth research paper on a single aspect of current scholarly interest. May be taken in any order.

531. * Studio Introduction to Contemporary Art (3) Introduction to contemporary art, theory, criticism, and cultural politics circa 1945 to the present. Emphasis on movements and themes. Graduate students will lead discussions, write two artists' statements, have a critique with the professor as well as a midterm, final and an extended paper.

534. * History of the American House (3) I (Identical with ARCH 534, which is home).

535. * History of Prints (3) I II The technique and functions of the printmaking media from their inception in the 15th century to the 19th century. Graduate students have additional reading assignments and must submit a paper of at least 10 pages, the topic of which must first be cleared with the instructor.

539a-539b. * African Art (3-3) 1-II 539a: African art in context through chronological, interdisciplinary focus; the art of Northeast Africa, Nigeria and Yoruba Diaspora. 539b: the main traditions of the Southern Savannah, Equatorial Africa and the Eastern Sudan. P, ARH 339. ARH 439a is not prerequisite to ARH 439b. Field Trips. Graduate-level requirements include a research paper on approved topic.

551. * Etruscan Art and Archaeology (3) I I (Identical with CLAS 552, which is home).

554. * Greek and Roman Sculpture (3) I (Identical with CLAS 554, which is home).

556. * Greek and Roman Painting (3) I I (Identical with CLAS 556, which is home).

557. * Greek Architecture (3) I (Identical with CLAS 557, which is home).

561. Greek Pottery 1200-400 B.C. (3) I II (Identical with CLAS 561, which is home).

564. * Women in American Architecture (3) I P, consent of instructor. (Identical with ARH 564, which is home).

566. Art and Archaeology of Le Corbusier (3) I (Identical with ARCH 566, which is home).

581. Contemporary Theory and Criticism (3) I II (Identical with ARH 481. Graduate-level requirements include an in-depth research project on a single aspect of a current scholarly interest.

584. * Roman Art and Architecture (3) I I (Identical with CLAS 584, which is home).

593. Internship (1-6) [Rpt.]

596 Seminar
b. Problems in Renaissance-Baroque (3) [Rpt. / 2] II
c. Studies in Medieval Art (3) [Rpt. / 2] II
d. Topics in Early Modern European Art (3) [Rpt. / 9 units] II

e. Pre-Columbian Art (3) [Rpt. / 4] I P, consent of instructor. (Identical with ANTH 596e).


data. Issues in Architectural History (3) I II P, graduate standing, ARCH 414 or ARCH 514 or consent of instructor. (Identical with ARCH 596h).

b. Issues in Contemporary Theory and Criticism (3) [Rpt. / 6 units] I II P, consent of department.

c. Issues in African Art History (3) [Rpt. / 3] I II (Identical with ANTH 596j, AFAS 596j).

m. Issues in Mexican Art (3) I II P, consent of department.

599. Independent Study (1-5) [Rpt. / 12 units] I II P, consent of instructor. (Identical with ARCH 599).

693. Internship (1-6) [Rpt. / 12 units] I II P, consent of instructor. (Identical with ARCH 693).

694. Practicum (1-4) [Rpt.]

900. Research (1-4) [Rpt.]

909. Master's Report (1-5) [Rpt. / 9 units] II

910. Thesis (1-6) [Rpt. / 9 units]

930. Supplementary Registration (1-9) [Rpt. /

Astronomy (ASTR)

933 N. Cherry Ave.
Phone: (520) 621-2288
FAX: (520) 621-1532
WWW: http://www.as.arizona.edu

Application Questions:
Adam Burrows, (520) 621-1795,
aburrows@as.arizona.edu

Advising Questions:
Christopher Impey, (520) 621-6522,
cimpey@as.arizona.edu

Degrees Offered: M.S.¹, Ph.D.

¹ The unit offers a Master's degree, but initial admission is to the doctoral program only.

Professors: Peter A. Strittmatter, Head, J. Roger Angel, W. David Arnett, Robert Brown (LPL), Adam Burrows, William J. Cocke, Li-Zhi Fang (Physics), Thomas Gehrels (LPL), William F. Hoffmann (Emeritus), Christopher Impey, J. R. Kokipsi (LPL), Robert C. Kennicutt, Jr., Hal Larson (LPL), James W. Liebert, Frank J. Low (Emeritus), Fulvio Melia (Physics), A. G. Pacholczyk, George H. Rieke, Marcia Rieke, Gary Schmidt, Rodger I. Thompson, William G. Tifft, Raymond E. White, Neville J. Woolf, Lucy Ziurys (Chemistry)

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Astronomy / 65
The department offers a program leading to the Doctor of Philosophy degree with a major in astronomy. Specializations are available within the department in theoretical or observational astrophysics and in astronomical instrumentation. In addition, the Department of Planetary Sciences offers a concentration in solar system astronomy and the Committee on Optical Sciences, through the Optical Sciences Center, offers advanced degrees and research in its own field of specialization. For further information see Optical Sciences and Planetary Sciences elsewhere in this Catalog.

The graduate program emphasizes doctoral studies, but admission as a Master's degree candidate may be granted under special circumstances.

In view of the heavy demand for admission to the graduate program, applicants are required to submit scores from the Graduate Record Examination (Aptitude and Advanced Test in Physics). All applications must be supported by letters of recommendation. Undergraduate majors in physics, mathematics, or astronomy are preferred, but exceptions may be made for applicants with other majors in special circumstances.

For the Master of Science degree, a written document, but not a formal thesis, is required. A final written or oral examination is required.

Successful completion of the eight "core" graduate courses (515, 518, 522, 535, 540, 541, 545 and 582), three graduate physics courses, and two elective graduate science courses is necessary for completing the Ph.D. program. Students may substitute equivalent graduate courses from other institutions.

Doctoral students from other departments who elect to minor in astronomy must complete 12 acceptable graduate units in astronomy.

The facilities of the Steward Observatory, which is associated with the Department of Astronomy, are available for student research. The 90-inch and 36-inch reflecting telescopes are located at the Kitt Peak Observatory at 48 miles southwest of Tucson and within the grounds of the Kitt Peak National Observatory. A dormitory and office building provide facilities for overnight and extended observing periods. The Steward Observatory, in collaboration with the Smithsonian Astrophysical Observatory, is upgrading the Multiple Mirror Telescope to a single 6.5 meter diameter primary mirror, which will be the fifth largest telescope in the world. In collaboration with the Carnegie Institution of Washington, the Observatory is constructing a second 6.5 meter telescope to be located in Chile. Together with several other partners, the Observatory is building the Large Binocular Telescope (LBT) on Mt. Graham, Arizona. This telescope will consist of two 8.4 meter diameter mirrors on a common mount, with the light gathering power of a single 11.8 meter telescope. The LBT will be the largest telescope on a single mount in the world. All telescopes have a wide range of modern photometric, spectroscopic, and photographic equipment, as well as TV acquisition and guidance systems and provision for computer-controlled telescope operation and data acquisition. The Observatory has completed on Mt. Graham a 10-meter telescope for work at mm and sub-mm wavelengths in collaboration with the Max Planck Institute for Radio Astronomy in Bonn, West Germany. Campus buildings provide lecture rooms, research laboratories, staff and student offices, and technical facilities.

Instrumental equipment at the observing stations located in the Catalina Mountains includes a 61-inch reflecting telescope used for a variety of investigations, including high-resolution photography of the moon and planets; a 60-Inch reflector and a 40-inch reflector both used principally for photoelectric photometry, including investigations in the infrared, an 18-inch Schmidt telescope for wide-field photometry, and several smaller instruments. A 21-inch telescope for planetary photography is located on Tumamoc Hill in Tucson. Staff members of the Lunar and Planetary Laboratory also may participate in supervision of doctoral dissertations.

The principal areas of research at the Steward Observatory include galactic and extragalactic investigations, both observational and theoretical; mm wave and sub-mm wave astronomy; infrared astrophysics; spectrographic and photometric research on single and multiple stars; astronomical instrumentation, theoretical investigations of stellar atmospheres and interiors, the interstellar medium, star formation, and magnetohydrodynamics and general relativity applied to astrophysical problems.

Joint colloquia are held with the Kitt Peak National Observatory and the National Radio Astronomy Observatory. The Steward Observatory building houses the research and technical staffs, the computer facilities, the MMT and SMTO staffs and the Tucson offices of the Vatican Observatory, the Smithsonian Astrophysical Observatory and the National Radio Astronomy Observatory.

502. Astronomical Instrumentation Project (3) I Design, construction, and testing of an astronomical instrument chosen by each student under the guidance and supervision of the instructor. Regular class sessions are devoted to discussing techniques and reporting progress and problems.

503. * Physics of the Solar System (3) II (Identical with PHY 503, which is home). 515. Interstellar Medium (3) II Derivation of physical conditions from spectral data. Ionized, atomic and molecular clouds, interstellar dust and magnetic fields. Ionization equilibrium, heating and cooling, supernova shocks, dust and protostellar evolution.

518. * Modern Astronomical Instrumentation and Techniques (3) Radiant energy; signals and noise; detectors and techniques for imaging, photometry, polarimetry and spectroscopy. Examples from stellar and planetary astronomy in the x-ray, optical, infrared and radio. Graduate-level requirements include an in-depth research paper. (Identical with PHY 518).

522. Atomic and Molecular Astrophysics (3) Interpretation of astronomical spectra: basic aspects of atomic and molecular spectra and processes that enable one to infer physical conditions in astronomical environments from analysis of their electromagnetic spectra. Familiarity with basic quantum mechanics is assumed.
535. Stellar Structure (3) II Equations of stellar structure, virial theory, energy transport, equations of state, opacities, nuclear reactions, stellar models, evolution of low and high mass stars, observational tests, rotation and magnetic fields, binary evolution.

540. Structure and Dynamics of Galaxies (3) I Observational properties of galaxies; structure, kinematics, star and gas content. Structure of our own galaxy. Dynamics of stellar systems: equilibria, instabilities, internally and externally driven evolution.

541. Extragalactic Astronomy and Cosmology (3) II The structure, origin and evolution of the physical universe from theory and observations of systems outside our own galaxy. Relativistic cosmology, galaxy evolution and clustering; active galaxies and quasars, the microwave background, galaxy formation; the hot big bang; and physics of the early universe. P. ASTR 540.

545. Stellar Atmosphere (3) I Radiative transfer, gray atmosphere, opacity, line formation, non-LTE, curves of growth, stellar hydrodynamics, planetary applications. (identical with PHYX 545).

553. Solar System Dynamics (3) II P, MATH 254, PHYX 422 or consult department before enrolling. (identical with PHYX 553, which is home).

555. Remote Sensing of Planetary Surfaces (3) II (identical with PHYX 555, which is home).

556. Electrodynamics of Conducting Fluids and Plasmas (3) II P, PHYX 321, PHYX 331, PHYX 332. (Identical with PHYX 556, which is home).

571. General Relativity and Cosmology (3) I II General relativity with application to celestial mechanics, stellar structure, gravitational radiation, black holes, gravitational lensing and cosmology. (Identical with PHYX 571).

582. High Energy Astrophysics (3) II Radiation mechanisms, synchrotron radiation, charged particle acceleration, pulsars, black holes, accretion disks, X-ray binaries, gamma-ray sources, radio galaxies, active galactic nuclei. (Identical with PHYX 582, PHYX 582).

587. Nuclear Astrophysics (3) I A survey of the origin of the elements in stars and the Big Bang. Topics include supernovae and stellar evolution, abundances in meteorites, metal-poor stars, and high-redshift systems, and the nature of the first stars. (Identical with GEOS 587, PHYX 587, PHYX 587).

589. Topics in Theoretical Astrophysics (3) [Rpt.] I I (Identical with PHYX 589, which is home).

590. Research (1-8) [Rpt.]

900. Thesis (2-4) [Rpt.]

920. Dissertation (1-9) [Rpt.]

930. Supplementary Registration (1-9) [Rpt.]

### Atmospheric Sciences (ATMO)

**Physics-Atmospheric Sciences Building, Room 542**

**Phone:** (520) 621-6831  
**Fax:** (520) 621-6833  
**WWW:** http://www.atmo.arizona.edu

**Application Questions:**
- Cynthia A. Malbrough, (520) 621-6832, atmosci@air.atmo.arizona.edu
- Advising Questions: Eric Betterton, (520) 621-2050, better@air.atmo.arizona.edu

**Degrees Offered:** M.S., Ph.D.

**Concentrations:**
- Climate and global change, mesoscale meteorology, atmospheric dynamics, convection, radiative transfer, remote sensing, atmospheric aerosols, atmospheric chemistry, cloud and precipitation physics, and lightning and atmospheric electricity.

**Professors:**
- Benjamin M. Herman, Head, Roger Davies, George A. Dawson (Emeritus), Robert E. Dickinson, A. Richard Kassander (Emeritus), E. Philip Krider, Richard M. Schotland, William D. Sellers, Dean O. Staley (Emeritus)

**Associate Professors:**
- Eric A. Betterton, Associate Head, Steven L. Mullen, Joseph A. Zehnder
- Assistant Professors: Rong Fu, Jon T. Nelson, Nilton O. Renno

The Department of Atmospheric Sciences offers programs leading to the Master of Science and Doctor of Philosophy degrees. Research is conducted through the Institute of Atmospheric Physics in areas such as climate and global change, mesoscale meteorology, atmospheric dynamics, radiative transfer, remote sensing, atmospheric aerosols, atmospheric chemistry, cloud and precipitation physics, lightning and atmospheric electricity.

Professors: Benjamin M. Herman, Head, Roger Davies, George A. Dawson (Emeritus), Robert E. Dickinson, A. Richard Kassander (Emeritus), E. Philip Krider, Richard M. Schotland, William D. Sellers, Dean O. Staley (Emeritus)

Associate Professors: Eric A. Betterton, Associate Head, Steven L. Mullen, Joseph A. Zehnder

Assistant Professors: Rong Fu, Jon T. Nelson, Nilton O. Renno

All candidates for an advanced degree in atmospheric sciences will be expected to demonstrate proficiency in statistics and computer programming.

Applicants with undergraduate majors in physics, chemistry, mathematics, or engineering are particularly encouraged to apply.

All candidates for an advanced degree in atmospheric sciences will be expected to demonstrate proficiency in statistics and computer programming.

Master of Science: 30 units of graduate work, including 541a-541b, 551a-551b, and at least two other graduate-level atmospheric sciences courses, are required. All candidates must submit a thesis or manuscript which has been judged by the student's committee to be acceptable for publication in an appropriate scientific journal, and present the results in a formal seminar or at a scientific meeting.

Doctoral of Philosophy: The Doctor of Philosophy with a major in atmospheric sciences is primarily a research degree. The candidate must complete at least 36 units of graduate course credit in the major field, 18 units of dissertation credit, and fulfill the minor requirement. All Ph.D. students must pass a written and oral comprehensive examination and complete and defend a dissertation based on original research.

Students in either the M.S. or Ph.D. program who have received a letter grade of C or lower in one or more of 541a-541b, 551a-551b, or the transferred equivalents thereof, are required to take a written examination covering the content of the course or courses in question.

All Ph.D. candidates in atmospheric sciences are required to complete a minor program. The student should consult the particular department in which they plan to minor for specific requirements.

Students entering the Ph.D. program in atmospheric sciences with an M.S. degree in another field are permitted to minor within the department with the approval of their committee. This minor will consist of 12 units of atmospheric sciences at the 500 level or higher in subjects other than those directly related to their area of research. These courses are in addition to those required for the Ph.D. program. With the approval of their committee, students can take up to 6 units of minor courses in other departments that relate to their area of research.

Doctoral students from other departments who wish to minor in atmospheric sciences must complete 12 units of atmospheric sciences at the 500 level or higher, including ATMO 541a-541b and 551a-551b.
521. Physical Climatology (3) II Graduate-level requirements include a more quantitative and thorough understanding of the subject matter. (Identical with ARL 521).

524. Hydroclimatology (3) I (Identical with HWR 524, which is home).

530. Micrometeorology (3) I Theoretical aspects of atmospheric turbulence, including discussions of laminar flow, turbulent flow, the mechanical energy equations, and the shearing stress and the wind profile. P, ATMO 541b.

535. Air/Sea Interactions (3) I Physical characteristics of the oceans; the dynamics of ocean currents and their interactions with the atmosphere; El Nino and other teleconnections between the oceans and the atmosphere. P, ATMO 300b.

541a-541b. * Dynamic Meteorology (3-3) I II Thermodynamics and its application to planetary atmospheres, hydrometasts, fundamental concepts and laws of dynamic meteorology. P, ATMO 300a and ATMO 300b or PHYS 325 or consent of instructor. Graduate-level requirements include a more quantitative and thorough understanding of the subject matter. (Identical with PTYS 541a-541b).

544. Physics of High Atmospheres (3) II (Identical with PTYS 544, which is home).

551a-551b. Introduction into Physical Meteorology (3-3) I II Graduate-level requirements include a more quantitative and thorough understanding of the subject matter.

565. * Mesoscale Analysis (3) II Description, analysis, and dynamics of weather systems of the mesoscale. Topics may include fronts, thunderstorms, gravity waves, lake effect storms and sea breezes. P, or CR, ATMO 441b; ATMO 471. Graduate-level requirements include a more quantitative and thorough understanding of the subject matter.

567. Inverse Problems in Geophysics (3) I II P, experience with linear algebra and computer programming recommended. (Identical with GEOS 567, which is home).

569a-569b. * Air Pollution I & II (3-3) I II An introduction to the chemistry of air pollutants in the troposphere and stratosphere. Topics include a physical chemistry refresher; air pollution; carbon cycle; stratospheric ozone; combustion; aerosols; samplings; legislation. P, MATH 223. ATMO 569a is not prerequisite to ATMO 569b but is recommended. Graduate-level requirements include additional homework and other exercises. (Identical with CHEE 569a).

570. * Advanced Weather Analysis Laboratory (2) [Rpt.] I II Exploration of dynamic and thermodynamic principles that govern the atmosphere. Use of computerized weather analysis and visualization software; interpretation of output from operational numerical weather prediction models; daily forecasting practice. P, ENGR 170; CR ATMO 471 or ATMO 472. Graduate-level requirements include additional quantitative material and a term paper.

571. * Synoptic Meteorology (1) II Principles of meteorological analysis; fundamental concepts of dynamic meteorology. Structure and dynamics of midlatitude cyclones and fronts. Use of computer driven graphical displays. P, ATMO 441a; CR or P, ATMO 350, ATMO 441b, and ATMO 470. Graduate-level requirements include a more quantitative and thorough understanding of the subject matter.


580. Convection and Tropical Meteorology (3) II An introduction to fundamentals of convection and convectively driven circulations. Topics include: Rayleigh-Bernard convection, moist thermodynamics, heat engines, planetary scale and synoptic and mesoscale tropical circulations. P, ATMO 451b, ATMO 551b or consent of instructor.

583. Remote Sensing Instrumentation and Techniques (3) II P, ECE 482. (Identical with ECE 583, which is home).

589. Atmospheric Electricity (3) II For a description of course topics see ATMO 489. Graduate-level requirements include different homework assignments and tests. (Identical with ECE 589).

900. Research (1-6) [Rpt.]

910. Thesis (1-4) [Rpt.]

920. Dissertation (1-9) [Rpt.]

930. Supplementary Registration (1-9) [Rpt.]

Bilingual/Bicultural Education

Bilingual/Multicultural Education

(See Language, Reading and Culture)

Biochemistry (BIOC)

Biological Sciences West, Room 357
Medical School Office: Arizona Health Sciences Center, Room 6223
Phone: (520) 621-9185
FAX: (520) 621-9288
WWW: http://www.biochem.arizona.edu

Application Questions:
Eva Wilson, (520) 621-3868, wilsone@u.arizona.edu
Advising Questions: Elizabeth Vierling, (520) 621-1601, vierling@u.arizona.edu

Degrees Offered: M.S., Ph.D

*The unit offers a Master's degree, but initial admission is to the doctoral program only.

Professors: Marc E. Tischler, Interim Head, Hans J. Bohnert (Molecular and Cellular Biology, Plant Sciences), Don P. Bourque (Molecular and Cellular Biology), Danny L. Brower (Molecular and Cellular Biology), Michael F. Brown (Chemistry), Louise M. Canfield, Herbert E. Carter (Emeritus), Michael A. Cusanovich, Carol Dieckmann, Rene Feyereisen (Entomology), Leslie S. Forster (Emeritus), Eugene W. Gerner (Radiation Oncology), Robert J. Gillies, Darrel E. Goll (Nutritional Sciences), William J. Grimes, Richard B. Hallick, David J. Hartshorne (Nutritional Sciences), Mark R. Haussler, John G. Hildebrand (Molecular and Cellular Biology), Division of Neurobiology/ARL), Victor J. Hruby (Chemistry), Richard G. Jensen (Emeritus), Henry Koffler (Microbiology and Immunology; Molecular and Cellular Biology), John H. Law, John W. Little, Roger L. Miesfeld, David W. Mount (Molecular and Cellular Biology), David F. O'Brien (Chemistry), Roy R. Parker (Molecular and Cellular Biology), John A. Rupley (Emeritus), Eugene G. Sander, Gordon Tollin, Elizabeth Vierling, F. Ann Walker (Chemistry), Michael Wells, Henry I. Yamamura (Pharmacology; ARL)
Associate Professors: Jennifer D. Hall
(Molecular and Cellular Biology),
Martinez J. Hewlett (Molecular and
Cellular Biology), William R. Montfort
Assistant Professor: Mark S. Dodson

Teaching and research in biochemistry
are carried out in several locations in the
University and involve the efforts of the
above-listed faculty members. These
individual faculty members constitute the
University Department of Biochemistry,
which is responsible for instruction in
biochemistry throughout the university.

The Department of Biochemistry offers
the Master of Science and Doctor of
Philosophy degrees. Except in unusual
circumstances, the department will only
admit graduate students whose stated
objective is the Doctor of Philosophy
degree. The department also offers
undergraduate instruction in the College
of Science, leading towards Bachelor of
Science and Bachelor of Arts degrees in
biochemistry.

In addition, the department offers a
Master of Science degree in General
Biology. This summer-oriented degree
program is specifically designed for
secondary school biology teachers. For
more details, see the General Biology
(GBIO) listing.

The Departments of Biochemistry and
Molecular and Cellular Biology (BMCB)
recruit jointly. Entering students have a
choice of obtaining a single degree in
either program, or a program leading to a
joint degree in Biochemistry/Molecular
and Cellular Biology. The joint degree program
requires no more units than either
individual program. The expanded
graduate program provides students with
a large pool of research laboratories from
which they can choose a dissertation
director. There are currently 50 faculty
members in the BMCB Graduate program,
representing 14 departments or interdisci-
plinary programs. Applicants to either
Biochemistry or Molecular and Cellular
Biology are considered jointly by the
BMCB committee. All students enroll in
the same core courses, irrespective of
whether they are in the individual or joint
degree programs.

Research areas in which graduate
studies may be pursued cover most
modern aspects of biochemistry including
electron and X-ray crystallography;
electron tomography; protein structure
and function; bioenergetics; plant
molecular biology and biochemistry; gene
regulation and expression; genetic
engineering; membrane and cell surface
biochemistry; muscle biochemistry and
cell motility; hormone biochemistry;
insect biochemistry; and protein, lipid,
and nucleic acid metabolism.

501. Medical Biochemistry (7) II P, formal
admission into the Ph.D./M.D. program,
consent of instructor.

510. Plant Molecular Biology (3) II P, 5
units of undergraduate biochemistry,
(Identical with PL S 510, which is home).

511. Topics in Molecular Biology (1) II
(Identical with MCB 511, which is home).

512. Biological Electron Microscopy (4) I II
P, one college level course in each of physics,
chemistry, and biology. (Identical with MCB
512, which is home).

516. * Bioinformatics and Genomic Analysis
(3) II (Identical with MCB 516, which is
home).

518. Laboratory Methods in Insect
Physiology (3) II P, ENTO 515, biochemistry
is preferred. (Identical with INSC 518,
which is home).

533. * Teaching Biology Labs (2) II
Preparation and teaching of lab and field
exercises for high school biology. Includes
brief high school teaching experiences.
Designed for prospective high school biology
teachers. P, open to prospective biology
teachers only, 12 units of biology. Graduate-
level requirements include an additional
project. (Identical with ENTO 533).

(Identical with V SC 543, which is home).

545. Concepts in Genetic Analysis (3) I P,
teritory undergraduate genetics course or
biology course. (Identical with MCB 545,
which is home).

549. Survival Skills for Students (2) I II
(Identical with SP H 549, which is home).

555. Molecular Mechanisms of Development
(3) II P, MCB 568, MCB 545, or consult
department before enrolling. (Identical
with MCB 555, which is home).

561. Introduction to Biochemical Literature
(1) II Discussion of the biochemical literature
aimed at helping the student evaluate and
report the published literature. Primarily for
first year graduate students planning a career
in biochemistry and desiring to prepare
themselves for continued study. P, CR, BIOC
462a, BIOC 462b. (Identical with CHEM
561).

565. Enzymes (3) I Advanced consideration
of enzyme structure and function. P, BIOC
462a, CHEM 480B. (Identical with CHEM
565).

568. Nucleic Acid (4) I Chemistry, structure,
and function of nucleic acids; replication,
transcription translation, gene organization,
regulation of gene expression and organelle
nucleic acids. Both prokaryotic and eucary-
otic systems will be considered. P, BIOC 411
or BIOC 513, consent of instructor. (Identical
with MCB 568, GENE 568, INSC 568).

569. Topics in Gene Reconfiguration (2) I II
Behavior of gene regulatory systems in
prokaryotes and eukaryotes. Knowledge of
mechanisms is assumed and discussed when
needed, but emphasis is on regulatory
circuitry. Most lectures will be student
presentations. P, BIOC 568 or consent of
instructor. (Identical with MCB 569).

572. Cell Regulation (3) II P, MCB 462a,
MCB 462b, and consult department before
enrolling. (Identical with MCB 572, which is
home).

574. Advances in Mammalian Genetics (2)
[Rpt/ 1] I Student participation in the
presentation and discussion of current
literature covering recent advances in the
molecular analysis of mammalian genetic
loci. P, undergraduate courses in genetics and
molecular biology. (Identical with GENE
574, MCB 574).

577. Biological Structure II (3) II Advanced
study of macromolecular structure; theory,
methods, and results of x-ray crystallography
and NMR. P, BIOC 585 or consent of
instructor.

585. Biological Structure I (4) II Introduc-
tion to the current understanding and
methods used for study of the structure,
thermodynamics, and dynamics of proteins,
nucleic acids, and membranes. P, BIOC
462a. (Identical with CHEM 585, MCB 585).

586. Intracellular Messengers (2) I P, NRSC
588 or consent of instructor. (Identical with
NRSC 588, which is home).

588. Principles of Cellular and Molecular
Neurobiology (4) I P, consult program office
before enrolling. (Identical with NRSC 588,
which is home).

593. Internship (1-6) [Rpt/1] I II

594. Practicum (1-6) [Rpt/]

595. Colloquium
a. Oncogenes and Signal Transduction (1) I
P, open to graduate students in biological
discipline, exceptionally qualified
undergraduates. (Identical with CBIO
595a).
b. Journal Club (1) [Rpt/5] I II (Identical
with MCB 595b).

a. Recombinant DNA Techniques (2) S P,
open to high school biology teachers
only. (Identical with MCB 597a).
c. Current Topics for Biological Teaching
(1) [Rpt/28] I II P, open to in-service
and pre-service teachers only, 18 units of
biological sciences.

599. Independent Study (1-5) [Rpt/]

621. Molecular Plant-Microbe Interactions
(3) I P, BIOC 460. (Identical with PL P 621,
which is home).

623a-623b. Biology Update (2-2) S Focuses
on recent advances in the understanding of
basic biology and new applications. P, open
to middle and high school biology teachers
Biological sciences.

and education faculty. The use of laboratories approaches. Course taught jointly by science science curriculum materials and teaching Curriculum (3) S Contemporary secondary 633. Secondary Biology Laboratory only. BIOC 623a is not prerequisite to BIOC 70 / Biomedical Engineering

Application Questions: Celia Stenzel, (520) 626-9134, stenzelc@u.arizona.edu

Advising Questions: Stuart K. Williams, Chair, (520) 626-4707, skwill@u.arizona.edu Degrees Offered: M.S., Ph.D.

Professors: Stuart K. Williams, Chair, (Surgery/Physiology/Materials Science and Engineering/Biomedical Engineering), A. Terry Bahill (Systems and Industrial Engineering), Paul Calvert (Materials Science and Engineering), Jack G. Copeland (Surgery); William J. Dallas (Radiology), Glen G. Gerhard (Electrical and Computer Engineering), Michael Meyersohn (Pharmacy), Neil H. Mendelson (Molecular and Cellular Biology), Joseph L. Mills (Surgery), Timothy W. Scemb (Physiology), Bruce R. Simon (Aerospace and Mechanical Engineering), Robin N. Strickland (Electrical and Computer Engineering), John Sziviek (Surgery/Aerospace and Mechanical Engineering/Materials Science and Engineering), Evan Unger (Radiology), John G. Williams (Aerospace and Mechanical Engineering)

Associate Professors: Ara Abgaryan (Aerospace and Mechanical Engineering), James B. Benjamin (Surgery), Richard Donnerstein (Pediatrics), Allan Hamilton (Surgery), Ronald L. Heimark (Surgery), Douglas F. Larson (Surgery/Pharmacology), Ronald Lynch (Physiology), Ralph Martinez (Electrical and Computer Engineering/Radiology), Qi Ying Yong (Speech and Hearing), Martin E. Weinand (Surgery)

Assistant Professors/Associate Members: Francisco Arabia (Surgery), David Arzooman (Surgery), Jennifer Barton (Biomedical Engineering), Scott Berman (Clinical Surgery), Carl Boswell (Surgery), Joel Cuello (Agricultural and Biosystems Engineering), James B. Hoving (Biomedical Engineering), Matthew R. Jones (Aerospace and Mechanical Engineering), Scott Klewer (Pediatrics), Farrell Lloyd (Medicine/Medical Informatics), Robert Noecker (Ophthalmology), Mark Riley (Agricultural and Biosystems Engineering), Theodore P. Trouard (Radiology), Jeffrey A. Weiss (Biomedical Engineering), Hunter Wessells (Surgery), Julie Zaetta (Radiology)

A complete list of the Biomedical Engineering Interdisciplinary Program (IDP) faculty members and their research interests is available upon request.

Biomedical engineering is a discipline which integrates the engineering sciences with biology and medicine. The field of biomedical engineering has seen a dramatic escalation in activity over the past 20 years leading to the development of a wide variety of medical devices, medical procedures, and a basic understanding of biological processes. Engineering approaches are becoming increasingly important in modern biological and medical research and in the development of new technologies that stem from recent discoveries. The University of Arizona has established strengths in medical and biological engineering with faculty members providing education and research opportunities from nearly every scientific discipline on this campus. The Biomedical Engineering Program's major goal is to provide graduate education. However, the Program also coordinates an undergraduate BME Option available to students in several colleges at the university.

Admission Criteria: A Bachelors degree in engineering, physical or life sciences, or mathematics will be required for admission to the program. Calculus, ordinary differential equations, linear algebra and matrix methods, and at least one course each in computing and in life science are normally required for admission. Applicants lacking some of these requirements at the time of application may provide a plan for completion of these requirements prior to admission, or may request conditional admission status. All applicants must submit GRE scores (General Test).

During the first year, course work includes foundation BME core courses and introduction to research opportunities in faculty laboratories. Continued studies and research are flexible and include advanced graduate courses in engineering and life sciences, research methods, thesis credits (M.S.), dissertation credits (Ph.D.) and a research seminar series. Students are also encouraged to participate in clinical and industrial internships which provide experience in state of the art applications of biomedical engineering.
The strength of the Biomedical Engineering Program derives largely from the flexibility afforded by the broad biomedical engineering research interests of the interdisciplinary faculty who participate in the Program. This allows each student the freedom to design a unique program of study to meet individual career goals. Each student's course of study is developed with the guidance of a mentor and advisory committee.

Master of Science. All master's students in the program must take 36 units of graduate credit including the following courses: (a) four Biomedical Engineering core courses, BME 510, 511, 516, and 517; (b) ethics, MCB 695e; (c) seminar, BME 696 (2 units); and (d) either internship, BME 693 and 3 units of methods, BME 597 or 6 units of methods, BME 597 (including BME 597x); (e) 9 units in advanced graduate engineering courses; and (f) 6 units of 910 thesis. All students are encouraged to attend the weekly BME seminar series. A final examination is required. Specific M.S. degree requirements and examination procedures are described in the Biomedical Engineering Program Graduate Handbook.

Doctor of Philosophy. All doctoral students must complete 46 units of graduate credit beyond the master's degree including 15 units in the major, a minimum of 9 units in the minor; 4 units of seminar, BME 696; and 18 units of 920 dissertation. The major and minor units will include advanced courses that focus on the student's biomedical engineering research/thesis interests and will be established in consultation with the student's mentor and advisory committee. A Plan of Study should be developed by the student and mentor and a copy of the written plan should be sent to the BME Program office for review and approval by the Program Committee. A student may transfer 6 units of graduate credit from another accredited institution. Each student must pass a qualifying examination. After completion of all or nearly all required course work, the comprehensive examination may be scheduled. The comprehensive exam in the major field is taken after the student has completed the requirements for the minor. A final oral examination including defense of the dissertation is required. Doctoral students are encouraged to attend the weekly BME seminar and present their research at this seminar during the last semester in residence. Specific Ph.D. degree requirements and examination procedures are described in the Biomedical Engineering Program Graduate Handbook.

Biomedical Engineering Minor. Ph.D. candidates in other disciplines may select a minor in Biomedical Engineering. The BME Minor is 12 units of approved BME courses including 9 units from BME 510, 511, 516 or 517 and in addition 3 units of BME 597 (not including BME 597x). The doctoral student's dissertation committee should contain two faculty members in the BME Program. The minor will be granted upon completion of these courses with a B average for the required units. A "Minor Program of Study" form must be completed and a signed copy filed with the BME Program Committee.

510. Biology for Biomedical Training (3) I Basic biological principles governing cellular processes and links to applications in medicine, engineering, and applied sciences.
511. * Physiology for Biomedical Engineering (3) P, MCB 462A or MCB 460; MCB 181R, MCB 181L, MCB 182; recommend MCB 320. Graduate-level requirements include a research paper.
516. Principles of Biomedical Engineering (3) I Designed for BME students, engineering principles governing the behavior of biomedical systems including solid and fluid mechanics, mass and heat transport, system dynamics and related mathematical techniques with applications in biomedical engineering.
517. Measurement and Data Analysis in Biomedical Engineering (3) II Topics in biomedical instrumentation, sensors, physiological measurements, analog and digital signal processing, data acquisition, data reduction, statistical treatment of data, and safety issues. P, BME 516.
595. Colloquium
a. Topics in Tissue Engineering (1) I II Reading and discussion of primary literature on the development, applications and biology of engineered tissues and tissues substitutes. P: a course in cell biology or physiology. Consult department before enrolling.
597 Research Methods in Biomedical Engineering (3) I, II, S 2D. 3L Offered in five subdivisions (3 units each) by interdisciplinary teams of faculty in engineering, mathematics, life sciences, and medicine. Laboratory work will involve rotations in faculty research laboratories, including computing as well as experimental methods. M.S. and Ph.D. candidates in Biomedical Engineering must complete three out of these five courses:
b. Biomedical Research Methods: Cardiovascular & Respiratory Mechanics (1-3) [Rpt./ 9 units] I II
c. Biomedical Research Methods: Signal Processing & Imaging (1-3) [Rpt./ 9 units] I II
d. Biomedical Research Methods: Neural Systems & Neural Network Modeling (1-3) [Rpt./ 9 units] I II
e. Biomedical Research Methods: Health Informatics (1-3) [Rpt./ 9 units] I II
f. Biomed Research Methods: Modeling & Simulation of Biological Systems (1-3) [Rpt./ 9 units] I II
x. Biomed Research Methods: Biomechanics and Biomaterials (3) I II
599. Independent Study (1-6) [Rpt./] Qualified students working on an individual basis with professors who have agreed to supervise their work.
693. Internship
a. Clinical/Industrial Internship (3) I II
696. Seminar
a. Biomedical Engineering (1) [Rpt./ 6 units] I II
699. Independent Study (1-6) [Rpt./] Qualified students working on an individual basis with professors who have agreed to supervise their work.
900. Research (1-12) [Rpt./] Individual research, not related to thesis or dissertation preparation, by graduate student.
909. Master's Report (1-12) [Rpt./] Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees.
910. Thesis (1-12) [Rpt./] Research for the master's thesis (whether library research, laboratory or field observation or research or thesis writing).
920. Dissertation (1-9) [Rpt./] Research for the doctoral dissertation (whether library research, laboratory or field observation or research, or dissertation writing).
930. Supplementary Registration (1-9) [Rpt./] For students who have completed all course requirements for their advanced degree programs. May be used concurrently with other enrollments to bring the total number of units to the required minimum.

Business Administration
(B AD)
McClelland Hall, Room 210
Phone: (520) 621-2169
FAX: (520) 621-2606
WWW: http://www.bpa.arizona.edu

Application Questions:
ellerne@bpa.arizona.edu

Advising Questions:
Susan K. Wong, (520) 621-4528

Degrees Offered: M.B.A.

Professors: John Buckingham, Head, Lee Roy Beach (Management and Policy), Price V. Fishback (Economics), Sudha Ram (Management Information Systems), Melanie R. Wallendorf (Marketing)

Associate Professor: Michael S. Weisbach (Finance)
in a manner that surpass competitive offerings. Students learn strategy analysis and development techniques, team building and leadership skills, and effective communication practices.

594b. Applied Research Project (3) I II Under direct supervision of a faculty member, students must design and complete a project that integrates their master's level coursework with an existing business problem to produce an effective solution. The project can take up to 3 semesters to complete and involves the following stages: problem definition; project design; project implementation. The net result is a project which utilizes the student's coursework acquired knowledge in developing a solution to a problem with a real business application.

594c. International Business Law (3)

596. Seminar
a. Master's Report (6) [Rpt./ 12 units] S
b. International Business Law (3) An introduction to international and domestic agreements, regulations and case law that affect global trade in goods and services. Intergovernmental organization that impact "doing business" internationally will be analyzed within the framework of logical business issues facing multinational enterprises.
c. International Business (3) I II This course reviews major concepts in international business from the viewpoint of the multinational firm. Key topics include the firm's international strategy and the way in which it influences the firm's organization; interactions with home and host governments and with super-national organizations; and the response of multinational firms to emerging trends in the world economy.

599. Independent Study (1-6) I II
699. Independent Study (1-3) [Rpt./]
900. Research (1-4) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Cancer Biology (CBIO)
Arizona Cancer Center, Room 4999
Phone: (520) 626-7479
FAX: (520) 626-4979
WWW: http://grad.admin.arizona.edu/idps/cbio/cbio.html
WWW2: http://www.azcc.arizona.edu

Application Questions:
Anne Cione, acione@azcc.arizona.edu

Advising Questions:
G. Tim Bowden, (520) 626-6006, bowden@azcc.arizona.edu

Degrees Offered: M.S., Ph.D.

1The unit offers a Master's degree but initial admission is to the doctoral program only.
The Graduate Committee on Cancer Biology offers a program of study and research leading to the Ph.D. degree. The curriculum in this graduate program has been designed to introduce students to the body of knowledge which encompasses the induction, properties, prevention, and therapy of cancer. In addition, the program has been designed to assure that the students have the necessary knowledge in one or more disciplines of fundamental science to enable them to carry out original research. Because the discipline of Cancer Biology is very broad-based (encompassing biology, molecular biology, biochemistry, pharmacology, immunology, and genetics) the curriculum requirements are flexible enough to provide the students opportunities to specialize in one of a number of areas including cancer etiology, altered regulation of proliferation and differentiation in cancer cells, prevention, and treatment of cancer.

Students should have a B.S. or B.A. degree or an M.S. degree usually with a major in biochemistry or chemistry, molecular biology, genetics, cell biology, toxicology, or a closely related area, and have a cumulative grade-point average of at least 3.00. The background of the students should include basic courses in these areas as well as several advanced courses from chemistry, microbiology and immunology, molecular and cellular biology, biochemistry, genetics, pharmacology, and toxicology. Prior research experience is highly desirable and may be recognized in certain instances as evidence of competence in that area. All applicants must take the Graduate Record Examination. Subject GRE tests are optional.

The deadline for receipt of application forms for fall admission is February 1.

As part of the minimum 18 hours of course work in the major field, graduate students are required to take Cancer Therapeutics (CBIO 555, 3 units), Molecular Mechanisms of Carcinogenesis (CBIO 551, 3 units), Cancer Genetics (CBIO 589, 3 units), Cancer Epidemiology and Prevention (CBIO 515h, 2 units), Science, Society and Ethics (CBIO 596e, 1 unit), and the Cancer Biology Seminar Series (CBIO 596h, twice for credit, 2 units total, although all students in the program are strongly encouraged to participate throughout their graduate careers).

515. Basic Human Pathology (4) II 3R, 3L. P, consent of instructor. (Identical with PATH 515, which is home).
550. Drug Disposition and Metabolism (2) II P, PCOL 602A. (Identical with PCOL 550, which is home).
551. Molecular Mechanisms of Carcinogenesis (3) I Physical and chemical carcinogenesis. Special emphasis will be upon molecular aspects of the interaction of the carcinogenic agents with mammalian cells and the subsequent mutagenic and metabolic consequences of such interactions. The topics of oncogene activation and tumor suppressor gene inactivation induced by carcinogens during multi-stage carcinogenesis will be emphasized. The molecular biological techniques used in the study of carcinogenesis will also be covered. P, consent of department. (Identical with MBIM 551, RONC 551).
555. Cancer Therapeutics (3) I Fundamental biological aspects of physical, chemical and biological therapies for cancer. (Identical with MEDI 555, MBIM 555, CBA 555, RONC 555).
560. Clinical Cancer Biology (1) I II Explores three areas of clinical cancer biology: Cancer Diagnosis and Pathology, Radiation and Surgical Oncology, and Medical Oncology. A practical experience for non-medical students investigating the problems of clinical cancer prevention, diagnosis, treatment, and medical management. One on one interaction of students with practicing physician specialists in selected areas of oncology. A minimum of sixteen hours of experience provided. Enrollment is limited to three students. P, consent of instructor.
562. Tumor Immunology (3) I (Identical with MBIM 562, which is home).
595. Colloquium a. Oncogenes and Signal Transduction (1) I P, open to graduate students in biological discipline, exceptionally qualified undergraduates. (Identical with BIOC 595a, which is home).
i. Molecular Cardiovascular Biology (3) [Rpt./ 2] I (Identical with SURG 596i, which is home).
599. Independent Study (1-9) [Rpt./]
Head, Christopher A. Leadem, Albert V. LeBouton, Nathaniel McMullen, Mary E. Morbeck (Anthropology), Naomi Rance (Pathology), Raymond Runyan, Paul A. St. John, Jean M. Wilson
Assistant Professors: Helen Amerongen, Carol C. Gregorio, Lisa Nagy, Mary Czuzak
Lecturers: Norman E. Koelling, Maria Paul A. St. John, Jean M. Wilson
Senior Clinical Lecturer: James C. Dunn

Research areas of faculty include cell biology, developmental biology, endocrinology, molecular biology, neurobiology, reproductive biology, systems biology, and biological anthropology. The Department of Cell Biology and Anatomy offers a program of study leading to the Doctor of Philosophy degree. The Master of Science degree is offered only in rare instances in which students are unable to continue in the doctoral program. Applicants for admission normally should have completed course work in organic and inorganic chemistry, physics, biology, mathematics through calculus, and biochemistry.

Additional courses in advanced biology, advanced chemistry, genetics, molecular biology, and statistics are recommended. In addition, applicants must submit scores from the aptitude test of the Graduate Record Examination (GRE); submission of the score on one of the advanced tests is optional. Application requirements also include 3 letters of recommendation from former science instructors and a statement of career goals.

The program of study is very flexible with only one required lecture course (CBA 577), two laboratory rotations, and a research presentation every year. Each student selects a personalized program of additional course work and study with guidance and approval from the student's dissertation advisor and members of the dissertation committee. Students are required to take a total of 36 units, 18 of which must be obtained from graded (A,B,C) courses. Students are required to teach one semester as part of their training. Students also must select a minor field and fulfill the requirements of that department for the minor. Doctoral students majoring in other disciplines may select cell biology and anatomy as a minor field of study. The minor program must consist of 9 units in cell biology and anatomy, 5 of which must be obtained from graded (A,B,C) courses, and approval from a Cell Biology and Anatomy minor advisor who serves on the dissertation committee.

502. Principles of Neuroanatomy (4) II P, 8 units of biological laboratory science; CBA 401, PSIC 302, PSIO 480 desirable. Consent of instructor. (Identical with MCB 502, which is home).

512. Biological Electron Microscopy (4) I II P, one college level course in each of physics, chemistry, and biology. (Identical with MCB 512, which is home).

515. Human Reproductive Biology (3) Review of the anatomy and physiology of the human reproductive system with emphasis on current research in the areas of biological structure and physiological mechanisms involved in gamete production, puberty, fertilization, pregnancy, birth, assisted reproductive technology and reproductive senescence. Requirements include oral presentations and a comprehensive research paper on a selected topic of interest in reproductive biology. P, consent of instructor, one semester of biology.

550. Topics in Pigment Cell Biology (2) I Selected topics on the development function and control of normal and abnormal pigment cells in various pigmented phenomena. (Identical with MCB 550).

555. Cancer Therapeutics (3) II (Identical with CBIO 555, which is home).

556. Topics in Developmental Biology (2) I II P, consent of instructor and prior course in developmental biology or equivalent. (Identical with ANS 556, which is home).

557. Experiments in Developmental Biology (4) II Graduate-level requirements include a deeper understanding of the subject through reading and discussion of original research papers. Graduate students will be examined primarily on their ability to synthesize and evaluate information and ideas in the field. (Identical with MCB 557).

575. Special Topics In Biological Imaging (2) I II Designed for graduate students in the biological and biomedical sciences to provide an understanding of the techniques of lecture and laboratory demonstrations/exercises. Student participation in discussion will be expected. (Identical with MCB 575, PSIO 575).

577. Principles of Cell Biology (4) II Intensive, graduate-level introduction to principles and mechanisms of cell biology, including current research strategies in the field. P, consent of course coordinator. (Identical with MCB 577).

582. Topics in Neural Development (2) I P, consult program office before enrolling. (Identical with NRSC 582, which is home).

583. Topics in Neural Plasticity (2) I P, consult program office before enrolling. (Identical with MCB 583, which is home).

584. Cellular Neurobiology (2) II Readings and discussions of primary literature on the cell biology of the synapse. P, consent of instructor, one semester of neurobiology or cell biology. (Identical with MCB 584, NRSC 584).

588. Principles of Cellular and Molecular Neurobiology (4) I P, consult program office before enrolling. (Identical with NRSC 588, which is home).

589. Principles of Systems Neurobiology (4) II P, NRSC 588. Consult program office before enrolling. (Identical with NRSC 589, which is home).

595. Workshop a. Journal Club (1) [Rpt./ 14] I II

596. Seminar i. Molecular Cardiovascular Biology (3) [Rpt./ 2] I (Identical with SURG 596i, which is home).


603. Microscopic Structure (1-3) I II Selected concepts of structural organization at light and electron microscopic levels of the anatomy and development of the cells, tissues, and organs of vertebrates. P, CBA 601, CBA 602.

604. Gross Human Anatomy (2-6) [Rpt./ 12 units] I II Comprehensive study of the development and gross structure of the human body or of selected areas of system. P, consent of instructor.

625. Human Neuroscience (6) P, consent of instructor. (Identical with MED 625, which is home).

696. Seminar a. Developmental Seminar (1) [Rpt./ 13] I II P, consent of instructor, open to majors only.

699. Independent Study (1-9) [Rpt./]

700. Laboratory Rotation (3) [Rpt./ 1] I II Rotations in the research laboratories of faculty in the Department of Anatomy. P, consent of instructor.

800. Research (3-6) [Rpt./] I Research project of special interest to the student. Research activities in the department include most sub-specialties of molecular, cellular, and systems biology, including biological anthropology, cancer cell biology, neurobiology, endocrinology, reproductive biology and developmental biology. P, consent of instructor and coordinator.
Chemical and Environmental Engineering (CHEE)
Harshbarger Building, Room 120
Phone: (520) 621-6044
Fax: (520) 621-6048
WWW: http://www.che.arizona.edu

Application Questions:
Nina Welch, (520) 621-6045, welch@engr.arizona.edu

Advising Questions:
Jost Wendt, (520) 621-6044, wendt@engr.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: Thomas W. Peterson, Head, Robert G. Arnold, Hamid Saadatmanesh, Farhang Shadman, Raymond A. Sierka, Jost O. L. Wendt

Associate Professors: James Baygents, William P. Cosart, Roberto Z. Guzman, Anthony Muscat, Kimberly L. Ogden, Eduardao Saez, Michael Zachariah

Assistant Professor: James Farrell

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in chemical engineering and environmental engineering. The graduate program in chemical engineering is designed to provide advanced work in a core of transport phenomena, thermodynamics, and reaction engineering with additional selected course in mass transfer, heat transfer, fluid dynamics, control theory, and process simulation. The graduate program in environmental engineering builds on core courses in water quality, water and wastewater treatment, hazardous wastes, air pollution, biological, and chemical processes. The following interdisciplinary options are also available: biomedical engineering, biosystems engineering, energy systems engineering, and material science and engineering. For details concerning these options see Engineering elsewhere in this Catalog.

Master of Science with a major in chemical engineering: 30 units, including (a) 9 units from 505, 506, and 530, (b) at least 9 additional units of course work in chemical engineering or allied fields, (c) 2 units 900, (d) 8-unit thesis and (e) 2 units seminar (696a). A non-thesis option consisting of 33 units of course work and 2 units of 696a is available with special permission.

Master of Science with a major in environmental engineering: 30 units, including (a) 18 units from the following courses: CHEE 574, 577, 673, 675, 676 and HWR 517; (b) 8 units from related areas, with advisor concurrence; (c) 3-unit thesis (required) and (d) 1 unit seminar (696a).

Doctor of Philosophy with a major in chemical engineering: In addition to the requirements for the Master of Science degree, advanced work in mathematics, chemistry, physics, or other engineering fields is required. No foreign language is required. It is often desirable to enter the Ph.D. program directly from a B.S. degree.

Doctor of Philosophy with a major in environmental engineering: A total of 78 units, including 30 units from the M.S. degree, 30 units of additional coursework from CHEE or other approved courses, a minor (typically 12 units), and 18 units of dissertation research.


506. Advanced Chemical Engineering Thermodynamics (3) I Advanced applications of First and Second Laws, nonideal gases and liquids and their mixtures, principles of chemical equilibrium, and molecular theory. P, CHEE 326.


515. * Microelectronics Manufacturing and the Environment (3) I This course will focus on presentation of the basic semiconductor processes which have direct environmental implications. Graduate-level requirements include extended written analysis and oral presentation going beyond the requirements for the students enrolled in CHEE 415. (Identical with ECE 515)

520. * Chemical Reaction Engineering (3) I Application of thermodynamic and kinetic fundamentals to the analysis and design of chemical reactors. 1.5 ES, 1.5 ED. P, CHEE 201, CHEE 326. Graduate-level requirements include an in-depth research paper on a current topic.

521. * Topics in Real-Time Computing (3) I Introduction to microcomputer- and minicomputer-based real-time computing for data acquisition and process control. Includes study of various languages and operating systems. 2R, 3L. 1.5 ES, 1.5 ED. Graduate-level requirements include a special project.


532. Solid-Fluid Reactions (3) I Characterization of solid structural properties; principles of heterogeneous reactions involving a fluid and a reacting solid. P, CHEE 326 and CHEE 420, or MSE 450R and MSE 412. (Identical with MSE 532).

535. * Corrosion and Degradation (3) II (Identical with MSE 535, which is home).

548. Combustion Generated Air Pollution (3) II P, A ME 230, A ME 331a. (Identical with A ME 548, which is home).

554. * Law for Engineers/Scientists (3) II Topics covered in this course include patents, trade secrets, trademarks, copyrights, product liability contracts, business entities, employment relations and other legal matters important to engineers and scientists. Graduate-level requirements include an in-depth research paper on a current topic. (Identical with ENGR 554)

560. * Aerosol Science and Engineering (3) I Physics, chemistry, mechanics and optics of aerosol particles. Topics include formation, dynamics, nucleation and growth, coagulation, scattering and absorption of radiation.
deposition and aerosol technology. Graduate-level requirements include a special project. (Identical with ECE 560).

561. * Chemical Process Stimulation (2) II Use of existing large, modular computer programs for computer-aided process design and analysis; program structure, convergence accelerators and control blocks. 2ED. P, CHEE 442. Graduate-level requirements include a special project.

569a-569b. * Air Pollution I - II (3-3) I-II (Identical with ATM 569a-569b, which is home).

370. * Fundamentals of Polymeric Materials (3) II Fundamental chemical, physical, and mechanical properties of organic plastics, fibers, coatings, adhesives, and elastomeric polymers. 1.5 ES, 1.5 ED. P, CHEM 241B, MSE 331R; CR, CHEM 480B. Graduate-level requirements include a special project.

573. Biodegradation of Hazardous Waste Compounds (2-3) I Chemical and microbiological considerations which affect the thermodynamics and kinetics of transformations of hazardous organic compounds in treatment facilities and in natural settings. 2R, 3L. P, CHEE 577 or consult department before enrolling. (Identical with C E 573).

574. Environmental Transport Processes (3) I Engineering concerns in toxic and hazardous waste management with focus on aspects of chemical transport between air, water and soil systems, and microbial degradation processes in natural and engineered environment. (Identical with C E 574).

577. The Physiological Bases of Microbial Treatment Processes (3) I Principles of bacterial physiology including morphology, metabolism and genetics. Applications of importance to waste treatment and environmental quality. P, CHEE 370 or consult department before enrolling. (Identical with C E 577).

578. * Introduction to Hazardous Wastes (3) I II Management, planning, legal and engineering aspects of liquid and solid hazardous waste treatment and disposal. P, CHEE 370 or consult department before enrolling. Graduate-level requirements include a report on an in-depth review of interdisciplinary aspects of an existing project (with a non-university project engineer).

580. * Bioseparation Techniques for Engineers (3) II Methods of separation for purification of bioproduct processes - amino acids, proteins, nucleic acids, carbohydrates, lipids, cells. P, CHEM 243a, CHEM 243b. Graduate-level requirements include a special project.

581. * Bioreactor Engineering (3) I Introduction to biotechnology; chemistry of microorganisms; design of bioreactors to include cellular and enzyme reactors of all types; transport phenomena and control of bioreactors; instrumentation and measurement in bioreactors. P, MATH 234, CHEM 241a, CHEM 480a. Graduate-level requirements include a special project.

583. Remote Sensing Instrumentation and Techniques (3) II P, ECE 482. (Identical with ECE 583, which is home).

585. * Biomedical Transportation Phenomena (3) I Transport processes in the cardiovascular system, hemorhology, pharmacokinetics, enzyme kinetics, extracorporeal mass transport devices, biocompatible materials. 3ES. P, CHEE 305 or A ME 331a, and MATH 223. Graduate-level requirements include a special project.

586. Advanced Biomedical Engineering (3) II Analytical methods applied to problems in biochemical and biomedical engineering. Course includes invited lecturers, journal critiques, and preparation of an original paper. P, MATH 223.

599. Independent Study (1-3) [Rpt./] I II


675. Wastewater Treatment (3) I Theoretical and applied principles of aerobic and anaerobic wastewater treatment systems. P, CHEE 370. (Identical with C E 675).

676. Advanced Water Treatment System Designs (3) II Design and operation of water treatment plants; physicochemical treatment processes for potable water production. (Identical with C E 676).

696. Seminar

a. Chemical Engineering (1) [Rpt./] 6 I II
b. Combustion (1) [Rpt./] 6 I II
c. Kinetics (1) [Rpt./] 6 I II
d. Pollution Control (1) [Rpt./] 6 I II
e. Crystallization (1-3) [Rpt./7 units] I II
f. Fluid Mechanics (1) [Rpt./] 6 I II
g. Biomedical (1) [Rpt./] 6 I II
h. New Developments (1) [Rpt./] 6 I II

900. Research (1-5) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Chemistry (CHEM)

Old Chemistry Building, Room 221
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chemistry@arizona.edu

Advising Questions:
Debbie Bober, (520) 621-2737

Degrees Offered: M.A., M.S., Ph.D.


Associate Professors: Michael F. Burke, Jacqueline Gervay, Joe W. Perry, Robin L. Polt, John V. Rund, S. Scott Saavedra, G. Krishna Vemulapalli, Vicki Wysocki

Assistant Professors: Dominic McGrath, Jon Rainier, Zhiping Zheng

Lecturer: Walter B. Miller III

The department offers programs leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees with a major in chemistry. Concentrations are available in analytical, biochemistry, inorganic, organic, and physical chemistry, and can include an emphasis in chemical physics, materials science, optical sciences, polymer sciences, surface sciences, astrochemistry, biorganic science and several other interdisciplinary fields.

Prospective students should contact the department for information and brochure about the variety of research programs, faculty involved, facilities available, and guidelines for the graduate program in chemistry.

The application deadlines are December 1st for international applicants and February 1st for domestic applicants. Official transcripts of all previous college
and university work, a personal statement of plans, goals and education, and the results of the Graduate Record Examination are required. Confidential letters of recommendation are also required from three persons familiar with the applicant’s work, preferable in chemistry, one of which must be from a major advisor/professor.

Teaching assistantships and/or fellowship support are available for incoming graduate students. Students in good standing after the first semester are generally supported by either teaching or research assistantships.

New students are assisted and advised by the department’s Graduate Program Committee until they are prepared to select a research program and a research advisor. The committee administers examinations for all new students during the week before registration each semester. These examinations cover various branches of chemistry, and the results are used to help students plan an appropriate graduate program.

Master of Arts: Students who plan to teach chemistry in secondary schools will find this program adapted to their needs. The M.A. degree is a non-thesis degree that is awarded for advanced study in chemistry beyond the bachelor's degree.

Master of Science: A thesis based upon original research is required. All students must pass a final oral examination.

Doctor of Philosophy: The Doctor of Philosophy with a major in chemistry is primarily a research degree. The number and selection of courses is tailored to the individual student’s needs and interests according to the guidelines available from the Department of Chemistry. The minor work may be satisfied within the Department of Chemistry. A dissertation based upon original laboratory research is required. All students must pass a comprehensive examination and a final oral defense examination.

501. Intermediate Analytical Chemistry (3) Survey of principles of modern analytical chemistry intended as a concise review of modern chemical analysis. P, CHEM 424, CHEM 480b or consent of instructor.

502. * Intermediate Organic Chemistry (3) I Survey of the principal classes of organic reactions. P, CHEM 241b or CHEM 242b. Graduate-level requirements include an in-depth research paper focusing on current research in a major area covered by the course.

503. Intermediate Physical Chemistry (3) I General survey of physical chemistry, including thermodynamics, structure, kinetics and electrochemistry. P, CHEM 480b or consent of instructor.

504. * Inorganic Chemistry (3) I Fundamentals of inorganic chemistry. Graduate-level requirements include an in-depth research paper focusing on current research in a major area covered by the course.

510. Advanced Inorganic Chemistry (3) I Aspects of modern inorganic chemistry with emphasis on transition metals. Structure and bonding, magnetic and spectroscopic properties, and reactions and reaction mechanisms of transition metal compounds. Catalytic properties of transition metal complexes and new directions in inorganic chemistry. P, CHEM 404 or consent of instructor.

511. Advanced Inorganic Chemistry (3) II Aspects of modern inorganic chemistry with emphasis on the Main Group elements. Synthesis, reactivity, and structures of main group inorganic compounds and the physical methods used in their characterization. P, CHEM 404 or consent of instructor.

512. Inorganic Preparations (3) I II Graduate level requirements include an individual synthesis project.

513. Current Topics in Inorganic Research (1-4) [Rpt./ 10 units] I II In-depth treatment of advanced topics in inorganic chemistry. Examples include kinetic and mechanism of inorganic reactions, bioinorganic chemistry, EPR spectroscopy, solid state materials chemistry, chemistry of particular elements or families of elements, and other topics characterized by faculty expertise. Topics will vary each semester. P, CHEM 510 or consent of instructor.

514. Organometallic Compounds (3) III Compounds containing carbon-metal bonds, with emphasis on those of the transition elements, their reactivity, and the determination of their structure. P, CHEM 404 or CHEM 504 or consent of instructor.

515. Physical Methods in Inorganic Chemistry (3) I Selected topics in the area of physical characterization of inorganic molecules and materials, with particular emphasis on ligand field theory, symmetry aspects, spectral properties and magnetic behavior of transition metal complexes. P, CHEM 510.

517L. Structural Chemistry Laboratory (1) I II Laboratory designed to accompany 517R. Students work in the lab, solve structures and report their findings in papers. P, CR, CHEM 517R.

517R. Structural Chemistry (2) I II Introduction to the determination of structures of complex molecules by X-ray crystallography; the evaluation of structural information; current topics in structural chemistry.

518L. Computational Chemistry Laboratory (1-2) I II Laboratory designed to accompany 518R. Students work in the computer lab and report their findings in papers. P, CR, CHEM 518R and consent of instructor.

518R. Computational Chemistry (1-2) I II State-of-the-art computational methods in chemical research, including approximate and abinitio electronic structure methods, molecular mechanics and modeling graphics. P, consent of instructor.

520. Advanced Topics in Analytical Chemistry (2-3) [Rpt./ 6 units] I II Special topics in modern analytical chemistry. Recent offerings have included principles of bioanalytical chemistry and mass spectrometry. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, CHEM 424 or consent of instructor.

521a-521b. Advanced Analytical Chemistry (3-3) I-II 521a: Principles of electronics, principles of signal processing hardware and software, instrumental principles of atomic and molecular spectroscopy, statistical treatment of data, chemometrics. 521b: Advanced fundamentals of equilibrium chemistry, principles of analytical separations including chromatography, principles of electroanalysis including ion selective electrodes and chemical sensors. P, CHEM 323, CHEM 424, CHEM 480b or consent of instructor.

522. Electroanalytical Chemistry (2-3) II Principles of electrochemistry and electroanalysis, including topics on electrochemical equilibria, electrode kinetics, potentiometry, coulometry, voltammetry and spectrophotometry. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, CHEM 424 or consent of instructor.

523. Advanced Topics in Equilibrium Chemistry (2-3) [Rpt./ 6 units] II Advanced topics in equilibrium chemistry including mathematical description of equilibria in aqueous and nonaqueous media, metal chelate chemistry. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, CHEM 521b or consent of instructor.

524. Chemical Instrumentation (4) II Data acquisition and experiment control by analog and digital techniques; design of chemical instrumentation. 3R, 3L. P, CHEM 424 or consent of instructor.

526a-526b. Analytical Spectroscopy (2-3/2-3) I-II 526a: Principles of atomic absorption and emission spectroscopies and x-ray methods for chemical analysis. 526b: Principles of molecular absorption, emission and scattering spectroscopies for chemical analysis. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, CHEM 424 or consent of instructor.

527. Analytical Separations (2-3) I Fundamentals of separation processes including single and multistage analytical chromatographic methods. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, CHEM 424 or consent of instructor.
528. Advanced Analytical Chemistry Laboratory (2) I Advanced laboratory experiments in analytical instrumentation. P, CHEM 424, CHEM 480b; CR, CHEM 521a.

529. Methods of Surface and Materials Analysis (2-3) I Fundamentals of electron, atomic and molecular spectroscopies for surface and materials analysis. Students enrolled for 3 units are required to complete an additional research project with paper and oral presentation. P, CHEM 424 or consent of instructor.

533. * Chemistry Demonstrations (3) II Preparations and presentation of demonstrations of chemical phenomena in the classroom. Designed for undergraduate teaching majors in chemistry, for graduate students interested in teaching chemistry at the secondary or college level, and for chemistry teachers already employed in secondary school. P, CHEM 241b, CHEM 243b or CHEM 245b or consent of instructor. Graduate-level requirements include additional demonstrations and more thorough analyses of each demonstration. In addition, secondary school chemistry teachers will be expected to offer insights and counsel to students who have never taught in a real classroom.

540. Organic Synthesis (3) I Organic reactions and the methods by which they are applied to synthetic problems in organic chemistry. P, CHEM 241b, CHEM 480b or consent of instructor.

541. Mechanisms of Organic Reactions (3) II Detailed analysis of the factors which influence the rates and courses of organic processes. P, CHEM 241b, CHEM 480b or consent of instructor.

542a-542b. Polymer Chemistry (3-3) I-II Synthesis, stereochemistry, and mechanisms of formation of high polymers. 542a: Condensation and ring-opening polymers. 542b: Vinyl polymers. P, CHEM 542a is not prerequisite to CHEM 542b.


544. Heterocyclic Compounds (3) I The behavior of the more important heterocyclic systems.

545. Chemistry of Natural Products (3) I Survey of natural organic compounds and their biosyntheses.

546. Advanced Organic Chemistry (3) [Rpt./1] II Advanced topics in organic chemistry, such as peptide chemistry, computer simulations, bio-organic chemistry, and other topics characterized by faculty expertise. Topics will vary each semester. P, consult department before enrolling.

547. * Organic Structural Analysis Laboratory (3) II Determination of structure and composition of organic compounds and mixtures using modern spectroscopic and separation methods.

551. Introduction to Biochemical Literature (1) II P, CR, BIOC 462a, BIOC 462b. (Identical with BIOC 561, which is home).

555. Enzymes (3) I P, BIOC 462a, CHEM 480b. (Identical with BIOC 565, which is home).

560. Introduction to Quantum Chemistry (3) I An introduction to quantum mechanics, with applications to atomic structure and spectra, the nature of chemical bonding and molecular structure. P, CHEM 480b or consent of instructor.

582. Statistical Thermodynamics (3) I Introduction to classical and quantum statistical thermodynamics with application to ideal gases and simple solids; equations of state and elementary solution theory. P, CHEM 480b or consent of instructor.

583. Chemical Kinetics (3) II Classical and modern techniques in studies of chemical reactions. P, CHEM 480b or consent of instructor.

584. Practical NMR Spectroscopy (3) I Basic principles of nuclear magnetic resonance (NMR) spectroscopy; common pulse sequences for 1- and 2-dimensional NMR experiments; operation of modern Fourier transform NMR spectrometers; interpretation of NMR spectra. P, CHEM 480b or consent of instructor.

584L. Practical NMR Spectroscopy Laboratory (1) I Laboratory designed to accompany 584R. Students work in the NMR lab and report their findings in papers. P, CHEM 480b; CR, CHEM 584R.

585. Biological Structure I (4) II P, BIOC 462a. (Identical with BIOC 561, which is home).

587. Introduction to Molecular Spectroscopy (3) I Modern molecular spectroscopy including rotational, vibrational, and electronic spectroscopy and their various combinations. P, CHEM 480a, CHEM 480b or consult department before enrolling.

591. Preceptorship

b. *Chemistry Course Development (1) [Rpt./1] A combination of CHEM 591b and CHEM 591c may be taken up to a total of 4 units.

c. *Professional Services (1) [Rpt./1] A combination of CHEM 591b and CHEM 591c may be taken up to a total of 4 units.

592. Internship (1-3) [Rpt./]

595. Colloquium

a. Current Topics in Chemical Research (3) I II
b. *History of Chemistry (1-2) I II
c. *College Teaching (1) [Rpt./1]

599. Independent Study (1-3) [Rpt./]


680. Quantum Chemistry (3) II Principles of quantum mechanics with applications to the properties of molecules. P, CHEM 580.


687. Molecular Spectroscopy (3) I-II Applications of quantum mechanics to the interpretation of the spectra of molecules of chemical and biological interest. P, CHEM 580.

694. Practicum (1-3) [Rpt./]

695. Colloquium

a. Chemical Research Opportunities (1) I
b. Exchange of Chemical Information (1-3) [Rpt./ 10 units] I II

696. Seminar

a. Analytical Chemistry (1-3) [Rpt./ 10 units] I II
b. Inorganic Chemistry (1-3) [Rpt./ 10 units] I II
c. Organic Chemistry (1-3) [Rpt./ 10 units] I II
d. Physical Chemistry and Chemical Physics (1-3) [Rpt./ 10 units] I II
ej. Advanced Seminar (1-3) [Rpt./ 10 units] I II

697. Workshop

a. Chemical Instruments (1-3) [Rpt./ 8 units] I II

900. Research (1-5) [Rpt./]

908. Case Studies (3) [Rpt./ 1 I II

909. Master's Report (1-5) [Rpt./]

910. Thesis (1-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Civil Engineering and Engineering Mechanics (C E / E M)

Civil Engineering Building, Room 206
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WWW: http://info-center.ccit.arizona.edu/civil

Application Questions:
Barbara Graham, (520) 621-2266, ceemgradsec@engr.arizona.edu

Degrees Offered: M.S., Ph.D.
Professors: Juan B. Valdes, Head, Muniram Budhu, Dinshaw N. Contractor, Chandrakant S. Desai, Mohammad R. Ehsani, Achintya Haldar, Simon Ince (Hydrology and Water Resources), Tribikram Kundu, Hamid Saadatmanesh
Associate Professors: George N. Frantzkonis, Panos D. Kicoussis, Kevin E. Lansey, Robert H. Wortman

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in civil engineering and engineering mechanics. Work is directed toward research and professional development in such areas as engineering mechanics, engineering materials, highway engineering, hydraulics and fluid mechanics, geomechanics, geo-technical engineering, water resources, structural engineering, and transportation engineering. Certain interdisciplinary options such as regional development and urban planning, and environmental engineering are available by combining various areas of the program with programs in other departments. For further information concerning these options, see the College of Engineering and Mines entry elsewhere in this chapter.

Master of Science: A thesis or engineering report is required. At the option of the department, the degree may be awarded to candidates for the Doctor of Philosophy degree who have passed the comprehensive examination, provided they write a thesis or engineering report.

Doctor of Philosophy: A minor field may be selected from architecture, chemistry, environmental engineering, geology, mathematics, mechanical engineering, materials science and engineering, mining engineering, nuclear engineering, physics, or systems engineering, or from within the Department of Civil Engineering and Engineering Mechanics. Additional fields are available as minors with the approval of the head of the department.

Civil Engineering (C E)


503. Subsurface Fluid Dynamics (3) I P, MATH 223 or (preferably) MATH 322 or MATH 422A or MATH 422B; C E 321 or AME 331. (Identical with HWR 503, which is home).

504. Numerical Methods in Subsurface Hydrology (4) II (Identical with HWR 504, which is home).

510. * Probability in Civil Engineering (3) Outlines the extent of uncertainties under which civil engineering designs and decisions are made. Theory and application. Advanced topics in risk-based engineering design. System reliability concepts. Statistical decision theory and its application in civil engineering. Identifying and modeling, nondeterministic engineering problems in understanding many recently issued engineering codes. P, Consult department before enrolling. Graduate-level requirements include a project paper.

517. * Mechanics of Materials II (3) Three dimensional analysis of stress and strain, Castigliano's theorems, curved beams, asymmetric bending, shear center, torsion of thin-walled sections, beams on elastic foundation, nonlinear material behavior, membrane stresses in shells. 2ES, 1ED. P, C E 217. Graduate-level requirements include a research report on a special problem.

523. Hydrology (3) I Graduate-level requirements include a project paper. (Identical with ARL 523, HWR 523).

524. * Hydraulic Engineering Design (3) Application of principles of hydraulic analysis to the design of hydraulic systems. Applications will vary and include hydropower systems, stilling basins, open channel distribution and collection systems, pipe networks and pumping systems, drainage problems and other topics. P, C E 322. Graduate-level requirements include a research paper and/or a design project.


526. Water Quality Management (3) II P, HWR 525. (Identical with HWR 526, which is home).

527. * Computer Applications in Hydraulics (3) I Computer modeling of surface water hydrology, flood plain hydraulics and water distribution systems. Theoretical basis. Application and design studies. 1ES, 2ED. Graduate-level requirements include a research paper or project. (Identical with HWR 527).

532. * Advanced Structural Design in Steel (3) Advanced problems in the analysis and design of steel structures including beam columns, plate girders, composite construction, multi-story buildings; static and dynamic lateral and vertical loads; connections; computer applications. 3ED. P, C E 336. Graduate-level requirements include a comprehensive design project.

533. Plastic Analysis and Design (3) II Material and member behavior to full plastification; redistribution of forces; plastic design of continuous beams and frames; influence of axial and shear forces; deflections and rotations; alternating plasticity; shakedown analysis. P, C E 432 or consult department before enrolling.

534. * Design of Wood and Masonry Structures (3) I II Determination of gravity and lateral loads on structures. Design of wood structures for axial load and bending; structural wood panels, diaphragms and shear walls. Types of masonry construction. Design of masonry structures for gravity and lateral loads. 3ED. P, C E 331; CR C E 337. Graduate-level requirements include a comprehensive design project.

536. Prestressed Concrete Structures (3) II Behavior, analysis, and design of statically determinate indeterminate prestressed concrete structures.

537. * Advanced Structural Design in Concrete (3) Advanced problems in the analysis and design of concrete structures, design of slender columns and one- and two-way slabs; lateral and vertical load analysis of bridges and multistory buildings; introduction to design for torsion and seismic forces; use of structural computer programs. 3ED. P, C E 337. Graduate-level requirements may include a research paper or a comprehensive design project.

540. * Foundation Engineering (3) II Settlement and bearing capacity of shallow and deep foundations; beam on elastic foundation; design of footings and pile foundations; foundations on metastable soils; the use of computer codes for foundation problems. 1ES, 2ED. P, C E 340. Graduate-level requirements include the development of computer codes for the solution of specified foundation problems or an in-depth research paper on a specific aspect of foundation engineering.

541. * Earth Structures in Geotechnical Engineering (3) I Stability analysis for earth slopes, including planar, circular piecewise-linear, and composite-surface methods; analyses for static and steady-flow conditions; earth pressure theories and calculations for generalized conditions; design of rigid and flexible retaining structures; design of braced and tie-back shoring systems; design of reinforced earth walls; computer-aided analysis and design. 1ES, 2ED. P, C E 340. Graduate-level requirements include a research paper and/or a comprehensive design project.

544. * Special Topics In Geotechnical Engineering (3) I Introduction to geoenvironmental engineering: physicochemical and microstructural behavior of geomaterials, effect of pollutants, design of waste disposal systems; advanced laboratory testing, geotextiles, space geomechanics, etc. P, C E 340 or
consent of instructor. Graduate-level requirements include a research paper and/or a comprehensive design project.

547. Seepage and Earth Dams (3) I Principles of flow in porous media; analytical and approximate solutions of confined and unconfined flow; seepage, erosion, piping and filter design; earth and rock fill dam construction and design; stability analyses. P, C E 340.

548. Numerical Methods in Geotechnical Engineering (3) I Brief statements and applications of numerical methods based on closed-form solutions, finite difference, finite element and boundary element methods for problems involving soil structure interaction such as piles, retaining walls, group piles, underground works; seepage; and consolidation. P, C E 402, C E 340.


552. * Engineering Surveys (3) I CDT Surveys the art and archaeology of the Etruscans between the 7th and 1st centuries BC. P, CLAS 340B or consent of instructor. Graduate-level requirements include a comprehensive surveying project.

555. * Irrigation Engineering (3) II (Identical with ABE 555, which is home).

558. * Agricultural Drainage and Efficient Treatment (3) II (Identical with ABE 558, which is home).


563. * Traffic Engineering (3) I Methods for the efficient and safe operation of transport facilities through analysis of capacity, safety, speed, parking, and volume data. 3ED. P, C E 360. Graduate-level requirements include a research paper or project.

564. * Airport Planning and Design (3) Location, analysis and design of airports and airport facilities, including aircraft characteristics, site selection, configuration, capacity, access and terminals. 3ED. P, C E 360. Graduate-level requirements include a research paper or project.

565. Project Planning and Modeling (3) II

568. * Urban Transportation Planning (3) II Transportation planning in relation to urban development; techniques and procedures for developing long-range regional plans. P, C E 360 or consult department before enrolling.

Graduate-level requirements include a research paper or project. (Identical with PLN 568).

571. Water Quality Control (3) II Aspects of water quality maintenance; physical, chemical and biological factors in water and wastewater treatment and natural purification. Degree credit available for nonmajors only. 2R, 3L. P, CHEM 103b. (Identical with WS M 571).

573. Biodegradation of Hazardous Waste Compounds (2-3) I 2R, 3L. P, CHEE 577 or Consult department before enrolling. (Identical with CHEE 573, which is home).

574. Environmental Transport Processes (3) I (Identical with CHEE 574, which is home).

577. The Physiological Bases of Microbial Treatment Processes (3) I P, CHEE 370 or consult department before enrolling. (Identical with CHEE 377, which is home).

578. * Introduction to Hazardous Wastes (3) II (Identical with CHEE 578, which is home).

584. Fundamentals of Industrial and Environmental Health (3) I (Identical with PHL 584, which is home).

593. Internship (1-5) [Rpt./]

594. Practicum (1-3) [Rpt./]

596. Seminar

597. Seminar w.*Advanced Cadastral Survey (1-4) II (Identical with RNR 597w, which is home).

599. Independent Study (1-5) [Rpt./]


621. Sediment Transportation (3) I Erosion, transportation and deposition of sediments by flowing water; sediment properties and their measurement; bed load and suspended load movement; river behavior and control. P, C E 321.


623. Flow through Hydraulic Structures (3) II Subcritical and supercritical flow through culverts, bridges, spillways, stilling basins, transitions, bends; hydrologic effects on inflow; pumps and turbines. P, C E 322.

624. Planning and Design of Multipurpose Water Resources Projects (3) I Design of water resource systems for surface water supply, flood control, hydropower and navigation, either as single purpose or as multipurpose projects; brief review of environmental, economic and legal aspects. Field Trips. P, C E 321, C E 423.

632. Infrastructure Rehabilitation (3) I Status of infrastructure and causes of deterioration of constructed facilities. Strengthening of bridges and buildings. Application of advanced modern materials such as fiber composites in new structures and for rehabilitation of existing structures. P, C E 331, C E 336, C E 337.

633. Reinforced Concrete (3) I Inelastic behavior of beams and columns; short- and long-term beam deflections; combined bending, shear, and torsion in beams; behavior under load reversals; analysis and design of beam to column connections and shear walls. P, C E 437 or consult department before enrolling.

637. Soil-Structure Interaction (3) I Definition of soil-structure interaction, static and dynamic loading, analytic and computer solutions, two and three dimensional structure foundation combinations. P, C E 340 or C E 548 or consent of instructor.

640. Advanced Soil Mechanics (3) I Site investigation and in situ testing; shear strength of sands and clays; interpretation of laboratory test results; consolidation theory: one-dimensional infiniteisimal and finite strain; slope stability. P, C E 340.


645. Geoenvironmental Engineering (3) II Interaction of environmental and geotechnology: physicochemical properties and mechanism of pollutant transport; effects on soil and foundation behavior and ground water, analytical and numerical modeling, design of geotechnical structures and waste contaminant systems. P, C E 340 or C E 544 or consent of instructor.

646. Soil Dynamics and Machine Foundations (3) I Soil behavior under dynamic loads, measurement of dynamic soil properties, soil liquefaction, wave propagation through soils, vibration analysis of shallow and deep foundations, machine foundation design. Case histories and rehabilitation. P, C E 640.


661. Structural Design of Flexible Pave-ments (3) I Analysis of loads, stresses, material characteristics, and environmental
factors for the theoretical and practical design, construction and maintenance of pavements. P, C E 340, C E 361.

662. Structural Design in Rigid Pavements (3) II Analysis of loads, stresses, material characteristics, and environmental factors for the theoretical and practical design, construction and maintenance of these pavements. P, C E 361, C E 340.

664. Transportation Engineering (3) I Economic analysis of transport projects, including rural and urban roadways, control systems, and mass transit; discussion of environmental and financial factors. P, C E 463 or C E 563.

665. Quick Response Transportation Planning Methods (3) I Quick response transportation tools for subarea, problem and policy analysis, and strategic planning in the urban setting. (Identical with PLN 665).

666. Highway Geometric Design (3) I Study of geometric elements of streets and highways, with emphasis on analysis and design for safety. P, C E 563 or C E 463.


673. Advances in Water and Waste Reclamation and Reuse (2) I P, CHEE 675. (Identical with CHEE 673, which is home).

675. Wastewater Treatment (3) I P, CHEE 370. (Identical with CHEE 675, which is home).

676. Advanced Water Treatment System Designs (3) II Identical with CHEE 766, which is home).

900. Research (1-3) [Rpt./]

909. Master's Report (1-3) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-12) [Rpt./]

930. Supplementary Registration (1-12) [Rpt./]

Engineering Mechanics (E M )

502. Introduction to Finite Element Methods (3) I II (Identical with C E 502, which is home).

505. Continuum Mechanics (4) I Analysis of deformation, principal stresses and strains, velocity fields, and rate of deformation; constitutive and field equations; elementary elasticity. P, C E 417 or consult department before enrolling.

508. Fracture Mechanics (3) I I Modes of fracture; crack propagation; Griffith energy balance; crack tip plasticity; J-integral; fatigue cracks; analytical and numerical techniques; constitutive models for damaged materials. P, E M 505 or consult department before enrolling.

511. Advanced Finite Element Analysis (3) II Approximation functions, Lagrangian and Hermitian interpolation, isoparametric elements and numerical integration; mixed, hybrid and boundary element methods, nonlinear analysis, nonlinear problems in solids under static and dynamic loads, time integration schemes, fluid and heat flow coupled problems and mass transport. P, C E 402 or consult department before enrolling.

593. Internship (1-5) [Rpt./]

596. Seminar a. Research Topics (1) I (Identical with C E 596a, which is home).

599. Independent Study (1-3) [Rpt./]

603. Elasticity Theory and Application (3) I General three-dimensional equations of elasticity; problems in plane stress, plane strain, extension, torsion; energy, residual and other solution methods; applications to rings, beams, plates, torsion and other problems. P, C E 217, C E 302.

604. Plasticity Theory and Application (3) I Yield conditions and flow rules for perfectly plastic and strain hardening materials; application to various elastoplastic problems such as bars, cylinders and plates; effect of volume change behavior, isotropic and anisotropic hardening plasticity with expanding/contracting yield surfaces. P, C E 417 or E M 603 or consult department before enrolling.

606. Wave Propagation in Solids (3) II P, EM 603 or A ME 564a-564b. (Identical with C E 606, which is home).


635. Matrix Methods in Structural Mechanics (3) I I Formulation of the force and displacement methods; the finite element method, with application to bar, beam, plate, and shell structures; organization and development of computer programs; linear and nonlinear systems. P, C E 331 or A ME 461.

637. Plates and Shells (3) I I Theory and analysis of circular, rectangular and continuous plates by classical, numerical and approximate methods; introduction to in-plane forces and shells. P, C E 336; A ME 324.


648. Constitutive Laws for Engineering Materials (3) I P, C E 603, E M 505 or consult department before enrolling. (Identical with C E 648, which is home).

900. Research (1-3) [Rpt./]

909. Master's Report (1-3) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-12) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Classics (CLAS / GRK / LAT)

Modern Languages Building, Room, 371, P.O. Box 210067
Phone: (520) 621-1689
FAX: (520) 621-3678
WWW: http://www.coh.arizona.edu/classics

Application Questions:
Patty Ward, (520) 621-1689, wardp@u.arizona.edu
Advising Questions:
Frank E. Romer, (520) 621-1689, ferome@u.arizona.edu

Degrees Offered: M.A.

Concentrations: Classical archaeology and classical philology are options.

Professors: J. Norman Austin, Head, Albert Leonard, Jr., Marilyn B. Skinner, H. David Soren ( Regents Professor), Jon Solomon

Associate Professors: Richard Jensen (Emeritus), Frank E. Romer, Mary E. Voyatzis, Cynthia White, Thomas D. Worthen

Assistant Professors: David Christenson, Gonda Van Steen

The Department of Classics offers the degree of Master of Arts with a major in classics, with concentrations in philology (Greek/Latin) and classical archaeology. Degree requirements include 33 units of graduate-level course work, accompanied by the passing of qualifying examinations, including demonstrations of research proficiency in French or German, and the completion and defense of a thesis.

For the concentration in classical philology, 27 units of 500-level courses in classical languages and literature are required, together with CLAS 510a-510b. The program of study should be planned in consultation with the graduate advisor for classical philology.

For the concentration in classical archaeology, prior completion of CLAS 340a-340b is a prerequisite. The classical archaeology concentration also requires 12 units of 500-level CLAS courses, including 6 units of CLAS 590 and the completion of one 500-level course in either ancient Greek or Latin, and of one 400-level course in the other language with a
grade of B or higher. A maximum of 15 units of elective credit may be earned in a related field, which may be outside the department. The program of study should be planned in consultation with the graduate advisor for classical archaeology.

Graduate courses in the Department of Classics are open to all graduate students with the permission of the instructor.

**Classical Art and Archaeology (CLAS)**

543a-543b. Archaeology of Neolithic and Bronze Age Greece (3-3) [Rpt./1] I-II Graduate-level requirements include extensive reading and an in-depth paper. (Identical with ANTH 543a-543b).

552. * Etruscan Art and Archaeology (3) I Surveys the art and archaeology of the Etruscans between the 7th and 1st centuries B.C. P, CLAS 340b or consent of instructor. Graduate-level requirements include extensive reading and an in-depth paper. (Identical with ARH 552).

553. * Research Methods in Classical Archaeology (3) [Rpt./1] I-II Analysis of various methods of research in classical archaeology emphasizing the critical use of source material, the development of independent thought, and the production of the finished, written product. P, CLAS 340b or CLAS 340a Graduate-level requirements include a 25-page written paper and new oral presentation.


556. * Greek and Roman Painting (3) I I Greek vase painting from the Dipylion vases of the geometric period in Athens to the Orientalizing animal styles of Corinth and the black and red figured Attic style. Also, survey of ancient Roman painting and mosaics. P, CLAS 340c, CLAS 340a. Graduate-level requirements include extensive reading and an in-depth paper. (Identical with ARH 556).

557. * Greek Architecture (3) I A survey of the architecture and architects of Greece from the Bronze Age through the Hellenistic period including such sites as Mycenae, Pylos, Delphi, Athens and Corinth. P, CLAS 340a, CLAS 340b. Graduate-level requirements include extensive reading and an in-depth paper. (Identical with ARH 557).

558. * Greek and Roman Provincial Archaeology (3) I Survey of classical archaeology in ancient Tunisia, Cyprus, Portugal and Turkey. P, CLAS 340a, CLAS 340b. Graduate-level requirements include extensive reading and an in-depth paper.

561. Greek Pottery 1200-400 B.C. (3) I II Graduate-level requirements include extensive readings and an in-depth paper. (Identical with ARH 561).

563. * Classical Field Archaeology (6) [Rpt./1] I Field training and lecture program for students beginning in archaeology; includes trench supervision, stratigraphy, locus theory, and oral and written reports on field techniques. Offered on several archaeological sites in the Mediterranean area. P, consult department before enrolling. Graduate-level requirements include extensive reading and an in-depth paper.

564. Topics in Ancient Mediterranean Archaeology (3) [Rpt./1] I-II Research papers and oral presentations on different aspects of Greek and Roman archaeology; preparation in writing scholarly articles for refereed journals. P, CLAS 340a or CLAS 340b.

574. * Archaeometry: Scientific Methods in Art and Archaeology (3) II (Identical with ANTH 574, which is home).

581. * Archaic Greek Sanctuaries (3) I II Archaeology of the sanctuary sites from the Archaic Period in Greece, both those which became panhellenic and those associated with individual states. Relationships between the polis and the local sanctuary. Graduate-level requirements include extensive readings and an in-depth paper.

584. * Roman Art and Architecture (3) I II The origins and development of Italian art and architecture from Etruscan beginnings through the Republic to the late Empire. P, ARH 117, ARH 118 or 6 units of ancient history. Graduate-level requirements include extensive readings and an in-depth paper.

599. Independent Study (2-8) [Rpt./] 910. Thesis (1-6) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./] 

**Classical Literature and Civilization (CLAS)**

510a-510b. Classical Philology (3-3) I-II Introduction to the various disciplines of classical scholarship: philology, textual criticism, paleography, papyrology and archaeology.

522. * Helen of Troy (3) I A study of the various interpretations of the enigmatic Helen of Troy, from Homer to modern literature. All texts will be read in English, but will be drawn from the literatures of ancient Greece and Rome as well as from later European authors (English, French, German, American). Graduate-level requirements include two analytic research essays and one classroom presentation. This course is temporary, and will be offered during the Fall of 1999 only.

570. * Greek Philosophy (3) [Rpt./1] I II (Identical with PHIL 570, which is home).

572a-572b. * Ancient Philosophy (3-3) I-II (Identical with PHIL 572a-572b, which is home).

585. Linguistic and Computer-Assisted Approaches to Literature (3) II

596. Seminar

a. Topics in Greek or Roman Literature, History or Archaeology (3) [Rpt./30 units] I II

j. Second Language Acquisition Research (3) [Rpt./4] II

695. Colloquium

f. Advanced Studies in Ancient History (3) [Rpt./10] II P, consent of department. (Identical with HIST 695, which is home).

**Greek (GRK)**

502. * Greek Reading Course (3) [Rpt./1] 1 Readings in major Greek authors including Homer, Plato, and the historians and dramatists. Graduate-level requirements include extensive reading and an in-depth paper. P, 3 units of 400-level Greek.

512. * Readings in Greek Philology (3) [Rpt./6 units] I II P, 3 units of 400-level Greek. (Identical with PHIL 512, which is home).

521. * Greek Lyric Poetry (3) [Rpt./1] I Study in Greek of the early Greek lyric writers from Archilochus to Bacchylides, including Pindar. Graduate-level requirements include extensive reading and an in-depth paper. P, 3 units of 400-level Greek.

522. * Readings in Greek Drama (3) [Rpt./1] I Close reading in Greek of either (1) tragedy (one play each by Aeschylus, Sophocles and Euripides) or (2) comedy (two plays of Aristophanes, one of Menander.) Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Greek.

524. * Homer (3) [Rpt./1] I II Close reading of selections from the Iliad and Odyssey in Greek and an introduction to the critical secondary literature. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Greek.

530. * Readings in Greek Historians (3) [Rpt./1] I Selections from Herodotus and Thucydides with an introduction to the critical secondary literature. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Greek.

531. Greek Orators (3) [Rpt./1] I Readings in Greek from Lysias, Isocrates and Demosthenes as sources for ancient rhetoric, politics, and private life. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Greek.
532. Literature of Archaic Greece (3) [Rpt./Rpt./Rpt.]
I II Readings in Greek from Hesiod and the early lyric poets. The agricultural perspective and the anti-heroic ideal. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Greek.

596. Seminar
a. Topics in Ancient Greek Literature (3) [Rpt./Rpt./Rpt.]
I II
b. Graduate Seminar in Ancient Greek (3) [Rpt./Rpt./Rpt.]
I II

Latin (LAT)

501. * Latin Reading Course (3) [Rpt./Rpt./Rpt.]
I II Readings in one of the following: epic, lyric, drama, history, oratory, satire, epistles, novel, philosophical, technical or medieval literature. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

503. * Late Antique Literature (3) [Rpt./Rpt./Rpt.]
Selections from genres and/or authors, both Christian and non-Christian, from the late antique period. Graduate-level requirements include writing a research paper using standard reference works, periodicals, and recent publications.

505. * Latin Composition (3) [Rpt./Rpt./Rpt.]
I II Analysis of Latin prose style, review of Latin grammar, practice in composing Latin prose. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

513. * Augustan Literature (3) [Rpt./Rpt./Rpt.]
Readings from a major writer or writers of the Augustan age. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

514. * Medieval Latin (3) [Rpt./Rpt./Rpt.]
I II Survey of Medieval Latin literature during the thousand years between the end of the classical period and the beginning of the Renaissance. Readings in Latin. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

515. * Latin Love Elegy (3) [Rpt./Rpt./Rpt.]
I II Reading in the Latin texts of Ovid, Tibullus and Propertius. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

520. * Latin Paleography (3) [Rpt./Rpt./Rpt.]
Identification and reading of major Latin bookhands of the Middle Ages and the Renaissance. Problems in text transmission, corruptions and emendation. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin. be convened with LAT 420.

525. * Cicero (3) [Rpt./Rpt./Rpt.]
I II The life of Cicero illustrated by means of close reading of selected works in Latin. Graduate-level requirements include extensive reading and an in-depth paper. P, 3 units of 400-level Latin.

526. * Roman Historians (3) [Rpt./Rpt./Rpt.]
I II Readings in Latin from the Roman historians and biographers. May be repeated without duplication of readings. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

527. * Silver Age Latin (3) [Rpt./Rpt./Rpt.]
I II Readings from Latin writers of the early Empire. Readings will be in Latin. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

528. * Roman Historians (3) [Rpt./Rpt./Rpt.]
I II Readings from Latin writers of the early Empire. Readings will be in Latin. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

529. * Latin Teaching Methodology (3) [Rpt./Rpt./Rpt.]
I II Readings from Latin writers of the early Empire. Readings will be in Latin. Graduate-level requirements include a research paper. P, open to majors only.

596. Seminar
a. Topics in Latin Literature (3) [Rpt./Rpt./Rpt.]
I II

Latin (LAT)

501. * Latin Reading Course (3) [Rpt./Rpt./Rpt.]
I II Readings in one of the following: epic, lyric, drama, history, oratory, satire, epistles, novel, philosophical, technical or medieval literature. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

503. * Late Antique Literature (3) [Rpt./Rpt./Rpt.]
Selections from genres and/or authors, both Christian and non-Christian, from the late antique period. Graduate-level requirements include writing a research paper using standard reference works, periodicals, and recent publications.

505. * Latin Composition (3) [Rpt./Rpt./Rpt.]
I II Analysis of Latin prose style, review of Latin grammar, practice in composing Latin prose. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

513. * Augustan Literature (3) [Rpt./Rpt./Rpt.]
Readings from a major writer or writers of the Augustan age. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

514. * Medieval Latin (3) [Rpt./Rpt./Rpt.]
I II Survey of Medieval Latin literature during the thousand years between the end of the classical period and the beginning of the Renaissance. Readings in Latin. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

515. * Latin Love Elegy (3) [Rpt./Rpt./Rpt.]
I II Reading in the Latin texts of Ovid, Tibullus and Propertius. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

520. * Latin Paleography (3) [Rpt./Rpt./Rpt.]
Identification and reading of major Latin bookhands of the Middle Ages and the Renaissance. Problems in text transmission, corruptions and emendation. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin. be convened with LAT 420.

525. * Cicero (3) [Rpt./Rpt./Rpt.]
I II The life of Cicero illustrated by means of close reading of selected works in Latin. Graduate-level requirements include extensive reading and an in-depth paper. P, 3 units of 400-level Latin.

526. * Roman Historians (3) [Rpt./Rpt./Rpt.]
I II Readings in Latin from the Roman historians and biographers. May be repeated without duplication of readings. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

527. * Silver Age Latin (3) [Rpt./Rpt./Rpt.]
I II Readings from Latin writers of the early Empire. Readings will be in Latin. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

528. * Roman Historians (3) [Rpt./Rpt./Rpt.]
I II Readings from Latin writers of the early Empire. Readings will be in Latin. Graduate-level requirements include extensive readings and an in-depth paper. P, 3 units of 400-level Latin.

529. * Latin Teaching Methodology (3) [Rpt./Rpt./Rpt.]
I II Readings from Latin writers of the early Empire. Readings will be in Latin. Graduate-level requirements include a research paper. P, open to majors only.

The program offers a minor in cognitive science for the Doctor of Philosophy degree. Inquiries should be directed to the Chair of the Graduate Interdisciplinary Program in Cognitive Science at the campus address given above.

Communication (COMM)

Communication Building, Room 302
Phone: (520) 621-2005
FAX: (520) 626-4300
WWW: http://grad.admin.arizona.edu
IDPS/cogn/cogn.html

Graduate Interdisciplinary Program in Cognitive Science

Application Questions:
Nova Hinrich, (520) 621-2065
Degrees Offered: Ph.D. minor only

Professors: Merrill F. Garrett, Chair (Linguistics), Carol A. Barnes (Psychology), Kathryn A. Bayles (Speech and Hearing Sciences), Thomas Bever (Linguistics), Robert C. Cummins (Philosophy), Richard A. Demers (Linguistics), Kenneth I. Forster (Psychology), Alvin I. Goldman (Philosophy), R. Michael Harnish (Philosophy), Thomas J. Hixon (Speech and Hearing Sciences), Audrey L. Holland (Speech and Hearing Sciences), William H. Itelson (Psychology), Alfred Kasznia (Psychology), D. Terence Langendoen (Linguistics), Adrienne J. Lehrer (Linguistics), John C. Maloney (Philosophy), Bruce McNaughton (Psychology), Lynn Nadel (Psychology), John Pollack (Philosophy), Amnon Rapoport (Management and Policy), Susan M. Petten (Psychology), Richard Zemel (Psychology)

The department offers advanced study of human communication from a social science perspective, with content concentrations in (a) interpersonal interaction and relationship management, (b) social influence (including mass media and political communication), and (c) message processing. The department also offers extensive preparation in scientific research methods. Graduates may enter a variety of academic, private sector, or public positions.

The department offers the Master of Arts and Doctor of Philosophy degrees with a major in communication.
In addition to the materials required by the Graduate College, applicants for admission must submit a completed departmental application form, three letters of recommendation (preferably from academic sources), Graduate Record Examination scores that are no more than five years old, and a sample of scholarly writing (preferably thesis chapters or a thesis proposal for doctoral program applicants).

Master's students may select a thesis or nonthesis option and a disciplinary or interdisciplinary track.

The thesis option: 31 units including 4 thesis units. May include up to 12 units taken outside the department (the interdisciplinary track) as long as these units form a coherent concentration and are approved by the guidance committee. All students are required to complete 610, 620, 660, and an additional graduate-level research methods course. Up to 3 units of independent study may be counted toward the minimum number of units. Students planning to enter a doctoral program are strongly urged to select the thesis option.

The nonthesis option: 36 units. May include the interdisciplinary track (described above). All students are required to complete 610, 620, 660, and an additional graduate-level research methods course. Up to 3 units of independent study may be counted toward the minimum number of units. Students interested in applied programs or positions in industry and government are urged to select this option which provides excellent flexibility in tailoring the program to the student's needs.

Doctoral students must complete the following requirements, as well as declare areas of concentration:

Major: 36 units (9 of which may be transferred in from the master's degree). With guidance committee approval, some of these units may be taken from other departments offering courses with communication-related content. As part of these units, all students are required to complete 610, 620, 660, and 670. These satisfy the qualifying examination requirement.

Minor: All students must select one or more minors, the requirements of which are determined by the minor department.

Scholarly research tool: All students must complete a minimum of 6 additional hours of research methods course work, preferably related to the type of research they plan to conduct for their dissertation.

Dissertation: 18 units.

For doctoral students, a maximum of 6 units of independent study may be counted toward the major and minor minimum number of units. All courses counted toward degree minimums must be passed with a grade of B or better (or P or better for S/P Special Grades).

503. * Theories of Small Group Presentation (3) I II Theory and research on social control and deviance in groups, from the perspective of communication behavior. P, P or CR, COMM 300 and COMM 318 or consent of instructor. Graduate-level requirements include an in-depth research paper on a single aspect of macro-communication patterns in groups.

509. * Theories of Mass Communication (3) II An in-depth analysis of theories of the social effects of various mass media sources. P, P or CR, COMM 300, COMM 318 or consent of instructor. Graduate-level requirements include an in-depth theoretical paper on the social effects of mass media.

510. * Struggle for the Presidency (3) I Examination of the campaign strategies and tactics of those seeking the nation's most powerful office from 1960 to the present. Graduate-level requirements include an in-depth research project.

511. * Communication and Conflict Management (3) I II Consideration of theory and research pertaining to the handling of conflict across diverse contexts. P, P or CR, COMM 300 and COMM 325, or consent of instructor. Graduate-level requirements include an in-depth research paper on communication in a conflict situation.

514. * Verbal Communication (3) I II Theory and research on verbal messages. Topics include patterns of conversational interaction, processes of message construction and interpretation, functions and contexts of messages. P, COMM 325 or consent of instructor. Graduate students are required to write a final paper.

515. * Nonverbal Communication (3) I II Theory and research on nonverbal communication codes (kinesics, touch, voice, appearance, use of space, time and artifacts) and social functions (impression formation and management, relational communication, emotional expressions, regulation of interaction, social influence.). P, P or CR, COMM 300, COMM 318, COMM 325; or consent of instructor. Graduate-level requirements include an in-depth research project on nonverbal communication.

517a-517b. * Relational Communication (3-3) I-II 517a: In Close Relationships. 517b: In Work and Professional Relationships. The relational communication process and messages people use to define interpersonal relationships, including dominance-submissiveness, affection, involvement and similarity in close relationships. P, P or CR, COMM 325 or consent of instructor. Graduate-level requirements include an in-depth research project or theoretical paper on issue involving the management of interpersonal relationships.

520. * Communication and the Legal Process (3) I Presents a number of accomplishments and challenges in the social scientific study of law, with special emphasis on the effects of communication and social structure on the legal process. P, P or CR, COMM 300, COMM 318, COMM 325, or consent of instructor. Graduate-level requirements include an in-depth research paper on a single aspect of communication in a legal context. (Identical with SOC 520).

521. * Political Campaign Communication (3) I II Investigation and analysis of communication principles and practices in contemporary campaigns for elective office. P, P or CR, COMM 300, COMM 318, COMM 325; or consent of instructor. Graduate-level requirements include an in-depth research project or theoretical paper on an issue involved in a recent campaign.

524. * Media and Politics in America (3) I Survey of field; media in political campaigns; media coverage of leaders, issues and institutions; leadership strategies to influence media. Graduate students are required to produce a 15 to 20 page research paper involving the application of two major, competing theories to a study of nightly network news.

525. * Scientific Argument in Public Discourse (3) I Advanced argumentation theory focused on the examination of scientific arguments in public decision-making. Topics include general theory of fallacies and special fallacies related to scientific reasoning. P, COMM 325 or consent of instructor. Graduate students are required to complete a controversy-centered literature review.

528. * Communication Research Methods (3) I I Theories of communication and their research backgrounds; research methodology in communication behavior studies. P, P or CR, COMM 300, COMM 318, COMM 325, or consent of instructor. Graduate-level requirements include an in-depth research project demonstrating ability to design and conduct research and to analyze data.
550. * Communication and Cognition (3) I II Interal relations between human communication and cognitive processes. Emphasis on theory and research in social cognition. P, P or CR, COMM 300, COMM 318, COMM 325, or consent of instructor. Graduate-level requirements include an in-depth research project on a single issue in communication and cognition.

562. * Communication and Human Relationships (3) S An advanced course enabling students to inventory, evaluate, and develop oral communication skills in the interpersonal, group, and organizational dimensions of their lives. P, Graduate-level requirements include an in-depth research project on a single aspect of communication and human relations, and additional examination questions.

576. Field and Observational Methods (3) I II P, admission to graduate program or 3 graduate credits in women's studies, sociology, or economics. (Identical with SOC 576, which is home).

589. Scholarly Communication (3) I II (Identical with IRLS 589, which is home).

599. Independent Study (1-3) [Rpt./]

610. Communication Theory 1 (3) I An overview of theoretical perspectives on the role of verbal and nonverbal communication in the process of generating and understanding the development of interpersonal relationships.

620. Communication Theory II (3) II An overview of historical and theoretical perspectives on communication, strategies used in social influence attempts from interpersonal to mass media contexts. (Identical with PHL 620).

630. Theory Construction in Communication (3) I Theoretical and meta-theoretical positions in the discipline of communication with an emphasis on approaches to analyzing and developing original theories.

640. Research Methodologies III (3) I S Issues in measurement and sampling in laboratory and field research in communication. P, COMM 670 or consent of instructor.

660. Research Methodologies I (4) I An introduction to research methods and designs used in contemporary communication research.

670. Research Methodologies II (4) II Advanced study of research design and statistical analysis in contemporary communication research.

691. Preceptorship (1-3) [Rpt./]

693. Internship (1-6) [Rpt./]

694. Practicum (1-4) [Rpt./]

696. Seminar
   a. Nonverbal Communication (3) [Rpt./ 3] I II
e. Linguistic Investigations and Applications (3) [Rpt./ 3] I II (Identical with LING 696f, which is home).

699. Independent Study (1-3) [Rpt./]

700. Research (1-3) [Rpt./ 90 units]

709. Master's Report (2) [Rpt./]

910. Thesis (1-4) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Comparative Cultural and Literary Studies (CCLS)**

1239 N. Highland Ave.
Phone: (520) 626-8693
FAX: (520) 626-8694
WWW: http://grad.admin.arizona.edu/idps/ccls/ccls.html

**Graduate Interdisciplinary Program in Comparative Cultural and Literary Studies**

Application Questions:
Dawn Winsor-Hibble, (520) 626-8693, dawnw@u.arizona.edu

Advising Questions:
Marvin Waterstone, (520) 626-8693

Degrees Offered: M.A., Ph.D.

Concentrations: Literary discourses in the original language, and non-literary subjects such as anthropology, culture and technology, cultural geography, media arts, and art history and science, among others.

Professors: Barbara Babcock (Graduate Advisor, CCLS), Malcolm Compitello (Spanish and Portuguese), Annette Kolodny, Jay Stauss (American Indian Studies), Melanie R. Wallendorf (Marketing)

Associate Professors: Marvin Waterstone, Head (Geography and Regional Development), Adele Barker (Russian and Slavic Languages), Kamakshi P. Murti (German), Eileen R. Meehan (Media Arts)

Assistant Professors: George Henderson (Geography and Regional Development), Miranda Joseph (Women's Studies)

Comparative cultural and literary studies explore similarities and differences within and among national cultures and literatures, as well as in the work of individuals, using a variety of methods from the humanities and social sciences. Such interdisciplinary studies focus on the production, circulation, and interpretation of meaning and value in all cultural activity.

The program offers the M.A. and Ph.D. degrees with a major in comparative cultural and literary studies. Students pursue a core of theoretical courses and study at least two primary discourses. Courses are taught by faculty from a variety of cooperating departments and programs. A list of affiliated faculty is available from the program office.

Discourses may be, but are not limited to, literary discourses in the original language. Examples of nonliterary discourses include anthropology, culture and technology, cultural geography, media arts, and art history and science, among others. Ph.D. students minor in a third discourse, which may be another literature or discipline/program of study in the human sciences. The master's degree is considered primarily as leading to the Ph.D. degree. CCLS also offers a 12-15 unit minor for doctoral students in other programs and departments.

Admission to the program is based on the following kinds of evidence: (1) excellent undergraduate performance in language, literature, and/or another form of discourse (preferably majors and minors) as indicated by a transcript; (2) three letters of recommendation from persons familiar with the student's performance in these areas and; (3) an example of the student's writing on a literary or cultural topic. For students applying to the doctoral program, a writing sample must be an article-length and article-quality piece that will serve as a qualifying exam.

In addition, students may wish to submit GRE aptitude and/or subject test scores. International students must submit TOEFL scores.

Master of Arts: Degree requirements include at least 30 units: 18 units in graduate-level courses in at least two disciplines (no more than 9 units may be taken in any one discipline); 3 units of 503; 3 units of 549a or 549b; 3 units of 909 (Master's Report) in preparation for the master's examination. The master's examination consists of an article-length, article-quality paper evaluated by the student's graduate committee and presented to CCLS faculty and students.

Doctor of Philosophy: Degree candidates are required to take at least 48 units for the major, 18 units of dissertation and a minor of 12-15 units. The 48 units
include: 12 units in one specialization, 12 units in a second specialization, and 24 units in CCLS courses: 6 units of 503, 3 units of 549a or 549b, 6 units of 550, 3 units of 696, and an additional 3 units of 596 or 696.

503a-503b. Introduction to Comparative Cultural and Literary Theories (3-3) I-II Strategies of interpretation taught through practical critique. P: CCLS 503a is prerequisite to CCLS 503b.

549a-549b. Folklore (3-3) I-II (Identical with ENGL 549a-549b, which is home).


562. * Linguistics and the Study of Literature (3) (Identical with ENGL 562, which is home).

596. Seminar
  g. Comparative Literature (3) [Rpt./ 4] I II (Identical with ENGL 596g, which is home).

599. Independent Study (1-4) [Rpt./ 1] I II

693. Internship (1-6) I II

694. Practicum (1-6)

696. Seminar
  a. Theory and Criticism (3) [Rpt./ 1] I II (Identical with M AR 696a, which is home).

699. Independent Study (1-4) I II

799. Independent Study (1-4) I II

900. Research (1-6) [Rpt./ 1] I II

909. Master's Report (1-6)

910. Thesis (1-4) [Rpt./ 1] I II

920. Dissertation (1-9) I II

930. Supplementary Registration (1-9) I II

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**Computational Science and Engineering**

Gould-Simpson Building, Room 705
Phone: (520) 621-6613
FAX: (520) 621-4246

**Application Questions:**
greg@cs.arizona.edu

**Degrees Offered:** Ph.D. minor only

**Professors:** Gregory Andrews, Chair (Computer Science), David W. Arnett (Steward Observatory), Robert Dickinson (Atmospheric Sciences), Herman Fasel (Aerospace and Mechanical Engineering), Charles D. Levermore (Mathematics), Dennis L. Lichtenberger (Chemistry), Jerome V. Moloney (Mathematics), Richard Shoemaker (Optical Sciences), Michael Tabor (Applied Mathematics), Bernard Zeigler (Electrical and Computer Engineering), Richard Ziolkowski (Electrical and Computer Engineering)

**Advisors:**

Associate Professors: Moysey Brio (Mathematics), Pierre Deymier (Materials Science and Engineering), William R. Montfort (Biochemistry), Computational Science and Engineering is a rapidly evolving discipline with a fast moving technology that impacts on virtually every aspect of education, research, and manufacture in today's world. This area involves the application of high-performance computation to the modeling and simulation of science and engineering problems. The huge demand for expertise in computational science and engineering requires innovative and flexible modes of education and training that can keep up with the latest technical trends as well as changes in national policy.

Computational Science and Engineering offers a minor to doctoral students. The program introduces students to advanced techniques in scientific computation in a way that will complement and enhance their chosen Ph.D. major.

Interested persons should contact the program chair for further information.

**Computer Science (C SC)**

Gould-Simpson Building, Room 721
Phone: (520) 621-4632
FAX: (520) 621-4246
WWW: http://www.cs.arizona.edu

**Application Questions:**
Sonia Economou, (520) 621-4049, gradadmissions@cs.arizona.edu

**Advising Questions:**
Sonia Economou, (520) 621-4049

**Degrees Offered:**
M.S., Ph.D.

**Concentrations:**
programming languages, compilers, networks and operating systems, parallel programming, algorithms, and computational molecular biology

**Professors:**

**Associate Professor:** Stephen Pink

**Assistant Professors:** Christian S. Coolberg, Will Evans, Neelam Gupta, John H. Hartman, Bonki Moon, Toniann Pitassi

**Senior Lecturers:** Stuart Reges, Rick Mercer

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The Department of Computer Science offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in computer science. The department's programs prepare graduate students for positions in the design and development of computer systems and applications in business and industry, and for scientific positions in industrial or academic computing research. Areas of research interest within the department currently include programming languages, operating systems, distributed processing, theory, analysis of algorithms, databases, computer networks, and computer graphics.

Applicants for admission should hold an undergraduate degree in computer science or a related field. In addition to the application materials submitted to the Graduate College, all applicants must submit to the department scores from the general Graduate Record Examination (GRE). Ph.D. applicants must also submit the score from the subject GRE. An application packet containing detailed information and departmental forms is available by sending an email to: gradadmissions@cs.arizona.edu.

Master of Science: 30 units of graduate credit are required, including one course in each of the core areas: systems (552, 576), programming languages (520, 553), and theory (545, 573); four specialization courses; and at least one advanced topics course. A thesis is not required, but, with departmental approval, a student may elect to submit one in lieu of the required comprehensive examination.

Doctor of Philosophy: Doctoral students must complete 36 units of graduate credit in the major including the M.S. core, 520, 545, and 576, and at least two advanced topics. Course work in a related minor field is required. There is no foreign language requirement. Three examinations are required: a written and oral Qualifying Examination, a written and oral Comprehensive Examination, and a Final Oral. The minor department participates in the Comprehensive and Final.

Doctoral candidates majoring in other disciplines may minor in computer science by completing a sequence of courses and examinations set by the department. Those intending to minor in computer science should consult the computer science minor advisor early in their graduate work.

501a-501b. * Symbolic Logic (3-3) I-II (Identical with PHIL 501a-501b, which is home).
502. * Mathematical Logic (3) I (identical with MATH 502, which is home).

520. Principles of Programming Languages (3) I Important programming language concepts, including types, control and data abstraction, declarative and object-oriented languages, implementation issues. P, C SC 453.

521a-521b. Systems Modeling and Simulation (3-3) I-I 521a: P, fundamental knowledge of probability and statistics. 521b: P, MIS 521a or equivalent. (Identical with MIS 521a-521b, which is home).

522. * Parallel and Distributed Programming (3) II Concepts and applications of parallel and distributed programs. Process interaction using shared variables and message passing; systematic development of correct programs; general problem solving techniques; scientific computing; distributed systems. Program assignments on multiple processor machines. P, C SC 318, C SC 340, C SC 342 and MATH 243. Graduate-level requirements include more extensive problem sets, projects, and examinations.

525. * Principles of Computer Networking (3) II Theory and practice of computer networks, emphasizing the principles underlying the design of network software and the role of the communications system in distributed computing. Topics include routing, flow, and congestion control, multicast, and data representation, and RPC. P, C SC 338, C SC 340. Graduate-level requirements include additional and more challenging programming projects and different examinations.

533. * Computer Graphics (3) I Theory and practice of computer graphics: 2D and 3D transformations, clipping, and viewing, hierarchical modeling, computer graphics hardware, raster graphics, input models, interaction techniques, and applications. P, C SC 330, C SC 342 and MATH 215. Graduate-level requirements include more extensive and challenging programming assignments.

538. * Computational Linguistics (3) I (identical with LING 538, which is home).

541a-541b. Introduction to Information Systems Analysis and Design (3-3) I-II (identical with MIS 541a-541b, which is home).

543. * Theory of Graphs and Networks (3) I (identical with MATH 543, which is home).


549. * Continuous-System Modeling (3) I (identical with MATH 549, which is home).

550. String and List Processing (3) II Graduate-level requirements include more extensive problem sets and different examinations.

552. Advanced Operating Systems (3) I Operating system design, implementation and modeling; deadlock and memory management models; protection mechanisms; operating systems for parallel and distributed systems. P, C SC 452.


570. * Foundations of Artificial Intelligence (3) I General introductory course in Artificial Intelligence (AI). Discussion of AI and its relationship to cognitive psychology, philosophy, math, and computer science. Focus on underlying concepts rather than on the engineering and applied aspects of AI. For advanced undergraduate and graduate students coming from a variety of disciplines. P, C SC 127b or C SC 227 or equivalent, and C SC 344 or equivalent. Graduate level requirements include an additional project and assignments. (Identical with PSYC 570).

571. Advanced Logic Synthesis and Verification Algorithms (3) I II P, ECE 474a or ECE 574a; ECE 474b or ECE 574b; background in digital design, mathematical maturity, programming in C or equivalent. (Identical with ECE 571, which is home).

572. * Continuous-System Simulation (3) II (identical with ECE 572, which is home).


574a-574b. * Computer-Aided Logic Design (3-3) I-II (identical with ECE 574a-574b, which is home).

575a-575b. Numerical Analysis (3-3) I-II P, MATH 475b or MATH 456. (Identical with MATH 575a-575b, which is home).


578. Computational Methods of Algebra (3) II P, MATH 415a, knowledge of scientific computer programming language. (Identical with MATH 578, which is home).

579. * Game Theory and Mathematical Programming (3) II (identical with MATH 579, which is home).

589. Software Tools for Computational Science and Engineering (3) II P, C SC 318 and ability to program in at least one modern high-level language. (Identical with MATH 589, which is home).

593. Internship (1-6)

599. Independent Study (1-6) [Rpt.]

620. Advanced Topics in Programming Languages (3) [Rpt./3] I Design, implementation, and compilation of programming languages; specific topics to be determined by current literature and faculty and student interest.

630. Advanced Topics in Software Systems (3) [Rpt./3] I Problems in design and development of large systems of programs; specific topics to be determined by current literature and faculty and student interest.

645. Advance Topics in Algorithm Analysis (3) [Rpt./3] II Design and analysis of algorithms; specific topics to be determined by current literature and faculty and student interest.

652. Advanced Topics in Operating Systems (3) [Rpt./3] II Operating system design, development, analysis, and performance; specific topics to be determined by current literature and faculty and student interest.

674. Digital System Testing and Design for Testability (3) I P, ECE 574a. (Identical with ECE 674, which is home).

695. Colloquium a. Advanced Topics in Computing (1) [Rpt./6 units] I II Presentation of current research topics in systems, theory, languages and architecture.

696. Seminar a. Current Computing Research (1-3) [Rpt./27 units]

699. Independent Study (1-4) [Rpt./]

799. Independent Study (1-4) [Rpt./]

900. Research (1-6) [Rpt./]

910. Thesis (3-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Creative Writing
(See English)

Dance (DNC)
Ina Gittings Building, Room 8
Phone: (520) 621-4698
FAX: (520) 621-6981
WWW: http://arts.music.arizona.edu/dance/index.html

Application Questions:
Graduate Secretary, (520) 621-4698
Degrees Offered: M.A., M.F.A. (within Theater Arts)
Concentrations: Dance performance studies, and pedagogy.
The Dance Division of the School of Music and Dance offers a dance concentration within the theatre arts major leading to the Master of Arts or Master of Fine Arts degree. Interested students should consult the Dance Division.

500. * Dance and Culture (3) [Rpt./6 units] II CDT Course surveys dance forms in various cultures of the world. The course combines elements of the disciplines of history and ethnology as it focuses on the evolution of dance forms and their derivative styles in social context. Field Trips. P, TRAD 102 or TRAD 103; DNC 200 or equivalent; MUS or TAR history course. Graduate-level requirements include a research paper.

501. * Advanced Floor Barre (1) [Rpt./3] I II Develops deep strength, flexibility and alignment specific to all forms of dance. Building on the concepts presented in 201, this course is geared to the more advanced student, presenting exercises that are more rigorous and complex in nature. P, DNC 201. Graduate-level requirements include additional written assignments.

539a. * Advanced Pointe Technique (1) [Rpt./3] I Barre work; continuing development of strength, speed, and stamina. Introduction of advanced barre combinations. Center work; allegro en pointe; also adagio, pirouettes and consecutive turns. P, enrollment by audition only. Graduate-level requirements include completion of additional exercises.

539b. * Advanced Pointe Technique (1) [Rpt./3] II Continuation of 539a with increasing difficulty and complexity in the enchainments. P, enrollment by audition only. Graduate-level requirements include completion of additional exercises.

540a-540b. * Ballet Technique III (2-2) [Rpt./12 units] I-II P, DNC 340b, enrollment by audition only. Graduate-level requirements include completion of additional exercises.

541a-541b. * Modern Dance Technique III (2-2) [Rpt./1] I-II P, enrollment by audition only. Graduate-level requirements include an additional creative and/or research project.

543. Dance Ensemble (1-3) [Rpt./18 units] I II Rehearsal methods, repertorial development, and performance of dance with particular emphasis on ensemble. P, repertory audition, intermediate level in modern and ballet (DNC 340a-340b or DNC 341a-341b).

544a-544b. * Jazz Dance Technique III (2-2) [Rpt./3] I-II Continued development of jazz dance technique emphasizing stylistic diversity and technical proficiency including contemporary, lyric, funky and classical jazz styles. P, DNC 244a, DNC 244b, DNC 344a, DNC 344b or by audition. Graduate-level requirements include more stringent grading criteria and periodic seminars in critical issues in advanced jazz.

545a. * Advanced Choreography (2) I Movement, motif development for solo and group composition. P, DNC 245b. Graduate-level requirements include completion of a full-scale group composition, to be evaluated by the dance faculty.

545b. * Advanced Choreography (2) II Balancing the intuitive and intellectual components of the creative process to create meaningful and well-crafted dances. P, DNC 245b. Graduate-level requirements include completion of a full-scale group composition, to be evaluated by the dance faculty.

546. Careers in Dance (3) II Knowledge and skills to manage and pursue professional careers in dance. (Identical with TAR AR 546).


548. * Dynamics of Movement (3) [Rpt./1] II S Experiential approach to movement training and analysis based on anatomical and physiological principles, including movement, voice, guided imagery, lecture and hands-on practice. Graduate-level requirements include additional outside class reading and written assignments.


551a. Ballet Repertoire (2) [Rpt./3] II Graduate-level requirements include performance of classical repertoire at the professional level.

551b. * Ballet Repertoire (2) [Rpt./3] I Experiential approach to movement training and analysis based on anatomical and psychological principles, including movement, voice, guided imagery, lecture and hands-on practice. Graduate-level requirements include performance of classical repertoire at the professional level.

562. * Collaborative Play Development (3) II (Identical with TAR AR 562, which is home).

591. Preceptorship (1-3) [Rpt./]

592. Internship (1-3) [Rpt./]

593. Practicum (1-3) [Rpt./] I II

595a. Colloquium

596. Seminar
   a. Critical Issues in Dance (2-3) [Rpt./6 units] I II P, graduate status.
   b. Critical Issues (2) [Rpt./1] II S

597. Independent Study (1-3) [Rpt./]

693. Internship (1-3) [Rpt./]

694. Workshop
   a. Concert Production and Choreography (1-4) I II
   b. Dance Practicum (3-4) I II

695. Seminar
   a. Graduate Forum (1) [Rpt./4 units] I II P, graduate status.

900. Research (1-9) I II

930. Supplementary Registration (1-9) [Rpt./]

East Asian Studies (EAS/CHN/JPN)

Franklin Building, Room 404
Phone: (520) 621-7505
FAX: (520) 621-1149
WWW: http://dizzy.library.arizona.edu/branches/eas/eashome.html

Application Questions:
Sylvia Gourdin, (520) 621-7505, sgourdin@u.arizona.edu

Advising Questions:
Chinese Studies: Chia-lin Pao Tao, (520) 621-5480, cpatao@u.arizona.edu
Japanese Studies: Tsuyoshi Ono, (520) 621-5460, ono@u.arizona.edu

Degrees Offered: M.A., Ph.D.
Concentrations: East Asian history, literature, linguistics, thought, religion, and women's studies.

Professors: Brian E. McKeon, Head, Marie Chan (Emeritus), Anoop Chandola, Robert M. Gimello, William R. Schultz (Emeritus), Jing-shen Tao, Allen S. Whiting (Political Science)

Associate Professors: J. Philip Gabriel, Donald Harper, Charles H. Hiedtke (Emeritus), Kimberly Jones, Peng-hsi Liu

Ronald C. Miao (Emeritus), Chia-lin Pao Tao

Assistant Professors: Todd J. Brown, Elizabeth G. Harrison, Donald Kirihara (Media Arts), Tsuyoshi Ono

Lecturer: Edward D. Putzar (Emeritus), Karl Zhang, Hiromi Aoki, Chicko Yamada

Adjunct Professors: Gail Bernstein, John Olson, Barbara Sands, Elizabeth Harrison

The Department of East Asian Studies offers programs leading to the Master of Arts and Doctor of Philosophy with majors in East Asian Studies. Graduate training in East Asian Studies affords students important opportunities for careers in...
teaching, international business, international law, government and diplomatic service, and journalism.

Graduate programs at the master's level are available with concentrations based either in traditional academic disciplines or in specially constructed general study areas related to East Asia. The doctoral programs are rigorously based in traditional academic disciplines. Master's students must complete a minimum of 30 graduate units and a thesis, or 33 units and a departmental paper. Disciplinary concentrations, often in preparation for further Ph.D.-level study, are currently offered in a number of fields in Chinese history, linguistics, literature, and religion and thought, and in Japanese literature as well as linguistics and language pedagogy. A general master's study program may include a variety of courses in the Department of East Asian Studies and other departments in both Chinese and Japanese areas. To ensure programmatic integrity, the general program must be devised in consultation with appropriate faculty. The general program is often suitable for preprofessional training. Doctoral study must be focused on Chinese history, linguistics, literature, religion and thought or on Japanese language pedagogy, linguistics, literature or religion; minor fields are usually selected from other supporting disciplines. Subjects in East Asian Studies may serve as fields of study for students earning Ph.D. degrees in other departments. Contact the department for specific requirements for each degree program.

Admission requires adequate preparation, although admission with some deficiencies is possible. The department bases admission into the master's and doctoral programs upon the grade-point average from an official transcript, the applicant's statement of purpose, a writing sample, two letters of recommendation, and GRE scores. International students must achieve a minimum score of 550 on the TOEFL. Applicant objectives must also correspond to the department's programmatic capabilities. Contact the graduate secretary in the Department of East Asian Studies for further details.

Courses related to East Asia, in addition to the courses listed below, may be taught in the Departments of Anthropology, Economics, History, Media Arts, and Political Science.

**East Asian Studies (EAS)**

518. Issues in Teaching Asian Languages (3) II Issues in second language acquisition and teaching, with emphasis on teaching Asian languages as foreign/secondary language. (Identical with SLAT 518).

524a. * The Prehistory of East Asia (3) I (Identical with ANTH 527a, which is home).

545. * Hindu Mysticism (3) II Introduction to the major concepts and practices of Hindu mysticism, including yoga techniques, rites, symbols, and myths. Graduate-level requirements include two research papers or reports approved by the instructor. (Identical with RELI 545).

551. * The United States and East Asia: 1840 to the Present (3) II (Identical with HIST 551, which is home).

552. * Hindu Literature (3) I Introduces major literary works with ancient Sanskrit genres. Selections from the Vedas, epics, Puranas and other classics in English translation. Graduate-level requirements include submission of a graduate paper or presentation on a subject approved by the instructor. (Identical with RELI 552).

564. * International Relations of East Asia (3) II (Identical with HIST 564, which is home).

579. Issues/Methods in Post-Second Foreign Language Teaching/ Learning (3) I II (Identical with GER 579, which is home).

587. Testing and Evaluation in Foreign/ Second Language Programs (3) I II (Identical with GER 587, which is home).

587a-587b. * History of East Asian Buddhism (3-3) I-II Buddhism in China, Korea and Japan with emphasis on the relationship between East Asian Buddhist thought and practice and the various historical contexts in which they emerged. (Identical with RELI 587a-587b). Graduate-level requirements include assigned readings in primary Chinese or Japanese sources and in modern Chinese and/or Japanese secondary sources, together with a research paper based in part on such sources.

589. * Women in East Asia (3) I (Identical with HIST 589, which is home).

593. Internship (1-3) [Rpt./] II

594. Practicum (1-3) [Rpt./]

595. Colloquium a. Masters Colloquium (1) I


599. Independent Study (1-5) [Rpt./]

695. Colloquium g. Advanced Study in Asian History (3) [Rpt./ 3] I II (Identical with HIST 695g, which is home).

699. Independent Study (1-3) [Rpt./] II

799. Independent Study (1-3) [Rpt./]

900. Research (2-4) [Rpt./]

908. Case Studies (3) [Rpt./]

909. Master's Report (1-6) [Rpt./]

910. Thesis (2-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Chinese Studies (CHN)**

513-516-517-518. * Advanced Modern Chinese (3-3-3-3) Study of advanced modern (Mandarin) Chinese through (515) readings in social science texts, (516) readings in modern literature and composition, (517) readings in modern literature, and (518) conversation. F, CHN 402, consent of instructor. Graduate level requirements include additional translations and readings.

519. * Linguistic Structure of Modern Chinese (3) I Linguistic study of the phonological, morphological, and syntactic systems of modern Chinese, with particular attention to linguistic analysis. Graduate-level requirements include two presentations and one term paper. (Identical with LING 519).

520. * Linguistic Structure of Modern Chinese (3) II Linguistic study of the phonological, morphological, and syntactic systems of modern Chinese, with particular attention to linguistic analysis. P, CHN 519. Graduate-level requirements include two presentations and one term paper. (Identical with LING 520).

521. Resources and Methods in Sinology (3) I Introduction to and exercises in the use of standard sinological reference and research resources.

522. * Literary Chinese (3) I Introduction to pre-20th-century Chinese styles through readings in classical Chinese literature. P, CHN 402. Graduate-level requirements include additional assignments relating to translation skill and research methodology.

523. * Readings in Classical Chinese Philosophical Texts (3) [Rpt./ 2] II Graduate-level requirements include additional assignments relating to translation skill and research methodology.

527b. * The Archaeology of Pre-Han China (3) II (Identical with ANTH 527b, which is home.)

529. * Chinese-American Literature (3) II Studies of the significant literary works by Americans of Chinese descent between 1960 and the present. Graduate-level requirements include a longer and more substantive paper than that required of the undergraduate student, demonstrating advanced knowledge of either American literature, literary theory or Asian studies, as well as familiarity with relevant research tools. (Identical with ENGL 529).

530. * Law in Traditional China (3) I Survey of law in traditional China, including examination of dispute resolution processes, the development of written law codes, formal judicial procedures, the theory and practice of punishment, crime and criminals, and the social role of legal process as reflected in civil law disputes (over such issues as marriage,
divorce, property exchanges, and inheritance). Graduate-level requirements include additional reports.

540. * Chinese Calligraphy (2) [Rpt./ 1] I Theory, practice, and aesthetics of Chinese brush writing, with emphasis on individual training and development. Graduate-level requirements include an independent project assignment with instructor.

541. * Chinese Historical Linguistics (3) I Historical survey of the development of the Chinese language, with particular attention to linguistic changes in phonology, morphology, and syntax. P, CHN 402, a general linguistics course.


547. Readings in Classical Chinese Prose (3) [Rpt./ 2] I Readings in selected texts from literary, philosophical, and historical traditions; includes selections from the Five Classics and the great prose masters of the Han-Qing. Variable content. P, CHN 422.

550. * Studies in Modern Chinese (3) [Rpt./ 1] I Grammar and readings in modern Chinese texts, with emphasis on written comprehension and translation. P, any two courses of CHN 415, CHN 416, CHN 417, or CHN 418. Graduate-level requirements include an additional class presentation and a translation project of an essay of over 1500 words.

560. * Modern Chinese Foreign Relations (3) II (Identical with POL 560, which is home).

568. * Women in China (3) I Analysis of the role of women in Chinese society with equal emphasis on traditional and modern periods. Graduate-level requirements include a 15-page term paper.

575a-575b-575c-575d-575e. * Periods in Chinese History (3-3-3-3-3) [Rpt./ 1] I In-depth treatment of major premodern eras: (575a) Ancient and classical, to 200 B.C., (575b) Early Empire 200 B.C. - 200 A.D., (575c) Medieval 200-750 A.D., (575d) New Empire, 750-1350 A.D., and (575e) Late Empire, 1350-1800 A.D. Graduate-level requirements include a bibliography, reports, and a term paper similar to that required in a preliminary doctoral exam. (Identical with HIST 575a-575b-575c-575d-575e).

576. * Modern China (3) I II (Identical with HIST 576, which is home).

582. * Social History of China (3) I II Formation of ancient Chinese society; organization of families and clans; social stratification, mobility, conflict, and control in traditional China; and transformation from traditional to modern society. Graduate-level requirements include an extra term paper. (Identical with HIST 582).


584. * Confucianism: The Neo-Confucian Tradition (3) II (Identical with RELI 584).

593. Internship (1-3) [Rpt./]

594. Practicum (1-3) [Rpt./]


596. Seminar a. Ancient Chinese Philosophy (3) [Rpt./ 2] b. Classical Chinese Literature (3) [Rpt./ 1] I II c. Modern Chinese Literature (3) [Rpt./ 1] I II d. Per-Modern Chinese History and Politics (3) [Rpt./ 1] I II e. Modern Chinese History and Politics (3) [Rpt./ 1] I II

599. Independent Study (1-5) [Rpt./]

699. Independent Study (1-5) [Rpt./]

799. Independent Study (1-3) [Rpt./]

900. Research (2-4) [Rpt./]

908. Case Studies (3) [Rpt./ 29]

910. Thesis (2-6) [Rpt./ 90 units]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Japanese Studies (JPN)**

502. * Gender and Language in Japan (3) I II Introduction to general issues of gender and language use, specific gender-related differences used in the Japanese language, and gender roles in Japan. P, JPN 202 or consent of instructor. Graduate-level requirements include additional readings and reports. (Identical with LING 502, W S 502, SLAT 502).

505. Classical Japanese (3) I Introduction to classical Japanese grammar and to writing styles used from the 8th century through medieval times. P, grade of B or higher in JPN 416 or JPN 516 or consent of instructor.

511. * Introduction to Japanese Linguistics (3) I honology, morphology, syntax, pragmatics, and sociolinguistics of the Japanese language. P, JPN 202, or consent of instructor. Graduate-level requirements include a substantial term paper and a class presentation based on that paper. (Identical with LING 511, SLAT 511).


515. * Advanced Japanese (3) I II Advanced conversation, grammar, reading and writing in modern Japanese. P, grade of B or higher in JPN 202 and consent of instructor. Graduate-level requirements include a special projects component consisting of reports on aspects of Japanese grammatical idiom.

516. * Advanced Japanese (3) I II Advanced conversation, grammar, reading and writing in modern Japanese. P, JPN 415, consent of instructor. Graduate-level requirements include special projects component consisting of reports on aspects of Japanese grammatical idiom.

517. * Business Japanese (3) I II Advanced study of the Japanese language for business purposes. P, JPN 415 or JPN 515 and consent of instructor. Graduate-level requirements include additional readings, assignments and class presentations.

521. * Advanced Readings in Japanese (3) [Rpt./ 1] I Reading and discussion in Japanese of a variety of advanced-level materials, including newspaper articles, short stories, and poetry. P, JPN 416, consent of instructor. Graduate-level requirements include additional readings and an extra translation project.

522. * Advanced Practice in Japanese (3) [Rpt./ 6 units] II Reading and discussion in Japanese of a variety of advanced-level materials, including newspaper articles, short stories, and poetry. P, JPN 421, consent of instructor. Graduate-level requirements include additional readings and extra translation project.

536. * Japanese Sociolinguistics (3) I Introduction to Japanese sociolinguistics; pragmatics, conversation analysis, discourse analysis, variation theory, ethnography of speaking and ethnmethodology. P, JPN 202 or consent of instructor. Graduate-level requirements include extra readings, class presentations, and a substantial term paper. (Identical with LING 536, SLAT 536).

546a-546b. * Classical Japanese Literature (3-3) I-II Survey of classical Japanese literature, with readings in English translation: (546a) Ancient and medieval to 1600 and (546b) Tokugawa and Meiji, 1600-1900. Graduate-level requirements include an extra seminar meeting a week, additional readings, and a research paper.

547a-547b. * Modern Japanese Literature (3) I Survey of modern Japanese literature with readings in English translation: 547a: Meiji to World War Two and 547b: Postwar and Contemporary Literature. Graduate-level requirements include additional readings and a research paper.

574a-574b-574c. * History of Japan (3-3-3) I II 574a - The history of Japan from 574a: earliest times to 1500, 574b: 1500 to 1800, and 574c: 1800 to present. (Identical with HIST 574a-574b-574c, which is home).

585. * History of Japanese Religions: Ancient (3) I A selective survey of the history of religions in Japan from earliest times until the thirteenth century, emphasizing the roles of Shinto, Buddhism, and Confucianism in the formation of Japanese culture. Graduate-level requirements include longer, more in-depth readings, papers and leading of discussion groups. (Identical with RELI 585).

586. * History of Japanese Religions: Medieval to Modern (3) I A selective survey of religions in Japan from the 14th century to modern times, emphasizing the variety of religious forms and public reactions to them that have appeared in that time frame.
Graduate-level requirements include longer, more in-depth papers and readings, and leading of discussion groups. (Identical with RELI 566).

593. Internship (1-3) [Rpt.]

594. Practicum (1-3) [Rpt.]

595. Colloquium
   b. Japan (3) [Rpt./2] I II

596. Seminar
   a. *Japanese Literature (3) [Rpt./ 3] I II
   c. *Topics in Japanese Linguistics (3) [Rpt./
      2] II S (Identical with LING 596C, SLAT 596C).

599. Independent Study (1-5) [Rpt./]

699. Independent Study (1-3) [Rpt./] II

799. Independent Study (1-3) [Rpt./]

900. Research (2-4) [Rpt./]

908. Case Studies (3) [Rpt./]

910. Thesis (2-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

799. Independent Study (1-3) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Ecology and Evolutionary Biology (ECOL)

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Advising Questions:
Lucinda McDade, (520) 621-8220, mcadade@u.arizona.edu

Program Coordinator: Katrina Mangin

Degrees Offered:
M.S., Ph.D.

Professors: John R. Jaenike, Head, C.,
William Birky, William A. Calder, III,
Margaret G. Kidwell, John G.
Lundberg, Therese A. Markow, Richard
E. Michod, Nancy A. Moran, Howard
Ochman, Michael L. Rosenzweig,
William M. Schaffer, D. Lawrence
Venable, Arthur T. Winfree

Associate Professors: Judith L. Bronstein,
Wayne P. Maddison, Carlos Martinez
Del Rio, Lucinda McDade, Daniel R.
Papaj, Irene M. Pepperberg, Robert H.
Robichaux, J. Bruce Walsh

Assistant Professors: Leticia Aviles,
Michael Nachman

Associate Research Scientists: Michael F.
Hammer, Philip A. Hastings

Emeriti Faculty: E. Lendell Cockrum,
Russell Davis, C. William Gaddis,
William B. Heed, John R. Hendrickson,
Conrad A. Istock, Charles H. Lowe, Jr.,
Albert R. Mead, Robert S. Mellor,
Stephen M. Russell, Donald A.
Thomson, Oscar G. Ward, Newell A.
Younggren

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in ecology and evolutionary biology. Concentrations are available in plant ecology, systematics, and evolution; evolutionary theory; ecological and molecular genetics; marine biology; animal behavior; population and community ecology; vertebrate biology and systematics; and theoretical and mathematical biology. The department maintains excellent collections of fishes, amphibians, reptiles, birds, and mammals. An extensive herbarium is shared with the College of Agriculture. Field work is facilitated by a Marine Biology Station at Puerto Peñasco, Sonora, Mexico, and by the availability of the Coronado Ranch in the Chiricahua Mountains; the Southwestern Research Station, Portal, Arizona; the Research Ranch, Elgin, Arizona; and the Desert Laboratory on Tumamoc Hill, Tucson, Arizona.

To apply, forward the appropriate copy of the Graduate College Application; official transcripts (in sealed envelopes from the issuing institutions); department postcard (self-addressed and stamped); 3 letters of recommendation (sealed in the enclosed envelopes); completed department application form; GRE scores for both the Aptitude and Advanced Biology tests; and a separate, in-depth essay on the research questions and organisms you may wish to study in graduate school at The University of Arizona. All the above items are to be sent together in an envelope addressed to the department. Applications should be submitted by January 15. Admission is normally approved only for students beginning their graduate studies with the fall semester. Applicants are encouraged to seek external financial support from institutions such as the National Science Foundation. The department will make every effort to offer financial aid in the form of teaching or research assistantships.

Course work, while necessary, is no substitute for scholarship. Accordingly, particular emphasis is placed on the student's ability to formulate and pursue original research problems. One course, Research in Ecology and Evolution (610a- 610b), is required of all new graduate students. The remainder of the program is designed to meet the individual needs of each student.

In addition to the courses listed below, the department offers courses in quantitative genetics, phylogenetic systematics, evolutionary morphology, plant physiological ecology, biological rhythms, and approaches to problem-solving in biology.

500a-500b. Topics in Ecology and Evolutionary Biology (2-3) I-II 500a: Introduction to graduate study in ecology and evolutionary biology, via discussion of ongoing faculty research interests. 500b: Introduction to field research methods in ecology. (Identical with INSC 500a-500b).

501. * Teaching Biology (2) I Study of new methods in instruction and ideas on course content and behavioral objectives. Designed for prospective biology teachers in secondary schools. 1R, 3L, P, 12 units of biology. Graduate-level requirements include the design and presentation of a unique and challenging laboratory experience appropriate for a secondary school biology course.

503L. *Parasite Laboratory (1) I (Identical with V SC 503L, which is home).

503R. * Biology of Animal Parasites (3) I (Identical with V SC 503R, which is home).

505. * Aquatic Entomology (4) II (Identical with ENTO 505, which is home).

506L. * Conservation Biology in the Field (1) II Graduate level requirements include participation as team leaders. Two 3-day weekend trips March-April. Binoculars required. Field Trips. (Identical with GEOS 506L, RNR 506L).


511. * Insect Behavior (4) I II (Identical with ENTO 511, which is home).

512. * Plants Useful to Man (2) S Lecture-demonstration course for teachers and others wishing information on the uses of plants: foods and food plants, medicinal plants, plants and industry, plants in textiles and other manufacturers. Graduate-level requirements include a research paper.

514. * Plants of the Desert (2) S Designed for teachers and others wishing to become familiar with common native and cultivated plants; identification, ecology, and uses. Graduate-level requirements include a research paper on a relevant topic.

515L. * Insect Biology Laboratory (1) I P, ECOL 182. (Identical with ENTO 515L, which is home).

515R. * Insect Biology (3) I P, ECOL 182. (Identical with ENTO 515R, which is home).

516. * Bioinformatics and Genomic Analysis (3) II (Identical with MCB 516, which is home).

517. * Insect Systematics (4) I 3R, 3L. (Identical with ENTO 517, which is home).

518. Laboratory Methods in Insect Physiology (3) II P, ENTO 515, biochemistry is preferred. (Identical with INSC 518, which is home).
520. * Evolutionary Quantitative Genetics (4) II Rigorous coverage of the inheritance and evolution of quantitative characters. Theory, estimation and design issues, and experimental results are given equal coverage. P, calculus. Graduate-level requirements include a research paper.

521. * Philosophy of the Biological Sciences (3) II (Identical with PHIL 521, which is home).

524. * Theoretical Population Genetics (3) I Mathematical theory of modern population genetics developed from first principles with emphasis on evolutionary implications and the historical development of ideas. P, ECOL 320, MATH 223. Graduate-level requirements include an oral presentation. (Identical with ANTH 524, INSC 524, GENE 524).


526. * Population Genetics (3) II General introductory course on empirical and theoretical population genetics. The course involves two weekly lectures, weekly problem sets, and regular readings from the primary literature. A major goal of this course is to make students familiar with basic models of population genetics and to acquaint them with empirical tests of these models. As much as any field of biology, population genetics has been divided into a theoretical and an empirical branch. These two bodies of knowledge are intimately related and this course covers both in roughly equal amounts. The primary forces and processes involved in shaping genetic variation in natural populations (mutation, drift, selection, migration, recombination, mating patterns, population size and population subdivision), methods of measuring genetic variation in nature, and experimental tests of important ideas in population genetics are discussed. The course also covers more specialized topics such as transposable elements, the evolution of multigene families, and molecular clocks. P, ECOL 182, ECOL 335; either ECOL 320 or PL S 312. Graduate-level requirements include additional exam questions, additional readings from the literature, and presentation of a 15 minute overview and synthesis of a specialized topic in population genetics. (Identical with GENE 526).

533. * Human Genetics (3) I P, ECOL 320 or ECOL 321. (Identical with GENE 533, which is home)

534. * Population Interactions (4) [Rpt./ 1] II Empirical and theoretical treatment of competition, exploitation, and mutualism within and between species, with emphasis on the application of modern dynamics to ecological problems. 3R, 3L. P, ECOL 302, 2 semesters of calculus. Graduate-level requirements include independent study of a model or data ecological system to be specified by the professor.

535. * Evolution II (4) I A thorough coverage of the empirical and theoretical foundations of modern evolutionary thought. The fossil record and associated conceptual issues are explored in detail. The heart of the course is the theoretical, experimental, and analytical logic necessary to understand processes of evolutionary change at several levels of biological organization. The course is most appropriate for undergraduate and graduate students intending to pursue advanced study and research involving evolutionary questions in biology. P, ECOL 320 or ECOL 335. Graduate-level requirements include two term papers, the subject to be determined by the professor. (Identical with GENE 535).

538. * Biogeography (3) II The role of historical events and ecological processes in determining the past and present geographic distribution of plants and animals. P, ECOL 182. Graduate-level requirements include a research paper. (Identical with GENE 538).

539. * Animal-Human Communication (3) II Survey of animal-human communication studies. Critical discussion of papers describing the rationale, design and success of projects involving nonhuman primates, marine mammals, and parrots, supplemented by films and videos. Background material on animal-animal communication and animal intelligence. Emphasis on what can be learned about human and nonhuman capacities from studying how animals acquire and use human communication systems. P, ECOL 487 or equivalent, or consent of instructor. Graduate-level requirements include a research paper. (Identical with PSYC 539).

540R. * Oceanography (2) I Introduction to the physical, chemical, geological, and biological dimensions of the oceans, with emphasis on their importance as biological environments. Graduate-level requirements include an additional literature paper on a modern aspect of oceanography.

541. * Limnology (4) I (Identical with WFSC 541, which is home).

542. Marine Ecology (6) S A field introduction to basic concepts in marine ecology with emphasis on the behavior and ecology of invertebrates and fishes and the factors affecting the diversity and community structure of marine communities. The entire course is conducted at selected sites in the Gulf of California. Graduate-level requirements include an in-depth research project on a single aspect of the course topic. Optional travel fee.

544. * Insect Ecology (3) I (Identical with ENTO 544, which is home).

545. Concepts in Genetic Analysis (3) I P, introductory undergraduate genetics course or biology course. (Identical with MCB 545, which is home).


559. * Comparative Vertebrate Histology (4) II (Identical with V SC 559, which is home).


566. * Physiology Laboratory (3) II Emphasis on data acquisition, analysis and interpretation. Laboratory techniques and investigation of physiological mechanisms. 2R, 4L. P, ECOL 437 and ECOL 468 or V SC 400a and V SC 400b or PSIO 480. Graduate-level requirements include completion of a series of directed laboratory exercises, then designing and carrying out the student's own experiment. (Identical with PCOL 566, MCB 566, PSIO 566, V SC 566).

568. * Comparative Physiology (3) II The responses of physiological systems to the environment: energy exchanges, respiration, thermal and osmotic regulation, locomotion, behavioral regulation, and integration of responses. P, PSIO 480 or V SC 400a and V SC 400b or ECOL 437. Graduate-level requirements include an additional literature review paper on a modern aspect of comparative physiology. (Identical with PSIO 568, V SC 568).

570. * Plant Diversity and Evolution (4) I Survey of the plant kingdom, with emphasis on comparative structure and evolution of major plant divisions. 2R, 6L. Field Trips. P, 4 units of biological or plant sciences. Graduate-level requirements include a research paper on a relevant topic.

572. * Systematic Botany (4) II Evolutionary relationships and characteristics of seed plants: systems of classification; acquisition of skills to identify members of almost 50 families, collection and identification of local flora. 2R, 6L. Graduate-level requirements include the study of additional plant families and a class project of increased depth. (Identical with PL S 572).

574. * Aquatic Plants and the Environment (4) I (Identical with SWES 574, which is home).

575. * Freshwater and Marine Algae (4) II Systematics, ecology, and evolution of planktonic and benthic species; field techniques and lab culture. Field Trips. P, 4 units of biological or plant sciences. Graduate-level requirements include a special topic report on an aspect of freshwater algae. (Identical with WFSC 575, SWES 575)
576a. * Analysis of Biological Diversification
(3) [Rpt./1] I II P, ECOL 181 and ECOL 182 and either an evolution or paleobiology course or consent of instructor. (Identical with GEOS 576a, which is home).

576b. * Analysis of Biological Diversification
(2) [Rpt./2] I Explores approaches to studying biological diversification, integrating phylogenetic biology, ecology, population genetics, developmental biology and molecular biology. P, ECOL 335 or consent of instructor. Graduate students will explore the literature to supply a bibliography to the class. (Identical with MCB 576b, GEOS 576b).

578. * Global Change (3) II (Identical with GEOS 578, which is home).

579. * Art of Scientific Discovery (3) [Rpt./1] II Techniques of posing questions and solving puzzles encountered in scientific research, with emphasis on life sciences and mathematics. Graduate-level requirements include the use of all techniques in a semester-long research project and final paper.

580. * Invertebrate Zoology (4) I Comparative morphology, physiology, and ecology of invertebrates. 3R, 3L Field Trips. P, ECOL 182. Graduate-level requirements include an in-depth research project on a modern aspect of invertebrate zoology.

582. * Ichthyology (4) I Ecology, evolution and systematics of fishes, with field and lab emphasis on Gulf of California and Arizona fishes. 2R, 6L Field Trips. P, ECOL 182. Graduate-level requirements include an in-depth research project on a single aspect of the course topic. (Identical with WFSC 582).

583. * Herpetology (4) II Systematics, ecology, and evolution of the amphibians and reptiles. Graduate-level requirements include an in-depth paper. (Identical with WFSC 583).

584. * Ornithology (4) II Natural history of birds and its bearing upon the problems of animal behavior, distribution, and evolution. 2R, 2L Field Trips. P, one basic biology course. Requirements include an independent research project. (Identical with WFSC 584).

585. * Mammalogy (4) I Systematics, ecology, and evolution of mammals. Graduate-level requirements include an exercise in mammalian taxonomy and a higher level of performance. (Identical with WFSC 585).


587L. * Animal Behavior Lab (1) I Exposure to current topics in behavior and process of behavioral research through video presentations, demonstrations of live animals and readings. Graduate-level requirements include organizing and leading a group discussion.

587R. * Animal Behavior (3) I Concepts and principles of the mechanism, development, function and evolution of behavior, with emphasis on its adaptiveness. P, 8 units of biology. Graduate-level requirements include a term paper involving hands-on research.

588L. * Arizona Mammals Laboratory (1-2) S The identification and study of species of Arizona mammals; with laboratory, library, and field experience. P, or CR, ECOL 488R/588R or equivalent. Graduate-level requirements include an in-depth research paper, which may be an expanded version of that done for 588R. P, ECOL 588R. (Identical with WFSC 588L).

588R. * Arizona Mammals (3) S The distribution, ecology, relative abundance, conservation, politics and management implications of the mammals of Arizona. P, ECOL 182 or equivalent; CR, ECOL 488R. Graduate-level requirements include an in-depth research paper. P, ECOL 588L. (Identical with WFSC 588R).

589. * Selected Studies of Birds (2) [Rpt./1] I Recent advances in ornithology. 1R, 3L. Graduate-level requirements include an in-depth presentation of a single aspect of the course topics. (Identical with WFSC 589).

591. Preceptorship (1-4) [Rpt./]

596. Seminar
a. Evolutionary Ecology (1-2) [Rpt./12 units] II
b. Population Biology (1) [Rpt./6] I II P, open to majors only.
d. * Selected Topics in Marine Biology (1-4) [Rpt./6 units] II Field Trips.
g. Topics in Genetics and Evolution (1) [Rpt./3] II Various topics in genetics and evolution. Repeatable with permission of instructor. P, consent of instructor. (Identical with GENE 596g, MCB 596g).
k. *Topics in Plant Evolution (1) [Rpt./2] I II P, evolution course or consent of instructor.
m. Conservation Biology (1) [Rpt./5] II (Identical with RNR 596m).

597. Workshop
b. Phylogenetic Inference (2) II P, ENTO 465 or ENTO 565 or consent of instructor. (Identical with ENTO 597b, which is home).

598. * Topics in Biological Statistics (3) II Advanced topics in statistical methodology relevant to biology, genetics and ecology. Maximum likelihood, general linear models, randomization methods, power, distribution theory. P, basic course in statistics and/or matrix algebra.

599. Independent Study (1-4) [Rpt./]

600. Current Advances in Plant Physiology (4) I P, PL S 360, CHEM 462a, CHEM 462b. (Identical with PL S 660, which is home).

601. Recent Advances in Genetics (2) [Rpt./4] I (Identical with GENE 670, which is home).

699. Independent Study (1-4) [Rpt./]

799. Independent Study (1-4) [Rpt./]

900. Research (1-8) [Rpt./]

910. Thesis (1-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Economics (ECON)
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Degrees Offered: M.A., Ph.D.

Professors: Stanley S. Reynolds, Head, Michael K. Block, John E. Buehler (Emeritus), James C. Cox, Price V. Fishback, Helmut J. Frank (Emeritus), Bernard P. Herber (Emeritus), Jimmey S. Hillman (Emeritus, Agricultural and Resource Economics), Robert D. Innes (Agricultural and Resource Economics), R. Mark Isaac, Shawn E. Kantor,
students must complete a set of core program and field. All Ph.D. senior level research positions in government and private industry. All Ph.D. Economics prepares students for faculty positions in colleges and universities, and doctoral degree. There is no foreign language requirement. Motivated students may expect to complete the degree in four years students who have completed previous graduate work at other institutions may be able to transfer up to 12 credit hours of course work.

**500. Managerial Economics (3) I**


**504. Production Economics (3) [Rpt/ 6 units] I P, ECON 300 or ECON 361; MATH 113.** (Identical with AREC 304, which is home).

**505. * Comparative Economic Systems (3) I**
Analysis of economic policy in market (capitalist) economies and of economic ideology and planning in command economies. P, ECON 300 or ECON 361. Graduate-level requirements include a research project and different tests.

**506. Experimental Economics (3) I**

**507. * Studies in Microeconomics (3) II**
Studies in microeconomics, such as the economics of imperfect information and uncertainty, externalities and public goods, and imperfect competition. P, ECON 361; MATH 125b. Graduate-level requirements include a research paper or additional problem sets, depending on exact content.

**509. Applied Economic Analysis (3) I**
Uses economic history to show how research methods in economics are used to analyze data collected through empirical observation. P, ECON 501a ECON 520.

**510. Macroeconomics (3) I**
Theory of income, employment, interest rates, and the price level. P, ECON 500. Open only to students admitted to a BPA graduate program.

**511. * Microeconomic Theory and Behavior (3) II**
Microeconomic theory with an emphasis on the use of experimental laboratory and field methods for testing the behavioral implications of the theory. P, ECON 300 or ECON 361; MATH 125b. Graduate-level requirements include a research paper or additional problem sets, depending on exact content. P, ECON 521.

**512. Economic Policy in Developing Countries (3) I** (Identical with AREC 512, which is home).

**513. Consumption Economics and Price Analysis (3) II P, ECON 361, MATH 113.** (Identical with AREC 513, which is home).

**514. Cost-Benefit Analysis (3) I** (Identical with AREC 514, which is home).

**515. Operations Research in Applied Economics (3) I P, MATH 113, ECON 361.** (Identical with AREC 515, which is home).

**516. Agricultural Development (3) I P, ECON 361 or ECON 300.** (Identical with AREC 516, which is home).

**518. * Introduction to Econometrics (3) I II**
Statistical methods in estimating and testing economic models; single and simultaneous equation estimation, identification, forecasting, and problems caused by violating classical regression model assumptions. P, ECON 339 or ECON 376. Graduate-level requirements include a research project that involves applications of econometric methods to the estimating and testing of behavioral models, or simulation studies of the statistical properties of an econometric estimation technique.

**519. Mathematical Economics (3) I**
Introduction to the theory and methods of mathematical economics and its applications. Designed primarily for entering graduate students majoring in economics. P, P or CR, ECON 520; consult department before enrolling.
520. Theory of Quantitative Methods in Economics (3) I Introduction to the basic concepts of statistics and their application to the analysis of economic data. Designed primarily for entering graduate students majoring in economics. P, P or CR, ECON 519; consult department before enrolling.

521. * Introduction to Mathematical Economics (3) II Comparative statics, stability, classical optimization, the Kuhn-Tucker theory, calculus of variations, linear algebra, game theory, and application of these techniques in economic analysis. P, MATH 125B, six upper-division units of economics. Graduate-level requirements include a research paper or additional problem sets, depending on exact content.


524. * The Chinese Economy (3) I Analysis of some facets of economic development of historical and modern China. P, ECON 300 or ECON 361. Graduate-level requirements include a research paper or additional problem sets, depending on exact course content. Advanced credit available for non-majors only.

525. * Topics in the Economic History of the United States (3) I II Examines the economic history and development of the United States, including roles of legal and cultural institutions, changes in output mix, government regulation, income distribution, monetary policy, and demographic factors. P, ECON 300 or ECON 361. Graduate-level requirements include a research paper or additional problem sets, depending on exact course content.

526. Health Economics (3) I P, PA 522; ECON 500 or consent of instructor. (Identical with PA 526, which is home).

530. Macroeconomic Aspects of Finance (3) II The effects of changing economic conditions upon a firm's operation, including capital decisions as well as production decisions. P, ECON 500.

531. * Games and Decisions (3) II Introduction to decision theory and game theory and their application to various economic situations under conditions of complete and incomplete information. P, ECON 300 or ECON 361. Graduate-level requirements include a research paper.

534. Industrial Analysis and New Venture Development (3) I Value maximization; simulation of value distribution; sources of venture capital; timing of initial public offering; new venture ownership structuring. P, ECON 500, FIN 511, MKTG 500. Open to entrepreneurship program students only. (Identical with MAP 534).

535. * Public Sector Economics (3) The influence of governmental revenue and expenditure decisions on resource allocation, income distribution, and aggregate economic performance. P, ECON 300 or ECON 361. Graduate-level requirements include an in-depth research project on a major current public sector issue. P, ECON 500.

538. * Law and Economics (3) II The economic analysis of legal rules and institutions. The economics of common law, constitutional law, and the legal process. P, ECON 300 or ECON 361 or ECON 500. Graduate-level requirements include an extensive research project and different tests.

542. * International Macroeconomics (3) I Analysis of exchange rates, balance of payments, and macroeconomic/financial interdependencies among nations. P, ECON 330 or ECON 332. Graduate-level requirements include a research project and different tests.

543. * International Trade Theory (3) II General equilibrium analysis of product and input markets of international trade, tariffs, commercial policy, and growth and the welfare aspects of each. P, ECON 300 or ECON 361. Graduate-level requirements include a research project and different tests.


553. * Business and Economic Forecasting (3) I Forecasting techniques used in business and government; assembly, interpretation and use of economic data; analysis of business conditions; examination of related environmental factors; construction of actual sales or revenue forecasts. Graduate-level requirements include a research project and different tests.

560. * Industrial Organization (3) I Structure, conduct, and performance of American industry; governmental institutions and policies affecting business. Graduate-level requirements include an applied research project that examines the impact of public policy on industry performance. P, ECON 300 or ECON 361 or ECON 500; ECON 339 or ECON 376 or MKTG 552.

561. Economics of Regulated Industries (3) II Economic analysis of the regulated sector of the American economy, including communications, transportation and energy industries; impact of existing and alternative public policies. Graduate-level requirements include a case of regulation/ deregulation or other approved research project in regulatory theory or policy. P, ECON 300 or ECON 361 or ECON 500.

562. Theory and Institutions in Industrial Organization (3) I II Major issues in the field of industrial organization. Theoretical issues presented with complementary material dealing with specific American industries. P, ECON 500.

568. Environmental Scanning and Business Strategy (3) I II P, MKTG 500, ECON 500, FIN 511. Open to BPA graduate students only. (Identical with MKTG 568, which is home).

575. Economics of Natural Resource Policy (3) I II P, ECON 300 or ECON 361. (Identical with AREC 575, which is home).

576. Advanced Natural Resource Economics (3) I P, ECON 361, MATH 113. (Identical with AREC 576, which is home).

577. Advanced Topics In the Economics of Environmental Regulation (3) I II P, MATH 113, ECON 361. (Identical with AREC 577, which is home).

580. Mathematics for Economists (2) S (Identical with AREC 580, which is home).

584. * Economics of Fuels and Energy (3) II Analysis of demand/supply, pricing, competitive behavior, transportation, interfuel competition, technical change, and externalities for markets for coal, oil, natural gas, and nuclear power. Graduate-level requirements include a research project and different tests.

585. * Economics of Non-Fuel Mineral Industries (3) II Analysis of national and international minerals markets; reserves/ deposits, production technologies, market structure and pricing, recycling, and international trade. Graduate-level requirements include a research project and different tests. P, ECON 300, ECON 361, ECON 500, ECON 501a or AREC 504.

586. * Economics of Minerals, Residuals, Effluents, and the Environment (3) II Economic aspects and process analysis of minerals production, control and measurement of effluents and residuals for environmental compliance, case studies of production mitigation, competitiveness, and technology. Graduate-level requirements include a research project and different tests. P, ECON 300, ECON 361, ECON 500, ECON 501a or AREC 504.


591. Preceptorship (2-3) [Rpt./]

593. Internship (3) [Rpt./]

597. Workshop
   a. Practical Applications of Economic Theory (3) I P, ECON 501a, ECON 502a, ECON 521, ECON 549.
   b. Computational Methods in Laboratory Economics (1-3) [Rpt./ 12 units] I II P, MATH 125a, MATH 125b, consult department before enrolling.
   e. Economics Education Workshop (2) S P, consult department before enrolling.
Education (EDUC)

Education Building, Room 201
Phone: (520) 621-1463
FAX: (520) 621-9271
WWW: http://www.ed.arizona.edu/

Majors and degrees offered by the academic departments within the College of Education are as follows:

Department of Educational Leadership and Higher Education

educational leadership .......... Ed.S./Ed.D
higher education ............... M.A./Ph.D.

Department of Educational Psychology

educational psychology .......... M.A./Ed.S./Ph.D.

Department of Language, Reading and Culture

bilingual/bicultural education ..... M.Ed.
bilingual/multicultural education . M.A.
language, reading and culture .......... M.A./Ed.S./Ed.D./Ph.D.

Department of Special Education and Rehabilitation

special education and rehabilitation .... M.A./Ed.S./Ed.D./Ph.D.

Department of Teaching and Teacher Education

teaching and teacher education ...... M.Ed./M.A./Ed.D./Ph.D.
environmental education strand ... M.A.

Education (EDUC)
The College of Education offers certain courses that are not directly affiliated with any of the academic departments in the college. In many cases, these courses are college-wide requirements for degree programs.

500. Disciplined Inquiry in Education (3) Introduction to research methods in education: analysis of research; writing of research reviews; applying research results in educational settings.

501. Foundations of Education (3) Schools and social institutions; political and social influences on education; nature of the education profession; reform and implementation in education.

502. Variations in Learners (3) Nature and extent of differences among learners, both among and within groups; causes and factors relating to variations in learners; implications for educational placement, curricular planning and program development.

600. Quantitative/Inferential Methods in Education (4) Statistical procedures for addressing educational questions using data from experimental (ANOVA) and correlational (multiple regression) studies, relationships between inferential statistics and other forms of educational research inquiry. P, PSYC 230 or SOC 274 or equivalent, EDUC 500.

601. Qualitative Methods in Education (3) Introduction to theory and methods of conducting research through extended participant observation in school or community settings; field work, ethnography, case study, qualitative methods. P, EDUC 500.

602. Research Design and Techniques in Education (3) In-depth explorations of various research paradigms in educational inquiry and their research designs; critical analysis of the structure and logic of various designs and techniques; preparation of research proposals. P, EDUC 600, EDUC 601.

604. Leadership for Educational Change (3) Investigations of the characteristics of leadership as they apply to changing basic educational organizational structures and processes.

605. Evaluation of Educational Programs and Personnel (3) Models, purposes served, contextual influences and procedures employed in evaluating educational programs and personnel. P, EDUC 500.

606. Policy Analysis in Education (3) Understanding of educational policy development and analysis of and development of the necessary skills to provide leadership in the area.

612. Philosophy of Education (3) Analysis of values and conflicts in American culture as direct educational policy; critical examination of contending philosophies in the light of democratic ideals.

See: Educational Leadership and Higher Education

Educational Psychology
Language, Reading and Culture
Special Education and Rehabilitation
Teaching and Teacher Education
Educational Leadership (ED L)
The Educational Leadership program offers a Doctorate of Education degree with a choice of two specializations: Certification Doctorate and Executive Doctorate. The Certification Doctorate is designed to prepare individuals for leadership positions in schools and meets the administrative certification requirements of the State of Arizona. The Executive Doctorate offers an opportunity for individuals currently in leadership positions to expand their skills and knowledge in the areas of leadership, policy, personnel, curriculum, evaluation, and research.

A master's degree and a graduate grade point average of 3.5 are required for admission to both the Certification and the Executive Doctorate programs. Standardized test scores are also required (e.g., the Miller Analogies Test). Beyond these minimal requirements, applicants must meet other specific requirements. Enrollment is limited and the meeting of program standards does not guarantee admission. Students interested in applying should contact the Advising Coordinator.

The Educational Leadership Program is organized around the concept of cohort groups. As a result, new students are accepted only once a year and must begin their study in the fall semester.

594. Practicum (1-6) [Rpt.]
597. Workshop
a. *Trends in Educational Leadership (3) [Rpt. 3]
    b. School Evaluation/Accreditation: Problems and Procedures (3)
599. Independent Study (1-4) [Rpt.]
620. Personal/Interpersonal Leadership (5) I Examination of basic constructs of leadership in relationship to personal values and attributes, sensitivity, communication skills, cognitive skills, ethical behavior, and vision. P, open to majors only.

660. Leadership and the Educational Environment (5) Introduction to educational leadership; overview of administration within school contexts and larger societal environment; organizational and leadership theories.

661. Administration of Bilingual Education Programs (3) I Systems of bilingual education; management of bilingual programs for the bilingual learner including sociopolitical realities, mandated federal and state funded educational programs, and effective community participation.

662. Educational Law: Policy and Practice (3) I II Ethics and legal issues diversity; the effects of law on educational policy formation and administration.

663. Computer Applications in School Administration (5) I Techniques for using computers to make school administration more efficient; using computers to enhance the management of information. P, or CR, EDL 660.

664. Personnel Administration in Education (3) I Composition of school staffs and the functions of various personnel; patterns and practices in school personnel management; issues, trends, and prospects in personnel management.


666. Curriculum and Instructional Leadership (5) II Techniques for administrators to use in analyzing the quality of the curriculum in schools as well as the appropriateness of instructional techniques used to support the curriculum. P, or CR, EDL 660.

671. School Finance (3) I Historical background of the financing of education in the United States; economics and principles; sources and distribution of funds for education; budgeting, accounting, and reports. P, or CR, EDL 660 and EDL 661.

672. School Business Management (3) II The general management of school business; administration and accounting of school funds; administration of equipment and supplies; other business operations. P, or CR, EDL 660.

675. Leadership and Organizational Theory and Behavior (5) I II Perspectives on the nature of the individual in the school organization; nature of schools as organizations; development of individual-organizational relationships. P, EDL 660.

681. The Principalship (3) I II Functions and activities of building-level administrators, with emphasis on instruction, staff development, student services evaluation, and operational services. P, or CR, EDL 693a and EDL 693b; 15 units of educational administration.

692. The Superintendent (1-2) [Rpt.]
693. Internship (1-6) [Rpt.]
   a. Educational Leadership (2-3) [Rpt. 15 units] P, EDL 661 or EDL 662; EDL 660 or EDL 663.
   b. Educational Leadership (3-4) [Rpt. 8 units]

695. Colloquium
   a. Issues in Educational Leadership (3) [Rpt. 12 units] I II

696. Seminar
   a. Topics in Educational Leadership (1-3) [Rpt. 12 units] I II
   b. Research in Educational Leadership (1-3) [Rpt. 9 units] I II

697. Workshop
   a. Problems in Educational Leadership (1-3) [Rpt. 12 units] I II

699. Independent Study (1-4) [Rpt.]
900. Research (1-3) [Rpt.]
910. Thesis (1-3) [Rpt.]
920. Dissertation (1-9) [Rpt.]
930. Supplementary Registration (1-9) [Rpt.]

Higher Education (H ED)
The department offers programs leading to the Master of Arts and Doctor of Philosophy degrees with a major in higher education, and is nationally ranked in the top 5% of higher education programs. The major in higher education is offered through the Center for the Study of Higher Education, with concentrations in academic administration, student personnel services administration, finance and business affairs administration, community college administration, curriculum and instruction, higher education policy making, and institutional research and planning. It prepares students interested in becoming administrators and scholars of higher education, and practitioners who wish to better understand, analyze, and act within higher education organizations and systems. The Center also offers staff development, planning, and financial management services to Arizona colleges and universities. The Center maintains an active research program in each of the degree areas. Recent research topics include higher education technology transfer, administrative costs, retenchment, and supply and demand of scientists and engineers. Potential careers for the graduate include work at two and four-year institutions.
An undergraduate grade-point average of at least 3.00 is required for admission to full standing in a graduate degree program. However, applicants with undergraduate grade-point averages of 2.50 to 2.99 may be admitted on a provisional basis if approved by the Dean of the Graduate College. Standardized test scores also are required (e.g., GRE, Millsers Analogies). Beyond these minimal requirements, applicants must also meet the specific requirements for all majors offered in the department. The meeting of standards does not guarantee admission.

561. The Community College (3) I The scope, objectives, and educational functions of the community college, patterns of community college programs.

601. Higher Education in the United States (3) I The scope of higher education in the United States; brief survey of historical developments and philosophic bases, public policy issues at the state and federal level; types of institutions and their purposes; characteristics of faculty, students and curricula.

608. The College Student (3) I History and characteristics of the college student; interactions with campus environmental influences; developmental and normative trends; major research findings.

609. Organization and Administration in Higher Education (3) I Organizational theory, structures, systems, and administrative procedures in varied higher education institutions; patterns of governance and policy development.

617. Student Personnel Services in Higher Education (3) II Student personnel services, philosophy, history, administrative procedures, representative programs, current trends.

622. Teaching in Higher Education (3) II Planning, organizing, presenting and evaluating learning experiences for mature students.

641. Institutional Research and Planning (3) I Development of institutional research programs for short-term/long-term planning; input/output measures.

650. Higher Education Finance (3) I Historical patterns of financing private/public higher education; current sources/types of financial support; alternative methods of financing; social benefits and consumer theories.

651. Higher Education Business Management (3) II Budget planning and execution; systems of resource allocation; personnel management; physical plant planning and construction; information systems and use in management.

679. American Indian Higher Education (3) I II (Identical with AIS 679, which is home).

693. Internship (1-6) [Rpt./]
6. Higher Education (1-3) [Rpt./12 units] I II

694. Practicum (1-3) [Rpt./]
695. Colloquium
6. Issues in Higher Education (1-3) [Rpt./12 units] I II

696. Seminar
6. Topics in Higher Education (1-3) [Rpt./12 units] I II

699. Independent Study (1-6) [Rpt./]
793. Internship (3-6) [Rpt./]
794. Practicum (1-3) [Rpt./]
799. Independent Study (1-6) [Rpt./]
900. Research (2-4) [Rpt./]
910. Thesis (1-6) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Educational Psychology (ED P)
Education Building, Room 602 Phone: (520) 621-7828 FAX: (520) 621-2909 WWW: http://www.ed.arizona.edu/ edpsych/

Application Questions:
Karoleen Wilsey, (520) 621-7828, edp@u.arizona.edu
Advising Questions: Darrell L. Sabers, (520) 621-7828, sabers@u.arizona.edu

Degrees Offered: M.A., Ed.S., Ph.D.
Concentrations: Teaching, learning and development, measurement and methodology.

Professors: Darrell Sabers, Head, Robert E. Calmes (Emeritus), Sarah M. Dinham, Thomas L. Good, Lotus M. Knief (Emeritus), Anthony J. Nitko, Kenneth J. Smith (Emeritus), Janice Streitmatter

Associate Professors: Kris Bosworth, Harley D. Christiansen (Emeritus), Joseph D. Gullo (Emeritus), Mary McCaslin, Rosemary Rosser

Assistant Professor: Jerry D'Agostino

Educational Psychology graduate programs prepare students for assuming productive roles in research, teaching, and many other areas in which educational psychology is applied.

The Department offers two programs: Master of Arts in Educational Psychology with concentrations in Educational Psychology and Doctor of Philosophy with a major in Educational Psychology.

Concentrations at the doctoral level include Measurement/Research Methodology and Teaching, Learning, and Development. Student programs in each area are individualized with a wide range of courses, internships, and research offerings. The Department makes an effort to recruit and admit for the master's and doctoral degree programs students who represent a diversity of ethnic, cultural, and linguistic groups and national origins.

Master of Arts
The master's degree program provides a foundational understanding of the concepts, methods, and theories related to the profession of educational psychology. Students hold undergraduate degrees from diverse academic fields. Many are experienced educators who have chosen graduate work in educational psychology to increase their knowledge and skills; the program exposes these students to knowledge emerging from psychological research and theory, preparing them for a wide range of professional positions in education, government, and industry. For other students, master's work provides a level of entry into a doctoral program in Educational Psychology. All students learn how psychology is relevant to educational issues. The master's program offers specialized courses in the areas of the psychology of teaching and learning, human cognition and problem solving, human development, measurement, and research methodology.

Educational Specialist
Currently students are not being admitted to the Ed.S. program.

Doctor of Philosophy
In the Ph.D. program, students are expected to acquire a balanced knowledge of both the scholarly and applied aspects of the field of educational psychology. While the unified degree is in Educational Psychology and most students take many of the same courses in pursuing this unified degree program, most concentrate in one of our two specialization areas.

Concentration in Measurement/Research Methodology prepares students to pursue teaching or research careers in educational research, measurement, and evaluation in colleges, universities, testing firms, industry, research organizations, and school settings. Concentration in Teaching, Learning and Development prepares students for teaching and research careers, primarily in colleges and universities, but also in school settings.

Admission Requirements
Admission to graduate programs in Educational Psychology is based on the careful and comprehensive evaluation of
the applicant's overall potential. In reviewing applications, major attention is given to the student's long range goals, previous academic record, academic recommendations, scores on tests of academic aptitude, and evidence supporting the applicant's ability to communicate effectively in writing. The Department will limit the number of new applicants who will be accepted according to resources. Meeting minimum requirements does not ensure admission into the Department. The minimum entrance requirements in Educational Psychology are as follows:

1. A completed bachelor's degree or master's degree from an accredited institution with an overall grade point average of at least 3.0 on a 4.0 scale.

2. Three letters of recommendation. Letters must be dated within six (6) months of the date of the application. Letters should be written by professionals who are in a position to address the applicant's ability to succeed at the graduate level.

3. GRE (Verbal, Quantitative, and Analytical) scores forwarded to the Graduate College. Students for whom English is a second language must also submit TOEFL and TWE scores.

4. An approximately 500-word summary, written exclusively by the applicant, on a topic within the field of educational psychology.

5. A brief statement (200-500 words) of the applicant's long-range professional goals.

For a comprehensive listing of specific program requirements, please see the EDP web page at: http://www.ed.arizona.edu/edpsych/admit.html.

500. Foundations of Educational Developmental Psychology (3) Introduction to theory, research, and controversies in educational and developmental psychology through representative “classic readings” in the field.

501. Advanced Child Development (3) Aspects of growth and development which influence behavior of the school-age child; emphasis on current research findings.

502. Motivation and Development in Classroom Learning (3) II S Major theories of motivation as they bear upon developmental and classroom dynamics. Special emphasis on the relationships among basic and applied research and suggested classroom practice.

503. Advanced Adolescent Development (3) Major developmental tasks within the adolescent years. Emphasis on the importance of theoretically grounded research and the integration of theory, research and practice. (Identical with FS 503).

510. Learning Theory in Education (3) Major theories of learning and motivation; emphasis on relationships between theory and practice in the schools.

511. * Computer Applications in Education (3) I Essentials of computer operations; integration of computer technologies into the classroom; learning theory; instructional design in the use of technologies; use of presentation and related software; use and evaluation of computer-assisted instruction software. Graduate-level requirements include a substantial multimedia production project.

512. * Multimedia Production in Education (3) I Design of multimedia for instructional applications with an emphasis in production techniques and programming tools. Graduate-level requirements include justification of production with learning bases.

515. * Gender Issues in Education (3) I II Focus is on the influence of gender in educational processes. Topics include biological bases, theoretical approaches, research and measurement issues, familial and social influences, curriculum, teaching methods and interactions. Graduate-level requirements include in addition to the journal, discussion, group activities, and final exam requirements, a paper or class presentation is required.


530. Professional Orientation to School Counseling (3) I Orientation to the role and activities of a K-12 school counselor. Emphasis on the components of a developmentally oriented school counseling program. This course is temporary and offered Fall 1999 only.

531. Counselling Over the Life Span (3) I Major findings of developmental theories and research from infancy to late adulthood, with special emphasis on school counseling strategies to enhance development. Temporary course taught only Fall 1999.

541. Statistical Methods in Education (3-4) Descriptive, correlational, and inferential procedures for presenting and analyzing school and research data. For students in all fields.

548. Statistical Packages in Research (4) Covers SPSS and SAS; creating data files; writing syntax; understanding documentation and output. Descriptive statistics, chi-square test of independence, regression, ANOVA. P, ED P 541 or equivalent.

557. Design of Questionnaires and Scales (3) Theoretical, methodological, and practical issues related to the development and use of survey instruments. Representative topics include rating scales, item construction, sampling procedures, and response bias.

558. Educational Tests and Measurements (3) II Theoretical and practical application of psychometric techniques to test construction, analysis, and interpretation of test results.

559. Assessment of Minorities (3) Critical review of major recent research findings applied to state-of-the-art assessment models and measures, includes hands-on-practice assessment with minority school children.

593. Internship (1-6) [Rpt./] I Legislative Internship (1-9) [Rpt./] I II

594. Practicum (1-6) [Rpt./]

599. Independent Study (1-4) [Rpt./]

600. Theories of Human Development (3) Critical discussion of research standards, methodologies, and findings of traditional and contemporary developmental theories. Emphasis on applications to developing a personal theoretical position and opening research interests.

613. Psychological Theory in Educational Practice (3) Major theories of psychological thought; strategies for utilizing such theories in educationally relevant research. P, ED P 510.

614. Research in Educational Technologies (3) Theoretical bases for research. Review of research design. Examination of research and technologies. Identification of designs useful in research on use of technologies. Design and implementation of mini-study with report to class.


646a-646b. Multivariate Methods in Educational Research (3) 646a: regression: covers simple and multiple linear regression models, least squares parameter estimation, statistical inference in regression, techniques for selecting a model and diagnosing fit problems. 646b: experimental design: confounding of effects, statistical power, diagnosing violations of assumptions, crossed and nested designs including one way and factorial designs, repeated measures, hierarchical designs, and multiple comparison procedure. P, ED P 548; ED P 640 or equivalent.

647. Techniques in Dimensionality Analysis: Principal Components and Factor Analysis (3) Construction, use, and interpretation of principal component and factor analytical methods in data analysis.
Includes eigenvalues, eigenvectors, selection of factors, orthogonal and nonorthogonal rotation methods, interpretation of loadings. P, ED P 548; ED P 640 or equivalent.


679. Psychoeducational Assessment in the Schools (3) Psychoeducational assessment techniques; practice in prescribing remedial programs.

682a. Educational Evaluation (3) I Program evaluation history, principles and techniques; political context, illustrative cases, technical skills for determining merit or making decisions about educational and social programs. P, ED P 541; ED P 548.


693. Internship (1-6) [Rpt./ 12 units] a. Research /Evaluation (1-3) [Rpt./ 12 units]

693c. College Teaching (1-3) [Rpt./ 12 units]

694. Practicum (3) [Rpt./ 3]

695. Colloquium b. Issues in Educational Psychology (1-3) [Rpt./ 12 units] I II

696. Seminar b. Issues in Educational Psychology (1-5) [Rpt./ 12 units] I II

699. Independent Study (1-3) [Rpt./]

900. Research (2-4) [Rpt./]

910. Thesis (1-4) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Electrical and Computer Engineering (ECE)

Electrical and Computer Engineering Building, Room 230
Phone: (520) 621-6195
FAX: (520) 621-8076
WWW: http://www.ece.arizona.edu

Application Questions:
gradadvisor@ece.arizona.edu

Advising Questions:
Larry Schooley, (520) 621-2352, schooley@ece.arizona.edu

Degrees Offered: M.S., Ph.D.

Concentrations: Computer engineering, electromagnetics and optics, microelectronics, and signals and systems.


Assistant Professors: Pamela A. Delaney, W. Timothy Holman, Marwan M. Krunz, Ming-Kang Liu, Kathleen L. Virga, Indra Widiyaja

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in electrical engineering. These programs prepare students for careers in research and development in such areas as communications, computers, control, electromagnetics, microelectronics, optics, and signal processing.

The Master of Science degree requires a minimum of 30 units. There are thesis and nonthesis options. The thesis option requires at least 15 units in the major field (no more than 9 of these may be jointly convemed 400/500-level courses), 6 units in the minor field, and 6 units of thesis.

The nonthesis option requires at least 21 units in the major field (no more than 9 of these may be jointly convemed 400/500-level courses), and 6 units in the minor field. Candidates must pass a final oral examination. A nonmajors program is available for qualified students who do not hold a B.S. in Electrical Engineering or a B.S. in Computer Engineering degrees.

The Ph.D. program must include a minimum of 54 units of course work (including the Master of Science degree) and 18 units of dissertation study. A minimum of 18 units in the major field and 6 to 12 units in the minor field must be completed at The University of Arizona. To satisfy the residence requirement, students must spend a minimum of two regular semesters of full-time study on campus. Students must pass a qualifying examination, which is taken during the first semester of residence beyond the master's degree, and are admitted to candidacy after passing a written and oral comprehensive examination near the end of the study program. The final oral examination is a defense of the dissertation. There is no foreign language requirement.

Minors for the Ph.D.: 12 units of classes in a minor subject are required for the Ph.D. The minor subject is usually in an area complementary to a student's ECE studies, such as physics, mathematics, or computer science. It also is possible to minor within the department. Split minors are also allowable. The minor subject is determined by consultation between the student and a faculty advisor.

Students should be aware that the comprehensive examination will have written and oral components in the minor area, that examiners from the minor area will be present at the comprehensive oral examination, and that professors from the minor have the option to attend and participate in the final oral dissertation defense.

When a minor class is a dual numbered course, the Ph.D. student must enroll in the graduate section of the class for it to count towards the Ph.D. minor. Courses taken as minor courses during a Master's program may be counted toward the Ph.D. minor as long as the courses are 500 level or above. Applicants are required to submit Graduate Record Examination (GRE) General Test scores and a statement of purpose directly to the department. All
students whose native language is not English must submit TOEFL scores directly to the Graduate College. Applications to the Ph.D. program must also contain three letters of recommendation from M.S. professors.

Additional details concerning requirements for the master's or doctoral program may be obtained on request from the department graduate studies office (520) 621-6195.

501. Linear Systems Theory (3) I Mathematical descriptions of linear systems, state-variable models, analysis methods-stability, controllability and observability, state feedback techniques, design of feedback controllers and observers.


503. Random Processes for Engineering Applications (3) I II Probability, random variables, stochastic processes, correlation functions and spectra with applications to communications, control, and computers. P, SIE 305.

515. * Microelectronics Manufacturing and the Environment (3) I (Identical with CHEE 515, which is home).

522. Analog Signal Processing and Filtering (3) I II Graduate-level requirements include additional homework and a term project.

527. Holography (3) I P, OPTI 505. (Identical with OPTI 527, which is home).


529. * Digital Signal Processing (3) I II Discrete-time signals and systems, z-transforms, discrete Fourier transform, fast Fourier transform, digital filter design. P, ECE 340, MATH 222. Graduate-level requirements include additional homework and a term project.

531. Image Processing Laboratory for Remote Sensing (3) I Techniques and applications of digital image processing in remote sensing, multispectral image enhancement and analysis, classification, feature extraction for cartography, rule-based systems for mapping from imagery. (Identical with OPTI 531).

532. Computer Vision (3) I Digital image analysis, including feature extraction, boundary detection, segmentation, region analysis, mathematical morphology, stereoscopy and optical flow. P, ECE 340. (Identical with OPTI 532).


534. Advanced Topics in Electronic Materials (3) I (Rpt/ 2) I (Identical with MSE 534, which is home).


537. Digital Communications Systems II (3) I Carrier and symbol timing synchronization, equalization for intersymbol interference channels, CDMA for wireless channels. P, ECE 503, ECE 533.

539. Algebraic Coding Theory (3) II P, MATH 415a. (Identical with MATH 539, which is home).

540. Advanced Microelectronic Processing (3) I II Theory of diffusion, oxidation, deposition and processing, etc. and process integration. P, ECE 458.

541. Synthesis of Control Systems (3) I Introduction to design of state feedback controllers and optimal control, modeling of performance indices, controller design algorithms by dynamic programming, calculus of variations and Pontryagin's minimum principle. P or CR, ECE 501.

542. * Digital Control Systems (3) I II Modeling, analysis, and design of digital control systems; A/D and D/A conversions, Z-transforms, time and frequency domain representations, stability, microprocessor-based designs. P, ECE 441. Graduate-level requirements include additional homework and a term project.


545. Decentralized Control and Large-Scale Systems (3) II Introduction to large-scale systems, definitions and special problems, modeling/model reduction, structural properties, decentralization of control and information, hierarchical and multi-level controllers. P, ECE 501.

546. * Semiconductor Processing (3) I (Identical with MSE 546, which is home).

547. * Direct Energy Conversion (3) II (Identical with A ME 547, which is home).


552. Solid-State Devices (3) I II Basic semiconductor physics and materials, PN junctions, metal semiconductor junctions/contacts. BJTs and MOSFETs, device operation, terminal behavior and frequency response, device models. P, ECE 352, ECE 451.

553. * Design-Oriented Analysis of Electronic Circuits (3) I Emphasis on obtaining analytical approximations for maximum insight into circuit behavior. Extra element theorem, feedback theorem, low-entropy design equations, frequency-domain measurement of loop gains, impedances. P, ECE 351a, ECE 351b, ECE 352. Graduate-level requirements may include additional homework, different test problems.


556. * Optoelectronics (3) I Properties and applications of optoelectronic devices and systems. Topics include radiation sources, detectors and detector circuits, fiber optics, and electro-optical components. P, ECE 352, ECE 381. Graduate-level requirements include additional homework and a term project.

557. Integrated Circuit Laboratory (3) I II Experiments in diffusion, oxidation, processing, etc. Fabrication of an integrated circuit (Identical with MSE 557).
558. Vacuum System Engineering (3) II
Rarefied gas dynamics, pumping, gauging and systems as they apply to microelectronic device and thin-film fabrication. Materials and techniques for ultraclean and ultrahigh vacuum processing. P, ECE 557 or consult department before enrolling.

559. * Fundamentals of Optics for Electrical Engineers (3) I
Introduction to diffraction and 2D Fourier optics, geometrical optics, paraxial systems, third order aberrations, Gaussian beam propagation, optical resonators, polarization, temporal and spatial coherence, optical materials and nonlinear effects, electro-optic modulators. Applications to holography, optical data storage, optical processing, neural networks, associative memory optical interconnects. P, ECE 352, ECE 381.

Graduate-level requirements include different exam questions and/or grading.

560. * Aerosol Science and Engineering (3) I
(Identical with CHEE 560, which is home).

561. Power Electronics (3) I II
Design and analysis of switching converters: topologies, state-space averaging, feedback, power bipolar transistor and MOSFET characteristics, magnetic modeling and design. P, ECE 320, ECE 340.

562. * Computer Architecture and Design (3) [Rpt./3 units] I II
Intended to provide students with a study of computer architecture and design. Provides a basic knowledge and ability required for understanding and designing standard and novel computer architectures. Topics include: design methodologies at various levels, instruction set design, ALU design, memory organization and design, cache design, virtual memories, interleaved memories, associative memories, control organization and design, hardwired control, microprogrammed control, pipelining, superscalar and superpipelining, RISC design, vector processing and others. P, ECE 274, ECE 275, ECE 372 or consent of instructor. Graduate-level students will be required to complete a term paper and extra homework.

563. Engineering Applications of Graph Theory (3) II
Topics will emphasize engineering applications of graph theory. Terminology, algorithms and complexity analysis will be included. Application areas will include, but are not limited to, communication networks, VLSI routing and layout, analog circuits, and mapping of sequential and parallel algorithms onto computer architectures.

564. Broadband Networks and Multimedia Communications (3)
Broadband networking; ISDN and B-ISDN; asynchronous transfer mode (ATM) protocols and architecture; ATM layered protocol stack; traffic management; congestion control; IP over ATM; IPv6 and RSVP; Frame Relay; internetworking. P, ECE 478 or ECE 587; equivalent introductory course in networks.

565. * Microelectronic Packaging Materials (3) II
(Identical with MSE 565, which is home).

566. Knowledge System Engineering (3) I II
Design and implementation of knowledge-based software systems, machine intelligence, expert system design, reasoning under uncertainty, advanced automated problem solving methods, case-based reasoning, machine learning, genetic algorithms, distributed intelligent systems, logical foundations of intelligent systems. Applications to robotics, manufacturing and CAD.

Computational geometry, graphics programming, solid modeling, projections and transformations, display generation, hidden lines and surface algorithms, computer aided design and computer integrated manufacturing, spatial reasoning. (Identical with A ME 567).

568. Modern Computer Architecture (3) I
Overview of uniprocessor architectures, introduction to parallel processing, pipelining, vector processing, multi-processing, multiprogramming, memory design for parallel computers, cache design, communication networks for parallel processing, algorithms for parallel processing. P, ECE 369.

569. Parallel Processing: Architectures, Algorithms and Technologies (3) II

570. Computer Aided Engineering for Integrated Circuits (3) I
CAD systems for integrated circuits; terminal models of bipolar and MOS devices, computerized circuit analysis, methods, programs, SPICE simulation. P, ECE 352, SIE 270.

571. Advanced Logic Synthesis and VLSI Algorithms (3) II
Mathematical foundations of Boolean Algebras, elementary ﬁnite automata theory, exact algorithms and heuristic procedures for synthesis and minimization of two and multi-level logic, mathematical models of sequential systems and algorithms for synthesis and veriﬁcation of ﬁnite state machines, and algorithms for technology mapping. P, ECE 474a or ECE 574a; ECE 474b or ECE 574b; background in digital design, mathematical maturity, programming in C or equivalent. (Identical with C SC 571).

572. * Continuous-System Simulation (3) II
Techniques for simulating systems described by differential equations and difference equations. Numerical integration, parameter estimation, random number generation, simulation software, simulation hardware. P or CR, ECE 4340. Graduate-level requirements include more difﬁcult homework and separate grade normalization. (Identical with C SC 572).

573. Software Engineering Concepts (3) II
In-depth consideration of each of the phases of the software project life cycle. Object-oriented design and programming. Includes a large-scale software development project involving groups of students. P, ECE 275. Graduate-level requirements include additional homework and a term project.

574a. * Computer-Aided Logic Design (3) I
Tabular minimization of single and multiple output Boolean functions, NMOS and CMOS realizations, synthesis of sequential circuits, RTL description, laboratory exercises. P, ECE 274. Graduate-level requirements include additional homework and term projects. (Identical with C SC 574a).

574b. * Computer-Aided Logic Design (3) II
Standard cell layout, gate and switch level simulation, level mode sequential circuits. VLSI testing, GDS II, CAD, and design rules. Graduate-level requirements include additional homework and term projects. (Identical with C SC 574b).

575. Object-Oriented Simulation/Discrete Event Models (3) II
Introduction to object-oriented simulation methodology and its implementation on multi-processors. Modular hierarchical discrete event model design and mapping onto distributed simulator architectures. P, prior course in simulation recommended.

576. Engineering of Computer-Based Systems (3) II
Provides methods and techniques for engineering and design of systems that comprise heterogeneous, software, hardware, communication, and other components. Characterization of design methodologies, object-oriented modeling and design, systems synthesis and performance analysis. A term project is central to the course. P, ECE 471, ECE 479, consent of instructor.

577. Computer System and Network Evaluation (3) II

578. * Fundamentals of Computer Networks (3) I
Introduction to computer networks and protocols. Study of the ISO open systems interconnection model, with emphasis on the physical, data link, and network layers. Discussion of IEEE 802, OSI, and Internet protocols. P, ECE 275, ECE 372, SIE 305. Graduate-level requirements include additional homework and assignments.

579. * Principles of Artificial Intelligence (3) I
Provides an introduction to problems and techniques of artificial intelligence (AI). Problem solving; basic problem solving methods and techniques; search and game strategies, knowledge representation using predicate logic; structured representations of knowledge; semantic nets, system entity structures, frames and scripts; planning;
learning, expert systems; implementing AI systems. P, ECE 275. Graduate-level requirements include additional assignments.

581a. Electromagnetic Field Theory (3) II Time-harmonic fields; fundamental theorems and concepts; rectangular and circular waveguides and resonators; apertures in ground planes; cylinders, and wedges; scattering by cylinders and wedges. P, ECE 502 or MATH 422b.

581b. Electromagnetic Field Theory (3) I Spherical geometries; interface problems; perturbational techniques; integral equations; asymptotic techniques; introduction to transient fields.

583. Remote Sensing Instrumentation and Techniques (3) II Development of instrumentation, measurement and signal processing techniques required for electromagnetic remote sensing applications with emphasis on atmospheric remote sensing. P, ECE 482. (Identical with ATMO 583, CHEE 583).

584. * Antenna Theory and Design (3) II Introduction to the fundamentals of radiation, antenna theory and antenna array design. Design considerations for wire, aperture, reflector and printed circuit antennas. P, ECE 381. Graduate-level requirements include additional homework and a term project.

585. * Radio Waves and Telemetry (3) II Principles and properties of electromagnetic propagation through the atmosphere and space including terrain effects. Applications to telemetry, with emphasis on the design of microwave and optical links, frame and packet construction, data synchronization, link characterization and systems considerations. P, ECE 340, ECE 381, SIE 305; CR ECE 431 or ECE 435. Graduate-level requirements include a research report on a topic selected by the instructor from the course material.

586. * Microwave Engineering (3) I Review of transmission line theory; microstrip lines and planar circuits; RF/microwave network analysis; scattering parameters; impedance transformer design; filter design; hybrids and resonators; RF/microwave amplifier design; RF transceiver design; RF/microwave integrated circuits. P, ECE 381. Graduate-level requirements include additional homework and a term project.

587. * Fiber Optics Laboratory (3) II (Identical with OPTI 587, which is home).

589. Atmospheric Electricity (3) II (Identical with ATMO 589, which is home).

591. Preceptorship (1-3) I II

599. Independent Study (1-6) [Rpt./]

631. Neural Networks (3) I Theory and application of parallel distributed processing via elementary processing elements; PE models and neural analogies; statistical classification, supervised/unsupervised; neural net models; associative memories; training algorithms.

636. Information Theory (3) II Definition of a measure of information and study of its properties; introduction to channel capacity and error-free communications over noisy channels; rate distortion theory; error detecting and correcting codes. P, ECE 503. (Identical with MATH 636).

637. Channel Coding (3) I This course will cover encoding and decoding algorithms for block, trellis, and concatenated codes. Block code discussions will focus on BCH and Reed-Solomon codes, trellis code discussions will include both convolutional codes and trellis-coded modulation, and the concatenated code discussions will include concatenated codes with iterative (turbo) decoding. The treatment will also include performance calculations for the various codes. This course is temporary and will be offered only during Fall of 1999. P, ECE 537.


650. Advanced Analog Circuits (3) II Advanced topics in bipolar and CMOS analog integrated circuits including both switching and nonswitching applications. Voltage references, DAC and ADC systems, instrumentation amplifiers, sample-hold circuits, switched-mode power supply regulators. P, ECE 550.

652. Advanced Solid-State Devices (3) I Analysis and design of devices including BJTs, MOSFETS, MESFETs, MODFETs, microwave devices, and photonic devices. P, ECE 552.


659. Advanced Topics in Microelectronics and Solid-State Devices (3) [Rpt./2] I II Specialized topics, as announced, such as submicron MOSFETS, radiation effects on devices, yield analysis, advanced semiconductor processing technologies, and contamination control. P, consult department before enrolling.

672. Computer-aided Design Algorithms and Techniques for VLSI (3) I Introduction to VLSI design, combinational and sequential logic synthesis, layout generation and optimization, logic and timing simulation, design styles. P, ECE 474 or ECE 574.

Civil Engineering and Engineering Mechanics
  civil engineering .................. M.S./Ph.D.
  engineering mechanics ........... M.S./Ph.D.

Electrical and Computer Engineering
electrical engineering ............... M.S./Ph.D.

Hydrology and Water Resources
  hydrology .............................. M.S./Ph.D.

Water Resources
  water resources administration .......... M.S./Ph.D.

Materials Science and Engineering
  materials science and engineering .......... M.S./Ph.D.

Mining and Geological Engineering
  mining engineering .................. M.S./Ph.D.

Geological and Geophysical Engineering
  geological and geophysical engineering .......... M.S./Ph.D.

Systems and Industrial Engineering
  systems engineering .................. M.S.
  industrial engineering ............... M.S.
  reliability and quality engineering .... M.S.
  systems and industrial engineering .......... Ph.D.

Tri-University Master of Engineering
  master of engineering ................ M.Eng.

Qualified students working toward an advanced degree in various engineering programs may select certain options which are interdisciplinary or interdepartmental in nature. The programs in which these options are available and descriptions of the options follow:

Biomedical Engineering: This option is available in the departments of Aerospace and Mechanical Engineering, Chemical and Environmental Engineering, Electrical and Computer Engineering, Nuclear and Energy Engineering, and Systems and Industrial Engineering. Biomedical engineering is a multidiscipline in which physical scientists and engineers interact with life scientists and physicians to solve problems ranging from basic investigations to applications in clinics and related health service facilities. The work is coordinated by the Biomedical Engineering program.

Energy Systems Engineering: This option is available in the departments of Aerospace and Mechanical Engineering, Chemical and Environmental Engineering, Civil Engineering and Engineering Mechanics, Electrical and Computer Engineering, and Nuclear and Energy Engineering. The program is designed to encourage engineering study and research efforts directed toward society's energy needs. The scope of interest includes energy sources (fossil, geothermal, hydro, nuclear, and solar); systems to convert and transfer energy and power; efficient energy utilization; and environmental controls. Applied research and industrial interaction are stressed. The program is coordinated by a committee representing the departments in which the option is available.

501. Planning for Discovery (3) [Rpt/ 1] II
  P, a basic course in physical chemistry.
  (identical with MSE 501, which is home).

502. Research Proposal Preparation (3)
  [Rpt/ 1] I (identical with MSE 502, which is home).

554. * Law for Engineers/Scientists (3) II
  (identical with CHEE 554, which is home).

596. Seminar
  a. Technology and Social Theory (3) II
  (identical with CHEE 596S, which is home).

696. Seminar
  a. Science and Social Theory (3) II
  (identical with SOC 696A).

Engineering Mechanics
(See Civil Engineering and Engineering Mechanics)

English (ENGL)
Modern Languages Building, Room 445
Phone: (520) 621-1836
FAX: (520) 621-7397
WWW: http://w3.arizona.edu/~english

Application Questions:
  Graduate Secretary, 621-1358

Advising Questions:
  Lynda Zwinger, Director of Graduate Studies, (520) 621-1836

Degrees Offered: M.A., M.F.A., Ph.D.


Associate Professors: H. Douglas Adamson, Jon Anderson, Carl Berkhou, Laura Berry, Meg Lota Brown, Daniel F. Cooper, the Program, and the Charles E. Davis (Emeritus), Alisson H. Deming, Fred Dye (Emeritus), Elizabeth Evans, Margaret B. Fleming (Emerita), Donna M. Johnson, Arthur M. Kay (Emeritus), Gene S. Koppel, Naomi Miller, Thomas Miller, John A. Mills (Emeritus), Tenney Nathanson, Charles Sherry, Richard I. Snyder (Emerita), Judy N. Temple, John Warnock, Sue Warnock, Susan White, Thomas Willard, Lynda Zwinger

Assistant Professors: Jeremy Green, Jun Liu, Kenneth S. McAllister, Alison Moore, Irvin Morris, Roxanne Mountford, Alice Senob (Emerita)

Lecturer: Christopher F. Carroll, Ruth Gardner (Emerita)

The department offers programs leading to the Master of Arts degree with a major in English (with a concentration in Literature, in Rhetoric, Composition and the Teaching of English, or in English as a Second Language), the Master of Fine Arts degree with a major in creative writing, and the Doctor of Philosophy degree with a major in English or a major in Rhetoric, Composition and the Teaching of English.

Master of Arts, major in English with a concentration in Literature or in Rhetoric, Composition, and the Teaching of English. To be admissible, applicants must have completed the equivalent of the undergraduate major in English with a grade-point average of at least 3.50 in courses in English. Applicants must submit Graduate Record Examination scores for the English test, the Analytical tests, and a sample of their scholarly or critical writing. In addition, the literature program requires Graduate Record Examination scores for the Advanced Literature in English test. Applicants must also have sent directly to the department three letters of recommendation. These materials should be addressed to the Director of Graduate Study of the Department of English in the Literature program, at least 27 units (9 courses) must be in regularly scheduled literature classes, unless otherwise approved by the Program Director. Students in both programs must also pass an M.A. examination.

Master of Arts, major in English as a Second Language: Applicants should have an overall grade-point average of 3.50 in a relevant undergraduate major. Scores from the Graduate Record Examination must be submitted along with evidence of
significant teaching experience and completion of two years of study of a foreign language or equivalent proficiency. International students must provide TOEFL scores of at least 550.

Master of Fine Arts: For information concerning this degree refer to chapter IV, Requirements for Master's Degrees, in this Catalog.

Doctor of Philosophy: The admissions requirements for this degree program are the same as those set forth for the Master of Arts with a major in English, above. In Literature, students who have earned the Master of Arts degree from the Literature program must complete at least 15 units of 500-level course work beyond the requirements for the M.A., for a total of 45 units. At least 33 (11 courses) of the 45 units must be in regularly scheduled literature classes, unless otherwise approved by the Program Director. Literature students who earned the M.A. degree elsewhere must complete a minimum of 30 units of course work; of these, at least 21 units (7 courses) must be in regularly scheduled literature classes, unless otherwise approved by the Program Director. Students in the Rhetoric, Composition, and the Teaching of English program must complete at least 45 units of course work at the 500-level or above; those seeking to transfer credits from another institution or program should consult with the Program Director. In addition to these course requirements, all students in both programs must pass qualifying and comprehensive examinations, complete 18 units of dissertation credit, and write a dissertation acceptable to the Department of English.

Contact the Director of Graduate Study of the Department of English for further information.

501. Advanced Creative Writing Nonfiction Writing (3) [Rpt/24 units] I II For M.F.A. candidates working toward book-length writing project in nonfiction.

505. * History of the English Language (3) I II The evolution of English sounds, inflections, and vocabulary from earliest times to the present, with attention to historical conditions. Graduate-level requirements include an in-depth research paper. (Identical with GER 505).

506. Modern English Grammar (3) Introduction to the nature of grammar and approaches to the description of English grammar, emphasizing Chomsky's transformational-generative model. Focus is on grammatical structure, but scope includes phonology and social/historical factors which influence the form and use of English in various contexts. Includes practice in phonemic transcription and sentence diagramming. Graduate-level requirements include an in-depth outside paper. (Identical with SLAT 506).

508. * English as a Second Language in Bilingual Education (3) I II Methodology for the teaching of English as a component of bilingual education. Graduate-level requirements include a special in-depth paper.

510. * Teaching of Composition (3) I II Theory and practice of teaching writing in secondary schools and colleges. Graduate-level requirements include a special topics paper.

511. * Teaching of Literature (3) I II Theory and practice of teaching literature, with intensive study of genres and works commonly taught in secondary schools. P, 9 units of literature. Graduate-level requirements include a special topics assignment.

512. * Teaching of the English Language (3) I II Theory and practice of teaching various aspects of language in the secondary schools. P, ENGL 405, ENGL 406. Graduate-level requirements include a special topics report.

513. * Poetry in Forms (3) [Rpt/1 I II Explores prosody through discussing and writing of forms and types, research paper. P, ENGL 309. Graduate-level requirements include a research paper.

514. * Advanced Scientific Writing (3) I II Preparation of professional literature for publication. Graduate-level requirements include longer and more detailed papers.

515. History of Criticism and Theory (3) [Rpt/1 I II A systematic introduction to the history of criticism and/or modern and contemporary critical theory.


520. History of the German Language (3) I II (Identical with GER 520, which is home).

521. * American English (3) I II History of the development of American English from the colonial period to the present. Topics include regional and social varieties, language contact, and slang. Geographic atlas, social survey, and lexicographic research methods are utilized. P, ENGL 405; introduction to linguistics. Graduate-level requirements include additional readings and a special topics paper. (Identical with SLAT 521).

524. * Studies in Southwest Literature (3) I II Graduate-level requirements include an additional term paper. (Identical with AIS 524).

525a-525b. * Old English (3-3) I-II 525a: Introduction to Language and Literature. 525b: Beowulf: Study of the poem in the original language. Graduate-level requirements include an in-depth paper. (Identical with GER 525a-525b).

526. * Medieval English Literature (3) Survey of Old and Medieval English literature (exclusive of Chaucer), with some use of modernized or glossed versions. Graduate-level requirements include an in-depth paper.

527. * Chaucer (3) I II The Canterbury Tales and other poems, read in Middle English. Graduate-level requirements include an in-depth paper.

529. * Chinese-American Literature (3) I II (Identical with CHN 529, which is home).

531. Advanced Studies in Shakespeare (3) I

533. Studies in the Renaissance (3) [Rpt/1 I I

534. Advanced Studies in Milton (3) I

541. Studies in the Restoration and Eighteenth Century (3) [Rpt/1 I I

543. Mexican-American Literature in English (3) [Rpt/1 I II Graduate-level requirements include an extra paper and leading a class discussion.

545. * Introduction to TESL: Overview (2) Development of the field of English as a second language with emphasis on current trends, the influence of linguistic theory, and the international role of English. Graduate-level requirements include an in-depth paper.

548. * The Theory and Practice of Writing (3) I (Identical with FREN 548, which is home).

549a. Folklore (3) I Forms of verbal folklore. (Identical with CCLS 549a, AIS 549a, ANTH 549a).

549b. Folklore (3) II Non-verbal folklore and material culture. (Identical with AIS 549b, CCLS 549b, ANTH 549b).

550. Modern Theories of Cultural Studies (3) [Rpt/3 I (Identical with CCLS 550, which is home).

554. Contemporary Feminist Theories (3) I II P, consult the committee before enrolling. (Identical with W S 554, which is home).

555a. Studies in Nineteenth-Century British Literature (3) [Rpt/1 I I The Romantics.

555b. Studies in Nineteenth-Century British Literature (3) [Rpt/1 I II The Victorians.

557a. Modern British Literature (3) [Rpt/1 I I Modern British literature.

557b. Contemporary British Literature (3) [Rpt/1 I II Contemporary British literature.

562. *Linguistics and the Study of Literature (3) Linguistic methods in the analysis of literature and implications of literary language for linguistic theory; detailed consideration of prosody, metaphor, narrative technique and irony. Graduate-level requirements include a greater number of assignments and a higher level of performance. (Identical with LING 562, CCLS 562).

565. Studies in American Literature to 1900 (3) [Rpt/3 I I Reading course in American literatures before 1900.

577. Studies in American Indian Literature (3) I II In-depth study of works by and/or about American Indian writers. (Identical with AIS 577).

585. Linguistic and Computer-Assisted Approaches to Literature (3) II (Identical with GER 385, which is home).

587. Testing and Evaluation in Foreign/Second Language Programs (3) I II (Identical with GER 387, which is home).

591. Preceptorship (1-6) [Rpt./] I II

593. Internship (1-3) [Rpt./] I III

594. Practicum (1-6) [Rpt./] I II

595. Colloquium [a. Professional Studies (1-6) [Rpt./ 4] I II


597. Workshop [a. Southern Arizona Writing Project (3-9) [Rpt./ 12 units] (Identical with LRC 597a). b. The Teaching of English (3) [Rpt./ 1] (Identical with LRC 597o). c. Research and Composition (3) [Rpt./ 15 units] II

599. Independent Study (1-6) [Rpt./]

604. Writing Project in Fiction (1-6) [Rpt./ 18 units] I II For M.F.A candidates working toward book-length writing project in fiction.

609. Writing Project in Poetry (1-6) [Rpt./ 18 units] I II For M.F.A candidates working toward book-length writing project in poetry.


613. Methods of Teaching English to Speakers of Other Languages (3) I Foundations, theory, and methodology in English as a second language. (Identical with LRC 613, SLAT 613).


615. Second Language Acquisition Research (3) I Survey of major perspectives on second language acquisition processes, including interlanguage theory, the Monitor Model, acculturation/pidginization theory, cognitive/ connectionist theory, and linguistic universals. Analysis of research from the different perspectives includes consideration of grammatical, pragmatic, and sociolinguistic dimensions of language learning. P, ENGL 506. (Identical with SLAT 615).


646. Ancient and Contemporary Voices (3) I II (Identical with AIS 646, which is home).

693. Internship [a. Applied ESL (3) [Rpt./ 1] I II P, ENGL 613 or equivalent. (Identical with AIS 693).


c. History of Rhetoric (3) [Rpt./ 6] I II (Identical with LRC 696j).

d. Studies in Rhetoric and Composition (3) [Rpt./ 6]

794. Practicum (1-6) [Rpt./]

900. Research (1-3) [Rpt./]

909. Master's Report (1-6) [Rpt./]

910. Thesis (1-3) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Entomology (ENTO)

Forbes Building, Room 410
Phone: (520) 621-1151
FAX: (520) 621-1150
WWW: http://ag.arizona.edu/ENTO/entohome.html

Application Questions:
Graduate Secretary, (520) 621-1151
Advising Questions:
David Byrne, (520) 621-7169

Degrees Offered: M.S., Ph.D.

Professors: Bruce E. Tabashnik, Head, Elizabeth A. Bernays, William S. Bowers, David Byrne, Reginald F. Chapman (Neurobiology), Timothy J. Dennehy, René Feyereisen, Henry H. Hagedorn, John G. Hildebrand (Neurobiology), Nancy A. Moran (Ecology and Evolutionary Biology), Leon Moore (Emeritus), Nicholas J. Strausfeld (Neurobiology), Donald M. Tuttle (Emeritus), George W. Ware (Emeritus), Theo F. Watson, Diane E. Wheeler

Associate Professors: David R. Maddison, Daniel R. Papaj (Ecology and Evolutionary Biology), Robert L. Smith

Assistant Professors: Yves Carrierre, Martha S. Hunter, Martin F. Taylor

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in entomology. Faculty interests include behavioral ecology, chemical ecology, biological control, evolutionary biology, insect migration, integrated pest management, plant-insect interactions, toxicology, biochemistry, evolution, and management of resistance to insecticides, physiology, social insects, and systematics. Research opportunities with insects also exist in the departments of Biochemistry, Ecology and Evolutionary Biology, the Committee on Neuroscience, and the Program in Insect Science. The Center for Insect Science provides opportunities for collaborative research with a large group of insect scientists in the state. Facilities for field studies include University Agricultural Centers in Maricopa (MAC) and Yuma (YAC) and a farm with an entomology lab 3 miles from campus. Three faculty members are stationed off-campus: Peter Ellsworth (MAC), David Kerns (YAC), and John Palumbo (YAC). Natural habitats can be studied on University land in the Sonoran Desert and in the range-lands and canyons of the Santa Rita Mountains. Several excellent field centers are available in the diverse biomes of Southern Arizona.

Admission requirements include the completion of an undergraduate major in the biological sciences which should include course work in physics, organic chemistry, mathematics, and the evolutionary, ecological, organismic, cellular, and molecular aspects of biology. Applicants must submit scores on the general and subject tests of the Graduate Record Examination and three letters of recommendation from persons in a position to assess the applicant's potential as a graduate student. Inquiries concerning financial aid should be addressed to the department.
Graduate study programs are individually planned and approved by the student's committee. Candidates for the Master's degree in entomology will be required to take 2 units of seminar and 2 courses selected from ENTO 507, 508, 511, 515, 516, and 544. A thesis is required. Candidates for the Master's degree with a concentration in applied entomology can specialize in agricultural entomology, urban entomology, or medical and veterinary entomology. Course requirements are ENTO 508, 516, 544 and 3 courses selected from the area of specialization. A non-thesis option is available. The doctoral program requires 4 units of seminar and 3 courses selected from ENTO 507, 508, 511, 515, 516 and 544, plus 6 credits from upper-division courses offered by the Department of Entomology.

502. Agriculture and the Environment: Focus on Pesticides (3) II (Identical with AGTM 502, which is home).

503L. Parasite Laboratory (1) I (Identical with V SC 503L, which is home).

503R. Biology of Animal Parasites (3) I (Identical with V SC 503R, which is home).

505. * Aquatic Entomology (4) II Morphological, physiological and behavioral adaptations of insects to life in water; taxonomy and ecology of aquatic insects. 2R, 3L. Field Trips. P, ECOL 182. Graduate-level requirements include an original research or review paper on some aspect of aquatic entomology agreed upon by the student and the professor. Field Trips. (Identical with INSC 505, ECOL 505, WSC 505).

507. Insect Physiology (3) II Introduction to the diverse and unique ways insects solve physiological problems. A whole-animal approach will be used centered around various aspects of an insect's life (i.e., growing, flying, reproducing). P, P or CR, ENTO 407L, biochemistry recommended. (Identical with INSC 507).

508. * Insect Toxicology (3) II Introduction to the interactions of insects with natural and synthetic toxicants; metabolism, mode of action and resistance of insects to insecticides, P, 3 units of organic chemistry or biochemistry. (Identical with PCOL 408). Graduate-level requirements include additional in-depth material. P, 3 units of organic chemistry or biochemistry. (Identical with INSC 508, PCOL 508).

511. * Insect Behavior (4) II Survey of the behavioral solutions to ecological problems employed by insects and other terrestrial arthropods. Emphasis on patterns highly developed or uniquely expressed in insects such as social behavior, chemical communication, diet choice, pollination ecology, and parasitoid host finding. Evolutionary perspective, models, and theory. Student research exercises and projects. Field Trips. Graduate-level requirements include a written literature review and oral presentation of a selected topic. Field Trips. (Identical with INSC 511, ECOL 511).

512. Biological Electron Microscopy (4) I II P, one college level course in physics, chemistry, and biology. (Identical with MCB 512, which is home).

514. * Bee Biology and Pollination (2) II Fundamentals of pollination ecology with emphasis on bees as pollinators. A comprehensive review of the biology of all life stages of honey bees and honey bee colony management strategies. Field Trips. P, one course in biology. Graduate-level requirements include a research paper on some topic of bee biology or pollination, and an oral presentation of this research.

515L. Insect Biology Laboratory (1) I Graduate-level requirements include making a larger insect collection. P, ECOL 182. (Identical with ECOL 515L, INSC 515L).

515R. Insect Biology (3) I Graduate-level requirements include submission of reports on landmark papers in insect biology. P, ECOL 182. (Identical with INSC 515R, ECOL 515R).

517. * Insect Systematics (4) I Principles and methods of insect systematics. A review of the evolution of insects with an emphasis on their phylogenetic relationships. Practice in the identification of adult and immature insects, especially those from Arizona. 3R, 3L. Field Trips. Graduate-level requirements include a written literature review and oral presentation of a selected topic. 3R, 3L. Field Trips. (Identical with INSC 517L, ECOL 517).

518. Laboratory Methods in Insect Physiology (3) II P, ENTO 515, biochemistry is preferred. (Identical with INSC 518, which is home).

527. * Insect Chemical Ecology (4) I The chemistry of relationships regulating insect growth, development, reproduction, diapause and communication. Derivation of biorational methods of insect control. Laboratory includes experience with modern instrumentation focused on the isolation, identification and biological assay of natural products. 3R, 3L, P, ENTO 507 or equivalent, and 3 units of organic or biochemistry. Graduate-level requirement includes a written project report. (Identical with V SC 527).

533. Teaching Biology Labs (2) II (Identical with BIOC 533, which is home).

544. Insect Ecology (3) I The study of how variation in the environment, interactions with other species and the special features of insect "design," have determined the evolution of diverse insect life histories, the dynamics of insect population and the roles of insects in communities. 2R, 3L. Graduate-level requirements include an independent research project and a literature review paper. Field Trips. (Identical with ECOL 544, INSC 544).

552. Medical-Veterinary Entomology (4) [Rpt./3] II Survey of arthropods of public health and veterinary importance with emphasis on transmission dynamics of pathogens, biologies of vector populations, and current control concepts. Graduate-level requirements include a written review of contemporary journal articles. P, parasitology recommended. (Identical with INSC 552, V SC 552).

565. * Phylogenetic Biology (3) I (Identical with ECOL 565, which is home).

568. * Insect Pest Management (3) I Principles underlying the management of arthropods in agricultural systems. Graduate-level requirements include an additional report.

570. Biological Control (3) I Lecture and discussion of the theory and practice of the biological control of insects, weed, and plant pathogen pests. Graduate-level requirements include additional written work. P, ECOL 444 or equivalent. (Identical with INSC 570).

575. Entomology for Teachers (3) I Introduction to insect diversity and importance. Methods of collection/pollination/social insects/forensic entomology, insects in agriculture, using insects to learn biological principles. Field Trips. P, previous biology course (by approval).

576. Environmental Toxicology (3) II P, PCOL 602A, 6 units of biology and organic chemistry. (Identical with PCOL 576, which is home).

593. Internship (1-3) I II

596. Seminar

a. Entomology (1-3) [Rpt./21 units] I II

b. Medical-Veterinary Entomology (1-3) I P, ENTO 452.

c. Topics in Insect Diversity (2) I II

d. * Plant-Insect Interactions (1) [Rpt./5] I II (Identical with PL 596d, which is home).

e. Insect Physiology, Biochemistry, Toxicology (1-3) [Rpt./6 units] I II

f. Topics in Pest Management (1-3) [Rpt./6 units] I II

g. * Insect Ecology (3-3) [Rpt./18 units] I II

h. Insect Behavior (1-3) In depth analysis of special topics

i. Urban Entomology (1-3) In-depth analysis of special topics in entomology.

l. Chemical Ecology of Insects (1-3) In depth analysis of special topics

m. Insect Chemical Communication (2) I II In depth analysis of special topics

n. The Physiology of Insect Communication (1) II Short lectures, student presentations and discussion. Students are encouraged to take examples from their own study of organisms. Topics include: mechanisms of production and reception of chemical signals, sound, substrate vibration, and visual signals; physical constraints on transmission neural processing of incoming signals.

597. Workshop

b. Phylogenetic Inference (2) II P, ENTO 465 or ENTO 565 or consent of instructor. (Identical with ECOL 597b, GEOS 597b).

599. Independent Study (1-5) [Rpt./]
613. Applied Biostatistics (4) II 3R, 3L. (Identical with RNR 613, which is home).

660. Infectious Disease Epidemiology (3) II P, EPI 596a, EPI 596b. (Identical with EPI 660, which is home).

693. Internship (1-3) I II

694. Practicum (1-6) [Rpt./]

696. Seminar

a. Entomology (1) [Rpt./ 6] I II

699. Independent Study (1-3) I II

900. Research (1-4) [Rpt./]

909. Master’s Report (1-3) I II

910. Thesis (1-8) [Rpt.]

920. Dissertation (1-9) [Rpt./] 920. Supplementary Registration (1-9) [Rpt./]

Environmental Engineering
(See Chemical and Environmental Engineering)

Epidemiology (EPI)
Arizona Prevention Center Academic Office:
AHSC Room 1115A
Phone: (520) 626-6379
FAX: (520) 626-3206
WWW: http://grad.admin.arizona.edu/idsps/epi/epi.html

Graduate Interdisciplinary Program in Epidemiology

Application Questions: epireg@u.arizona.edu, or College of Medicine/Arizona Prevention Center, Epidemiology Interdisciplinary Program, AHSC 1115A, P.O Box 245033, Tucson, Arizona, 85724-5033

Advising Questions:
Michael Lebowitz, (520) 626-6379, mlebowit@u.arizona.edu

Degrees Offered: M.S., Ph.D.

Concentrations: Infectious disease, cancer, respiratory, cardiovascular, and environmental epidemiology.

Professors: Michael D. Lebowitz, Chair (Arizona Prevention Center and Internal Medicine), Carlos C. "Kent" Campbell (Arizona Prevention Center), Stephen J. Coons (Center for Pharmaceutical Economics), Theodore M. Dembroksi (Arizona Prevention Center, Emeritus), Joe Galgiani (Medicine), Charles Gerba (Soil, Water and Environmental Science), Robert Kuehl (Agricultural and Resource Economics), C. John Mare (Veterinary Science, Microbiology and Immunology), James Marshall (Arizona Prevention Center) E. Petersen (Medicine), Charles R. Sterling (Veterinary Science), Terence Valenzuela (Surgery and Emergency Medicine)

Associate Professors: Antonio Estrada (Mexican American Studies), Larry C. Clark (Family and Community Medicine), Duane Sherrill (Arizona Prevention Center)

Assistant Professor: Antonio Estrada (Mexican American Studies/MASRC), Anna R. Guilliano (Arizona Prevention Center), Robin B. Harris (Arizona Prevention Center), Bryan Williams (Arizona Prevention Center)

Research Associate Professor: Paul Enright (Respiratory Sciences Center), D.J. Roe (Family and Community Medicine)

Research Assistant Professors: Zhao Chen (Arizona Prevention Center), M. Elena Martinez (Arizona Prevention Center), Mary Kay O'Rourke (Arizona Prevention Center), Mark A. Veazie (Arizona Prevention Center)

The graduate interdisciplinary program in epidemiology offers the opportunity for study in the scientific discipline concerned with the causes and prevention of disease in human populations. Advances in clinical medicine, laboratory science, environmental health, nutrition, statistics, computer data processing, and the basic understanding of the pathogenesis of disease enable epidemiology researchers to better examine causes of disease and to evaluate more effective strategies for disease prevention and control.

Multidisciplinary collaborations between program faculty and members of university departments, state and national health institutions provide classroom and community training opportunities. To accomplish this goal, faculty program from several health science departments members with overlapping expertise have been selected to direct courses and research.

Degrees: The graduate program in Epidemiology offers a major in epidemiology for the Master of Science and Doctor of Philosophy degrees, and a minor in epidemiology for the Ph.D. degree. A qualifying examination is required of all students. The M.S. requires a thesis.

Admission Requirements: Applicants are required to have an undergraduate degree and a 3.2 GPA or above in the last 60 units (2 years) of course work; all their transcripts should be submitted. Applicants are required to have at least one year each of biology and physical sciences and one year of college mathematics (calculus for Ph.D. applicants).

546. Biobehavioral Approaches to Cardiovascular Health & Illness (3) [Rpt./] I II The course has two major themes: a) biobehavioral antecedents of cardiovascular-related diseases and b) biobehavioral interventions in the prevention and management of these diseases. Included will be lifestyle (e.g. diet, exercise, smoking), individual characteristics (e.g. psychosocial traits, personality, and differences in physiological reactivity), social, environmental and stress-related factors (e.g. SES, occupation, ethnicity, social support, and quality of life). All of these factors have received epidemiological research attention. The course is designed to give a scientific overview and status evaluation of biobehavioral accomplishments, opportunities and future directions for research and clinical application within these categories. Some areas will receive more coverage than others depending on the quality of the scientific work available and the interests of the students. (Identical with PHL 546, PSC 546).

573a. Basic Principles of Epidemiology (3) [Rpt./] I II P, EPI major or minor, MPH major, or consent of instructor (Identical with PHL 573a).


573c. Advanced Epidemiology (3) I II P, EPI 573a, EPI 575b, EPI 576a, EPI 576b and advanced standing. (Identical with PHL 573c).


576b. Biostatistics for Research (3) I II Descriptive statistics and statistical inference relevant to biomedical research, including data analysis, regression and correlation analysis, analysis of variance, survival analysis, biological assay, statistical methods for epidemiology, and statistical evaluation of clinical literature. P, EPI 576a or PHL 576a. (Identical with PHL 576b).

576c. Applied Biostatistic Analysis (3) [Rpt./] I II Integrates methods in biostatistics (EPI 576a, b) and epidemiology (EPI 573a, 573b) to develop analytical skills in an epidemiological project setting. P, EPI 576a, EPI 576b, EPI 573a, EPI 573b or consent of instructor. (Identical with PHL 576c).

594. Practicum (1-5) [Rpt./] II

599. Independent Study (1-5) [Rpt./] II

615a. Cancer Epidemiology and Prevention (3) I P, EPI 573a (Identical with PHL 615a, CBIO 615a, RONC 615a).

615b. Cancer Control (3) II P, EPI 615a, EPI 573a. (Identical with PHL 615b, RONC 615b).

640. Psychosocial Epidemiology (3) II P, EPI 573a and EPI 573b. (Identical with PHL 640).

660. Infectious Disease Epidemiology (3) II Introduction to epidemiologic methods used in infectious disease investigations. Emphasis
Retaining and Consumer Studies: Kenneth Gehrt, (520) 621-1295, gehrt@ag.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: Soyeon Shim, Interim Director, Rodney M. Cate, Victor A. Christopherson (Emeritus), Oscar C. Christensen (Emeritus), Roger J. Daidrup (Emeritus), Kathryn L. Hatch, Jean Ruley Kearns (Emerita), Amy Jean Knorr (Emerita), Doris E. Manning (Emerita), Naomi A. Reich (Emerita), Robert R. Rice (Emeritus), Carl A. Ridley, Michael Rohrbaugh, David C. Rowe

Associate Professors: Bonnie Barber, Mary Ann Eastlick, Wendy Gamble, Kenneth C. Gehrt, Ellen Goldsberry, Donna R. Iams, Maureen E. Kelly, Roger M. Kramer, Philip J. Lauver (Emeritus), Mary H. Marlon (Emerita), Betty J. Newlon (Emerita), Angela Taylor, Mari S. Wilhelm

Assistant Professors: David Almeida, Donna H. Christensen, Sherry Lotz, Jennifer Maggs, Susan B. Silverberg

Extension Specialists: Sherry L. Betts, Shirley Jo Taylor

Research Scientists: Maria Teresa Velez

Adjunct Professor: Shirley O'Brien

Adjunct Instructor: Ruth Ann Fowler

The School of Family and Consumer Resources offers programs leading to the following graduate degrees: Master of Science with a major in family and consumer resources with concentrations in family studies, family and consumer sciences education, retailing and consumer studies, and Doctor of Philosophy with a major in family and consumer resources and a concentration in family studies emphasizing interpersonal relationships, human development, or family economics/consumer resource management; or a concentration in retailing and consumer studies emphasizing retailing or consumer studies. All applicants are required to submit scores on the aptitude test of the Graduate Record Examination, three letters of reference, and a statement of academic and professional goals.

A minor in family and consumer sciences education is available for doctoral students with majors in other disciplines.

Family Studies (FS)

Family studies involves the scientific study of family structures, interactions, and outcomes, emphasizing change over time in individual, interactional, and group level phenomena. Emphases are available in interpersonal relationships and human development.

When students are accepted into the concentration in family studies within the family and consumer resources major for the Ph.D., it is assumed that they have the ability and interest to pursue the doctoral degree. Students are expected to meet all university requirements for doctoral studies with a major concentration in family studies and a minor from an area outside of the School of Family and Consumer Resources. Contact the Division of Family Studies for specific degree requirements.

Retailing and Consumer Studies: Kenneth Gehrt, (520) 621-1295, gehrt@ag.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: Soyeon Shim, Interim Director, Rodney M. Cate, Victor A. Christopherson (Emeritus), Oscar C. Christensen (Emeritus), Roger J. Daidrup (Emeritus), Kathryn L. Hatch, Jean Ruley Kearns (Emerita), Amy Jean Knorr (Emerita), Doris E. Manning (Emerita), Naomi A. Reich (Emerita), Robert R. Rice (Emeritus), Carl A. Ridley, Michael Rohrbaugh, David C. Rowe

Associate Professors: Bonnie Barber, Mary Ann Eastlick, Wendy Gamble, Kenneth C. Gehrt, Ellen Goldsberry, Donna R. Iams, Maureen E. Kelly, Roger M. Kramer, Philip J. Lauver (Emeritus), Mary H. Marlon (Emerita), Betty J. Newlon (Emerita), Angela Taylor, Mari S. Wilhelm

Assistant Professors: David Almeida, Donna H. Christensen, Sherry Lotz, Jennifer Maggs, Susan B. Silverberg

Extension Specialists: Sherry L. Betts, Shirley Jo Taylor

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Family Studies (FS)

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When students are accepted into the concentration in family studies within the family and consumer resources major for the Ph.D., it is assumed that they have the ability and interest to pursue the doctoral degree. Students are expected to meet all university requirements for doctoral studies with a major concentration in family studies and a minor from an area outside of the School of Family and Consumer Resources. Contact the Division of Family Studies for specific degree requirements.

503. Advanced Adolescent Development (3) (identical with ED P 503, which is home).

505. Theories of Counseling (3) S Graduate-level requirements include an additional research paper dealing with a theoretical aspect of Adlerian psychology.

507a-507b. Research Methods in Family Studies (3-3) I II 507a: Design issues of general relevance to behavioral research. 507b: Design issues of particular relevance to family and developmental research.

509. * Occupational Family and Consumer Sciences Program (3) I Identifying, packaging, and applying professional knowledge and skills to achieve satisfying lives as Family and Consumer Science professionals while balancing family, home, work, and community outreach. Graduate-level requirements include developing two evaluation instruments (one affective and one psychomotor) and developing two sets of teaching materials, e.g., a job training manual.


515. * The Design of the Mind: Genes, Adaptation, and Behavior (3) I (Identical with PSYC 515, which is home).

528. * Professional Presentations and Techniques (3) I II Theory and practice of educational techniques in non-formal settings in positions in business, government and human services. Graduate-level requirements include a paper and a 30 to 45-minute presentation on a topic from the outline. In addition, graduate students must design an educational program tailored to their interest.

537. Statistical Analysis of Family Studies and Human Development (3) I An analysis of major research strategies, statistical analysis; critical resources relevant to quantitative research, and ethical/professional issues related to the conduct of research. P, consent of instructor.

539. * Non-Formal Education (3) I (identical with A ED 539, which is home).

546. Foundations of Family and Interpersonal Theory (3) I Analysis of theories relevant to family behavior including formation, development and internal processes. Course will focus on developing
knowledge of world views, assumptions, themes, concepts, and interrelationships of theories. P, 6 units of FS, PSYC, or SOC.

547. * Advanced Human Development (3) I
In-depth examination of various dimensions of human growth and development.
Graduate-level requirements include additional assignments. P, consent of instructor.

557. Methods in Marital Therapy (3) I
Theories and principles of counseling for premarital, marital, and group counseling situations.

558. * Violence and Youth (3) I (Identical with PSYC 558, which is home).

567. * Genetic Basis of Normal and Deviant Traits (3) II
In-depth examination of various dimensions of human growth and development.
Graduate-level requirements include extra required readings and an in-depth term paper.

573. Applications of Family and Interpersonal Theory (3) II
Identification of current issues in family and interpersonal relationships and the application of selected theories and research to the analysis of the issues. P, 6 units of FS, PSYC, or SOC.

577. Trends in Human Relations (3) I
Philosophy, content, and resources for understanding, teaching and working in the field of human relations.

691. Preceptorship (1-8) [Rpt./]
693. Internship (1-12) [Rpt./]
694. Practicum (1-6) [Rpt./]
696. Seminar

e. Ethics and Professional Practice (3) I P, FS 644, FS 622, FS 601.

699. Independent Study (1-5) [Rpt./]
900. Research (2-8) [Rpt./]
909. Master’s Report (1-6) [Rpt./]
910. Thesis (1-6) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Family and Consumer Resources (FCR)

565. * Women in International Development (3) II (Identical with ANTH 565, which is home).

593. Internship (1-3) [Rpt./] II
594. Practicum (1-4) II
597. Workshop

g. Instructional Advances in Vocational/Technical Education (1-3) [Rpt./12 units] (Identical with A ED 597g, which is home).
t. Instructional Advances in Non-Formal Education (1-3) [Rpt./12 units] (Identical with A ED 597t, which is home).

599. Independent Study (1-3) [Rpt./]
607. Topics in Family Studies (1-3) [Rpt./12 units] II Variable content: cognitive development, biological theories of development, role theory, middle childhood, and others.

610. Studies in Family and Consumer Sciences Education (3) I Study and analysis of research literature, methods, techniques, and procedures for conducting investigations, selecting and developing plans for research problems.

613. Family Issues in Aging (3) II (Identical with GER 613, which is home).

622. Appraisal of the Individual (3) I
Methods of appraising and reporting individual behavior, with emphasis on nonpsychometric data.

636. Economics of Aging (3) I (Identical with GER 636, which is home).

637. Trends in Human Relations (3) I
Philosophy, content, and resources for understanding, teaching and working in the field of human relations.

691. Preceptorship (1-8) [Rpt./] II
693. Internship (1-12) [Rpt./]
694. Practicum (1-6) [Rpt./]
696. Seminar

e. Ethics and Professional Practice (3) I P, FS 644, FS 622, FS 601.

699. Independent Study (1-5) [Rpt./]
900. Research (2-8) [Rpt./]
909. Master’s Report (1-6) [Rpt./]
910. Thesis (2-6) [Rpt./]
920. Dissertation (1-4)
930. Supplementary Registration (1-9) [Rpt./]

Retailing and Consumer Studies (RCS)

S. Shim, Division Chair

The Master of Science with a major in family and consumer resources, and a concentration in retailing and consumer studies is available. Students are required to complete 34 units including statistics and research methods, and 6 units of thesis. The major components of the course include retail management and consumer studies. This program prepares students for pursuing a doctoral degree or for employment in retail firms, consumer service firms, teaching at the secondary-school, community college, and university levels.

The doctoral program in retailing and consumer studies prepares students for faculty positions in higher education and for research positions in government and private industry. The program requires the completion of a minimum of 66 credit hours and is built around a research mentoring program.

Contact the Division of Retailing and Consumer Studies for specific degree requirements.

524. * Services Retailing (3) II An in-depth exploration of the marketing of profit-centered services to consumers, highlighting the distinct characteristics of services as compared to physical goods, and the special challenges posed by those characteristics. Strategies employed by service firms to effectively address these special conditions will be studied. P, MKTG 361. Graduate level requirements include an in-depth research paper or project.

534. * Nonstore Retailing (3) II Application of retail planning and control procedures with emphasis on development and evaluation of retail practices and strategies using the case method. P, MKTG 361. Graduate-level requirements include an in-depth research paper or project.

546. * Global Retailing (3) I Analysis of international market environment and retailing structure, system, issues and trends in the global market, understanding global consumers and developing retail strategies. P, RCS 114, MKTG 361; or CR, MKTG 361. Graduate level requirements include an in-depth research paper or project.

555. Visual Merchandising and Display (3) I S All aspects of displaying merchandise, including window display, interior display, color and lighting techniques, line and composition, three-dimensional presentation, fixtures and systems, planning and layout. P, RCS 115 or ART 101.
606. Advanced International Consumption and Retailing (3) I Analysis of major retailers’ strategies; retailing environments in specific regions of the world. Implementation of international strategies utilizing the case methods. P, RCS 446 or equivalent.

607. Topics in Merchandising and Retailing Methods. P, RCS 446 or equivalent.

614. Non-Store Retailing (3) I Investigation of retailing that does not involve conventional store facilities, including catalog retailing, telemarketing, and home shopping. Various aspects of management and strategic development of non-store retailing operations. P, or CR, MKTG 400; MKTG 361.

624. Advanced Services Retailing (3) I Investigation of retailing that involves the sale of services to the ultimate customer as well as the customer-service aspect of product retailing. Examines various aspects of management and strategy development in services retailing. P, or CR, MKTG 400; MKTG 361.

634. Retail Merchandising Analysis (3) I Analysis of research and case studies related to retail management and planning issues. Topics covered include theories of institutional change, consumer patronage behavior, strategic planning, store atmosphere, retailer information systems, merchandise planning, control, distribution, and buying, pricing, location, and customer support services. P, or CR, MKTG 400; MKTG 361.

656. Consumer Socialization (3) S Analysis of the process by which consumers acquire consumption-related skills, cognition, knowledge, attitudes, and behavior from a life-cycle perspective.

676. Theoretical Application in Retail Management (3) I Analysis of theoretical applications in retail management focusing on particular issues in retail management and consumer studies.

Finance (FIN)
McClelland Hall, Room 315L
Phone: (520) 621-7554
FAX: (520) 621-1261
WWW: http://www.bpa.arizona.edu/~finhome/main.html

Application Questions:
Lori Magloire, (520) 621-7554, lmagloire@bpa.arizona.edu

Advising Questions:
Mike Weisbach, (520) 621-1908

Degrees Offered: Ph.D. (major in Management)

Professors: Chris Lamoureux, Head, Willard T. Carleton, Edward A. Dyl, Nestor R. Roos (Emeritus), Michael Weisbach

Associate Professors: Erich K. Bleck (Emeritus), Joseph S. Gerber (Emeritus)

Assistant Professors: Walid Busaba, Laurie Krigman, Charles Schnitzlein, Jose Suay

The department participates in the programs leading to the Master of Business Administration and the Doctor of Philosophy degree with a major in management. For information concerning these degrees, see Requirements for Master’s Degrees/Master of Business Administration and the headnotes of Business Administration elsewhere in this Catalog.

For admission, the applicant is expected to have completed undergraduate work in managerial accounting, economics, finance, marketing, organizational behavior, production, business policy, statistics, and mathematics through calculus (MATH 119 and 123). A score on the Graduate Management Admissions Test in the 70th percentile or above, and an academic average of B or better, are required for admission consideration.

510. Managerial Finance (3) I II Integration of the basic principles and underlying theory of finance, with emphasis on the analytical financial management of business firms and other organizations. P, ACC 550.

512. Advanced Corporation Finance (3) II Financial theory applied to capital structure; investment decisions; corporate valuation; and corporate financial policies. P, FIN 412 or FIN 511.


518. Investment Banking (3) I Examines the role of financial institutions and economic activities. In-depth evaluation analysis recognizing that the value of assets may depend on who controls them. P, FIN 511.


528. Topics in Public and Nonprofit Financial Management (3) I II P, PA 508; FIN 511. (Identical with PA 528, which is home).


536. New Venture Finance (3) I Role of entrepreneurship and innovation in economic growth. Development of new venture ideas and assessment of financial requirements and potential. P, ECON 500, FIN 511. Open only to students in the entrepreneurship program.

537. Finance for New Ventures (3) I Value maximization; simulation of value distribution; sources of venture capital; timing of initial public offering; new venture ownership structuring. Open only to students in the entrepreneurship program. P, FIN 511, MKTG 500. (Identical with MAP 537).

539. Planning of New Ventures (3) II P, ECON 500a, ECON 500b, FIN 511, MKTG 500. (Identical with MAP 539, which is home).


599. Independent Study (1-4) [Rpt./]


601. Financial Decision Making Under Uncertainty (3) II Theoretical and applied financial economics relating to uncertainty in markets, information, and choice.


695. Colloquium
a. Investments (1-3) [Rpt./ 15 units] I II

696. Seminar
a. Investments (3) [Rpt./ 1] I II
b. Financial Markets (3) [Rpt./ 1] I II
c. Taxation (1-3) I II (Identical with ACCT 696c, which is home).
French and Italian (FREN / ITAL)
Modern Languages Building, Room 549.
Phone: (520) 621-7349
FAX: (520) 626-8022
WWW: http://www.coh.arizona.edu/french/french.html

Application Questions:
Lise Leibacher, (520) 621-7349,
lleibach@u.arizona.edu

Advising Questions:
Lise Leibacher, (520) 621-7349,
lleibach@u.arizona.edu

Degrees Offered:
M.A., Ph.D.

Concentrations: French literature and culture (from the Middle Ages to the 20th century), francophone literature (Belgium, Black Africa, Maghreb, Quebec), creative writing, critical theory, women's studies, applied linguistics, and second language acquisition and teaching.

Professors: Robert M. Gimello, Head, Robert A. Ariew, Jonathan Beck, Frank M. Chambers (Emeritus), Ronnie Terpening, Monique Wittig

Associate Professors: Edward G. Brown (Emeritus), Irene A. d’Almeida, Ingeborg M. Kohn (Emerita), Lise Leibacher, Reginald McGinnis, Henri Servin (Emeritus), Gianni Spera

Assistant Professors: Fabian R. Alfie, Dalila Ayoun, Teresa L. Picarazzi

Lecturers: Gerard Agnieri, John L. Gesell, Jean Goetinck, S. Prosper Sanou, Elizabeth Zegura

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in French. A doctoral minor is available in French. The department also cooperates with the University of Arizona Center for Medieval and Renaissance Studies.

Admission to graduate programs in French requires the completion of a bachelor's degree with a major in French. Admission to a doctoral program is dependent upon the completion of a Master of Arts degree with a major in French. Students with a master's degree from another institution must take a qualifying examination during the first two weeks of residence.

Master of Arts (Major in French): Students must complete at least 30 units of course work. A thesis option is available. Concentrations are available in literatures in French (which may include French and Francophone literature), and literature/ pedagogy. Candidates must pass a final written and oral examination.

Doctor of Philosophy: The major in French consists of a minimum of 50 units of graduate course work in the department in addition to the dissertation. The minor, consisting of 12 or more units, may be taken within the department or in a field approved by the department. All students are required to demonstrate knowledge in another foreign language. After successful completion of the written and oral comprehensive examination, each candidate will write and defend a doctoral dissertation.

French (FREN)
500. French for Reading (1) II A one-semester course that permits rapid acquisition of reading skills. Even with no prior study of French, students are able to read and understand materials written in French in the standard literature and professional journals of their field of interest by the end of a semester. This course does not count toward a graduate program of study.

510. Introduction to Graduate Study in French Language and Literature (3) I Problems and methods of advanced research in French language and literature. Use of specialized library resources and computerized data bases. Issues in the history, sociology, and politics of the professional practice of language and literature study in American universities. Taught in English or French.

511. Topics in Literary History, Criticism, and Theory (3) [Rpt./ 3] II Current, recent, and traditional ways of analyzing and interpreting literary texts and the cultural contexts in which they are produced, with emphasis on French and attention to understanding various means by which knowledge of literary issues is transmitted to others. May be repeated when topics vary.

512. Introduction to the History of the French Language (3) I Taught in English.

516. Literature of the 16th Century (3) [Rpt./ 1] I II Studies in the French Renaissance, including theater, fiction, poetry, essay. Analysis of the main literary, artistic, and socio-cultural movements in France during the 16th century. P, graduate status.

517. Literature of the 17th Century (3) [Rpt./ 1] I II Main literary movements in France during the 17th century. Theater, poetry, novel, philosophical thought. Cultural context: architecture, painting, religious currents, philosophy. P, graduate status.

518. Literature of the 18th Century (3) [Rpt./ 1] I II Studies in the French Enlightenment, including theater, fiction, and essays. Analysis of the main literary, artistic, and socio-cultural movements in France and in Europe during the 18th. P, graduate status.

519. Literature of the 19th Century (3) [Rpt./ 1] I II Examines various aspects of literary works ranging from poetry, the theater, the novel and critical essays. Studies in French Romanticism and Realism. P, graduate status.

520. Literature of the 20th Century (3) [Rpt./ 1] I II Studies in contemporary French literature, including theater, fiction, poetry, essays. Analysis of the main literary, artistic, and socio-cultural movements in France during the 20th century. P, graduate status.

548. *The Theory and Practice of Writing (3) I An experiment in writing, concerning the means, the raw material at our disposal, and the different literary devices that allow us to achieve it. French students will write in French and English students will write in English. Graduate-level requirements include more theoretical readings and assignments. (Identical with ENGL 548).

550. French Literature of Black America and the Caribbean (3) I Graduate-level requirements include more demanding readings and assignments.

552. *French Literature of Quebec (3) II Comprehensive study of the most significant literary expression in Quebec. P, FREN 350. Graduate-level requirements include more demanding readings and assignments.

553. Culture and Civilization of North Africa (3) I II Historical, religious, social, literary and artistic influences on the civilization of North Africa. Graduate-level requirements include more demanding readings and assignments. Taught in English.

554. *Francophone Literature of the Maghreb and Lebanon (3) II Francophone literature of Algeria, Lebanon, Morocco and Tunisia. P, FREN 350. Graduate-level requirements include more demanding readings and other assignments. P, graduate status.
Italian (ITAL)

500a-500b. * Main Currents of Italian Literature (3-3) 1-II 500a: The Middle Ages and Renaissance. 500b: The 17th through 20th Centuries. Counts toward the major or minor in Italian or Italian Studies. Taught in Italian. Graduate-level requirements include more demanding readings and other assignments. P, 202.

599. Independent Study (1-4) [Rpt./]

696. Seminar
a. Italian Literature (3) [Rpt./] I II

General Biology (GBIO)

Biological Sciences West, Room 270
Phone: (520) 621-5903
FAX: (520) 621-9288
WWW: http://biology.arizona.edu/sciconn/

Initial Application Coordinator: Ellie Warder, (520) 621-5093, warder@u.arizona.edu
Advising Questions: Lisa Elfring, (520) 621-1671, elfring@u.arizona.edu
Degrees Offered: M.S. (This degree program is restricted to secondary school biology teachers.)

Professors: Michael A. Wells (Biochemistry) Associate Professors: William J. Matter (Wildlife and Fisheries Science) Assistant Professors: Lucinda A. McDade (Ecology and Evolutionary Biology)

The Departments of Biochemistry, Ecology and Evolutionary Biology, and Molecular and Cellular Biology offer a program leading to a Master of Science degree with a major in general biology. This program is designed for middle and high school teachers who desire advanced, specialized training in biological sciences to enhance their classroom teaching methods.

The Master of Science in General Biology degree is a summer-oriented, 32-unit program of course work and research units. Participants usually complete their degree requirements in a 4-year period; most course work is taken in the summers. The curriculum consists of: Biology Update I (BIOC 623a), Biology Update II (BIOC 623b), Secondary Biology Laboratory Curricula (BIOC 633), Biology Lesson Development (BIOC 643), Workshop Development and Presentation (BIOC 691a), and electives, independent study, research, and thesis units.

Participants take 6 units of graduate electives in the biological sciences and an additional 3 units in any approved science, math or education course. A maximum of 3 units of BIOC 597c may be used to fulfill the elective requirements. 6 units of research are required, 4 of which must be in a biology field; the other 2 units may be in biology, science education, or science issues.

Participants take 3 units of independent study: 1 unit to follow up on course work resulting from BIOC 633; 1 unit to prepare for research units; and 1 unit for the purpose of field testing lessons developed through research and BIOC 643. A 1-unit preceptorship (BIOC 691a) to disseminate scientific knowledge, curriculum materials and teaching approaches among the participants' peers is required, along with a written thesis, an oral presentation at a regional convention for science teachers, one or more poster presentations, and a final oral examination over the thesis. For course descriptions, see Biochemistry (BIOC) course listings elsewhere in this Catalog.

Applicants are required to submit a completed program application (available in the General Biology Program Office located in the Department of Biochemistry) and official transcripts of all college work. Applications are due on March 1 each year for summer admission. Students usually are not admitted in the Fall and Spring semesters. Applicants must have a minimum of 1 year's classroom teaching experience at the high school or middle school level. In addition, applicants must have completed a minimum of 18 units of college-level biology course work with a grade-point average of 3.0 or higher.

Genetic Counseling
(See Genetics)

Genetics (GENE)

Bio Sciences West, Room 220
Phone: (520) 621-7511
FAX: (520) 626-5097
WWW: http://eebweb.arizona.edu/genet/genweb
Graduate Interdisciplinary Program in Genetics

Application Questions: Karen Hill, (520) 621-7511, khill@u.arizona.edu
Advising Questions: Bill Birky, (520) 626-6513
Degrees Offered: M.S., Ph.D.

Professors: Bill Birky (Ecology and Evolutionary Biology) Chair, Murray Brilliant (Pediatrics) Danny L. Brower (Molecular and Cellular Biology), Vicki Chandler (Plant Sciences), Sue K. DeNiSe (Animal Sciences), Robert P. Erickson (Pediatrics, Molecular and Cellular Biology), Christina K. Kennedy (Plant Pathology, Molecular and Cellular Biology),
Margaret G. Kidwell (Ecology and Evolutionary Biology), Brian A. Larkins (Plant Sciences), John W. Little (Biochemistry), Robert G. McDaniel (Plant Sciences), Neil H. Mendelson (Molecular and Cellular Biology), Richard E. Michod (Ecology and Evolutionary Biology), Nancy Moran (Ecology and Evolutionary Biology), David W. Mount (Molecular and Cellular Biology), Howard Ochman (Ecology and Evolutionary Biology), David C. Rowe (Family and Consumer Resources), Hans VanEtten (Plant Pathology), Samuel Ward (Molecular and Cellular Biology)

Associate Professors: Rodney Adam (Microbiology/Immunology), Alison E. M. Adams (Molecular and Cellular Biology), Christopher Cunniff (Pediatrics), Carol L. Dieckmann (Biochemistry), Kenneth A. Feldmann, (Plant Sciences), Jennifer D. Hall (Molecular and Cellular Biology), Michael Hammer (Ecology and Evolutionary Biology), Richard Jorgensen (Plant Sciences), Lynn J. Manseau (Molecular and Cellular Biology), Wayne L. Nicholson (Veterinary Sciences), Marc J. Orbach (Plant Pathology), Roy Parker (Molecular and Cellular Biology), Leland Pierson III (Plant Pathology), Dennis T. Ray (Plant Sciences), Linda L. Restifo (Neurobiology / Neurology), Steven E. Smith (Plant Sciences), J. Bruce Walsh (Ecology and Evolutionary Biology)

Research Associate Professors: John Meaney (Pediatrics)

Assistant Professors: Qin Chen (Pharmacy/Toxicology), Jesse Martinez (Radiation/Oncology), Michael Nachman (Ecology and Evolutionary Biology), Scott B. Selleck (Neurobiology, Molecular and Cellular Biology)

Research Associate Professor: John Meaney

Clinical Assistant Professor: Randall A. Heidenreich (Pediatrics)

The program offers an M.S. degree in Genetic Counseling and a Ph.D. in Genetics.

501. Molecular and Medical Genetics (3) I (Identical with PED 501, which is home).

509. Statistics for Research (4) I II (Identical with MATH 509, which is home).

512. Medical Ethics (1) [Rpt./ 9] I II Ethical issues in genetic counseling, genetics testing and gene therapy. The student will prepare a paper suitable for publication on a selected topic.

513. Quantitative Genetics (3) I P, 6 units of genetics. (Identical with ANS 513, which is home).

516. Bioinformatics and Genomic Analysis (3) II (Identical with MCB 516, which is home.)

520. History of Genetics (1) I Experiments and discoveries which have led to the present state of knowledge in the various areas of genetics. P, ECOL 320 or ECOL 321.

524. Theoretical Population Genetics (3) I (Identical with ECOL 524, which is home).

526. Population Genetics (3) II (Identical with ECOL 526, which is home.)

528. Microbial Genetics (3) II (Identical with PL P 528, which is home).

533. Human Genetics (3) I Genetic theory and technique, as applied to man; methods of analysis of genetically determined cytological and biochemical differences in individuals and populations. 2R, 3L, P, ECOL 320. (Identical with ECOL 433). Graduate-level requirements include an in-depth research paper on a current problem in human genetics. P, ECOL 320 or ECOL 321. (Identical with ECOL 533).

535. Evolution II (4) I (Identical with ECOL 535, which is home).

545. Concepts in Genetic Analysis (3) I P, introductory undergraduate genetics course or biology course. (Identical with MCB 545, which is home).

555. Molecular Mechanisms of Development (3) II P, MCB 568, MCB 545, or consult department before enrolling. (Identical with MCB 555, which is home).

568. Nucleic Acid (4) I P, BIOC 411 or BIOC 511, consent of instructor. (Identical with BIOC 568, which is home).

570. Molecular Genetics and Evolution (3) I (Identical with MBIM 570, which is home).

574. Advances in Mammalian Genetics (2) [Rpt./ 1] I P, undergraduate courses in genetics and molecular biology. (Identical with BIOC 574, which is home).

581. Genetic Counseling (2) [Rpt./ 7 units] I II Principles of genetic counseling, general topics related to issues raised during genetic counseling (such as coping with chronic illnesses), and specific genetic counseling issues related to unique disorders encountered in the genetics clinic and other genetic counseling situations. Such disorders include prenatals, pediatric and adult genetic conditions. P, limited to students in the genetic counseling training program except by consent of instructor.

589. Cancer Genetics (3) [Rpt./ 1] I P, ECOL 320, MCB 320. (Identical with CBIO 589, which is home).

595. Colloquium

a. Genetics (1) [Rpt./ 1] I II

596. Seminar

b. Topics in Genetics and Evolution (1) [Rpt./ 2] I P, consent of instructor. (Identical with ECOL 596G, which is home).

c. Rounds (1) [Rpt./ 6 units] I II P, Limited to students in the genetic counseling training program except by consent of instructor.

599. Independent Study (1-6) I II

601. Molecular and Cellular Biology (4) I Provides a basic understanding of modern genetics, molecular biology and cell biology, and how to apply that understanding to human disease. P, open to students in the Master's degree program in Genetics Counseling only.

627. Advanced Genetics (3) I II P, PL S 312 or ECOL 320. (Identical with PL S 627, which is home).

666. Human Microevolution (3) [Rpt./ 1] II P, ANTH 665. (Identical with ANTH 666, which is home).

670. Recent Advances in Genetics (2) [Rpt./ 4] I Recent advances in the field of genetics. (Identical with ECOL 670).

695. Colloquium e. Science, Society, and Ethics (1) II (Identical with MCB 695E, which is home).

699. Independent Study (1-4) [Rpt./ ]

900. Research (1-8) [Rpt./ ]

910. Thesis (1-8) [Rpt./ ]

920. Dissertation (1-9) [Rpt./ ]

930. Supplementary Registration (1-9) [Rpt./ ]

**Geography and Regional Development (GEOG)**

Harvill Building, Room 409
Phone: (520) 621-1652
FAX: (520) 621-2889
WWW: http://climate.geog.arizona.edu/...web/

Application Questions: Linda Koski, koski@geog.arizona.edu
Advising Questions: Brigitte Waldorf, (520) 621-7486, waldorf@geog.arizona.edu

Degrees Offered: M.A., Ph.D.

Concentrations: Optional specialized tracks are available in regional development, physical geography, and critical human geography for the M.A.

Professors: Michael E. Bonine (Near Eastern Studies), Terence Burke, Robert D. Carpenter (Emeritus), Lay J. Gibson, Diana Liverman, Lawrence D. Mann (School of Planning), Janice J.
At the master's level, the department offers programs leading to the Master of Arts with a major in geography. The department also offers courses in regional planning leading to the Master of Science degree through the program in Planning. At the doctoral level, the department offers programs leading to the Doctor of Philosophy degree with a major in geography. Students pursuing a doctoral degree in other departments may elect the Ph.D. minor in geography. All applicants are required to submit scores on the verbal, quantitative, and analytical sections of the Graduate Record Examination, as well as complete transcripts, three letters of recommendation, and a statement of purpose. Students in their final year of an M.A. degree in the Department who wish to continue in the Ph.D. program must submit a new statement of purpose and three letters of recommendation from the student's M.A. committee members to the departmental Graduate Admissions Committee.

Master of Arts: A minimum of 33 units of graduate credit are required, to include (1) a core of 9 units consisting of 500, 657 or 658, and 689; (2) a minimum of 12 units of graduate work in geography exclusive of both core and thesis, at least 6 of which must be in courses or seminars exclusive to graduate students (i.e., not jointly convening 400/500-level courses, and not independent studies); and (3) an additional 9 units of approved electives, which may include up to 6 units of thesis, which is optional. In addition, students are required to register for 1 unit of 695a colloquium each semester they are in residence. Students electing the non-thesis option must pass a written and oral comprehensive examination. Students electing the thesis option must pass a final oral examination.

Master of Science (major in Planning): The department cooperates with the University's program in Planning in offering courses for students seeking professional preparation for careers in planning for urban and rural regions. For further information, see Planning elsewhere in this Catalog.

Doctor of Philosophy: Doctoral students must complete the requirements for the master's degree plus a minimum of 18 units in geography (exclusive of the dissertation) of which at least 12 units must be in courses or seminars exclusive to graduate students (i.e., not convening 400/500-level courses, and not independent studies) plus 1 unit of 695a colloquium during each semester they are in residence. Doctoral students must also achieve high-level competence in either (a) one topical and one areal field, or (b) two topical fields. Students will ordinarily complete a minimum of 6 units in each field of proficiency. Topical and areal proficiencies include those officially listed by the Association of American Geographers and for which there is a departmental faculty member who possesses such proficiency. Doctoral students must also demonstrate proficiency in at least one research tool. Doctoral students who propose to undertake research in or on a non-English speaking area are required to demonstrate the necessary language skills before taking the comprehensive examination. The minor(s) must be complementary to the student's program of specialization and is subject to the approval of the student's mentor and the Director of Graduate Studies.

Ph.D. Minor in Geography: Students who elect a minor in geography must complete a minimum of 12 units of coursework in geography, including one core course (500, 657, or 658, 689) and a maximum of 3 units of independent studies. The course work must be pre-approved by the Director of Graduate Studies. Doctoral students considering the minor in geography should consult the Director of Graduate Studies and potential committee members at an early date.

501a-501b. Introduction to Planning (3-3) I-II (Identical with PLN 501a-501b, which is home).

505. Principles of Economic Geography (3) II Survey of micro- and macro-level theory in economic geography, location theory, central place theory, spatial behavior and interaction, development issues, impact models, and project evaluation.

507. * The American Landscape (3) Origin and character of the visual aspects of places viewed individually and regionally; changes in habitat, vernacular structures and landscapes, townscape, country sides and special features. Graduate-level requirements include the completion of an essay and annotated bibliography on the work of a specific scholar, place, or region. (Identical with LAR 507).

508. * Arizona and the Southwest (3) I Origin and character of the visual aspects of places viewed individually and regionally; changes in habitat, vernacular structures and landscapes, townscape, country sides and special features. Graduate-level requirements include the completion of an original research paper on an approved topic.

509. Russia and the Former Soviet Union (3) II Graduate-level requirements include two research projects.

510. Planning in the Americas: Past, Present and Future (3) I, open to majors only. Credit allowed for only one of these courses: PLAN 510, PLAN 501. (Identical with PLN 510, which is home).

511. * Middle America (3) II Land, people, and culture in the major natural and cultural regions of Mexico, Central America, and the West Indies. Graduate-level requirements include three tutorial sessions and a research-review paper. (Identical with LA 5 511).

512. * South America (3) I Physical and cultural bases of South America's geographic patterns, with emphasis on human settlement and problems of resource development. Graduate-level requirements include three tutorial sessions and a research-review paper. (Identical with LA 5 512).

513. * Africa (3) II Physical and human bases of regional contrasts, with emphasis on tropical environmental systems and changing patterns of resource utilization and development. Graduate-level requirements include the completion and oral presentation of an original research paper on an approved topic.

514. Analytic Methods in Local Planning and Management (3) II P, MKTG 552; GEOG557 or consent of instructor. (Identical with PA 514, which is home).

515. * Introduction to Water Resources Policy (3) II (Identical with HWR 515, which is home).

516. * Geographic Information Systems for Geography and Regional Development (3) II Introduction to the use of computers for map production, with emphasis on cartographic principles and practical experience with several user-oriented mapping programs. Graduate-level requirements include the completion of a project report. (Identical with PLN 516, NNR 516).
517. * Geographic Information Systems for Natural Resources (3) II (Identical with RNR 517, which is home).

519. * Cartographic Modeling for Natural Resources (3) I (Identical with RNR 519, which is home).

520. * Advanced Geographic Information Systems (3) II (Identical with RNR 520, which is home).

522. * Resource Mapping (3) II (Identical with RNR 522, which is home.)

530. * The Climate System (3) I Systematic examination of processes and circulations comprising Earth’s climate. Emphasis on circulations influencing geographic processes using examples of atmospheric environmental issues, P. NATS 101 or ATM 171 or GEOG 171. Graduate-level requirements include the completion of a term paper. (Identical with ARL 530, GC 530).

531. * Global and Regional Climatology (3) II Description and analysis of the atmospheric circulation process that produces differences in climates throughout the world. Emphasis on the earth’s problem climates and climatologically sensitive zones most susceptible to floods, droughts, and other environmental stresses due to global change. Graduate requirements include an additional term paper.

546. * Health and the Global Economy (3) I The interconnection of the global economy, local social structures, political economies, and health. Examines theoretical approaches and case studies as well as strategies for ameliorating ill health. Graduate-level requirements include an independent study project. May be convened with GEOG 446.

550. Metropolitan and Regional Planning (3) I (Identical with PLN 550, which is home).

554. * Locational Analysis (3) I Industrial location theory and location factors, consumer travel behavior and market areas, geography of economic impacts, location of public facilities. Graduate-level requirements include the completion of an original research paper on an approved topic. (Identical with PLN 555).

557. * Statistical Techniques in Geography, Regional Development and Planning (3) I Methods of gathering and analyzing data for the solution of geographical, urban, and regional planning problems, with emphasis on quantitative and statistical techniques used in spatial analysis and cartography, and program planning. Graduate-level requirements include the completion of several data-intensive research projects. (Identical with PLN 557).

559. * Land Use and Growth Controls (3) II (Identical with PLN 559, which is home).

560. * The State of Sonora (3) II (Identical with LA S 560, which is home.)

561. Resource Management (3) I Examination and critical appraisal of social and behavioral science aspects of resource management, with special emphasis on factors affecting decision making. (Identical with PLN 561).

563. Perception of Environment (3) II Examination of interdisciplinary research on environmental perception; consideration of social and behavioral variables at all scales of environmental perception and planning. (Identical with PLN 563).

564. The Arid and Semi-arid Lands (3) I Graduate-level requirements include the completion of an original research paper on an approved topic. (Identical with ARL 564).

565. Physical Aspects of Arid Lands (3) II Graduate-level requirements include the completion of an oral presentation of an original research paper on an approved topic. (Identical with ARL 565).

566. * The Middle Eastern City and Islamic Urbanism (3) I (Identical with NES 566, which is home).


571. * Problems in Regional Development (3) I II Regionalization and geographic scale; spatial variation and well-being and development; multiplier and analysis; demographic-economic models; theories of regional growth; regional policy. Graduate-level requirements include the completion of an original research paper on an approved topic. (Identical with AREC 571, PLN 571).

574. Introduction to Geostatistics (3) I P, linear algebra, basic course in probability and statistics, familiarity with DOS/Windows, UNIX. (Identical with MATH 574, which is home).

576. * The Land Development Process (3) [Rpt./ I] (Identical with PLN 576, which is home).

578. * Global Change (3) II (Identical with GEOGE 578, which is home).

583. * Geographic Applications of Remote Sensing (3) II Use of aircraft and satellite imagery for monitoring landforms, soils, vegetation and land use, with the focus on problems of land-use planning, resource management and related topics. Field Trips. P, 2 units of remote sensing or equivalent. Graduate-level requirements include the completion of a project report. (Identical with SWES 583, RNR 583, PLN 583.)

593. Internship (1-5) [Rpt./ I]

900. Research (2-4) [Rpt./]

909. Master's Report (3) [Rpt./ I]

910. Thesis (3-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Geological and Geophysical Engineering
(See Mining and Geological Engineering)

Geology
(See Geosciences)

Geosciences (GEOS)
Gould-Simpson Building, Room 208
Phone: (520) 621 - 6024
FAX: (520) 621 - 2672
WWW: http://www.geo.arizona.edu
Application Questions: Boyleyn Baylor, (520) 621-6004, gradinfo@geo.arizona.edu
Advising Questions:
Boleyn Baylor, (520) 621-6004, gradinfo@geo.arizona.edu

Degrees Offered: M.S., Ph.D.

Concentrations: Tectonics, geochemistry, petrology, economic geology, chemical and isotopic studies of water, geophysics, planetary geology, archaeological geology, quaternary studies, stratigraphy/paleontology


Associate Professors: Suzanne L. Baldwin, Susan L. Beck, Roy A. Johnson, Jay Quade

Assistant Professors: Robert T. Downs, Michelle Hall-Wallace

Senior Lecturer: Peter L. Kresan

Laboratory of Tree Ring Research
West Stadium Building, Room 105
(520) 621-6469

Professors: Malcolm K. Hughes, Director, Bryan Bannister (Emeritus), Jeffery S. Dean, Harold C. Fritts (Emeritus), Steven W. Leavitt, William J. Robinson (Emeritus), Charles W. Stockton, Marvin A. Stokes (Emeritus).

Associate Professors: Lisa J. Graumlich, Katherine K. Hirschboeck, Thomas W. Swetnam

The Department of Geosciences offers graduate studies leading to the Master of Science and the Doctor of Philosophy degrees with a major in geosciences.

Applicants for graduate degrees must have completed the baccalaureate with a major in geosciences or in an allied discipline. All applicants must submit their scores on the General Graduate Record Examination directly to the department and provide three letters of recommendation and a personal resume including a statement of proposed academic and research activities. Application materials are available from the department.

Master of Science: Designed to train students aspiring to professional employment in industry, government, or in the teaching profession at the community-college level. The program also serves as a foundation for graduate studies continued beyond the M.S. level, especially for those students whose M.S. research experiences are vital to their professional growth and for those who develop strong research interests and abilities. Requirements include 30 units of course work. A thesis or pre-publication manuscript is required.

Doctor of Philosophy: Designed for students who plan to work as professional geoscientists in research-oriented capacities in the academic community, industry, or government. Qualified students with a bachelor's or a master's degree may be accepted into the Ph.D. program. Requirements include 36 units of graduate credit in addition to 18 units of dissertation credit. A dissertation is required. A 5-unit minor is required in a related subject.

The Department of Geosciences focuses on research and education dealing with the nature, genesis, and history of the Earth and its crust, and with the evolution of the environment and biota at the Earth's surface. Our faculty and students are active in the following areas:

- Tectonics: structural geology and regional tectonics
- Geochemistry/petrology: isotope geochemistry, geochronology, and thermodynamics
- Economic geology: regional metallogenesis and the role of fluids in the ore genesis
- Chemical and isotopic studies of water
- Geophysics: earthquake and reflection seismology, paleomagnetism, and plate dynamics
- Planetary geology
- Archaeological geology
- Quaternary studies: geomorphology and paleoenvironmental studies
- Stratigraphy/paleontology: paleoclimatology and paleobiology

Special Research Facilities: State-of-the-art laboratory and support facilities include a Sun-based network of workstations; a new broadband seismic station; a scanning electron microscope; several mass spectrometers including the Tandem Accelerator Mass Spectrometer facility for radiocarbon analysis; X-ray diffraction and analytical facilities; a high-pressure and temperature laboratory; an SEM-EDS image analysis laboratory; and a dedicated student computer facility.

The Department of Geosciences encourages interdisciplinary approaches to research in the geosciences, both within the department and through interdepartmental programs.

500. * Introduction to Geochemistry (3) I Nuclear systematics and thermodynamics with applications to geologic processes. Graduate-level requirements include an independent research report.

501. * Earth Science Teaching Methods and Materials (3) II Instructional methods in laboratory and classroom, resources development, curriculum planning and assessment. Graduate-level requirements include two additional projects.

502a-502b. * Statistical Analysis of Geological Data (3-3) 1-1-1 502a: Application of statistical methods to the analysis and description of geologic data. Geologic similarity, estimation, classification of geologic objects, and structure of data on multiple features. Examples and case studies from major subdisciplines of geoscience. 502b: Graduate-level requirements include an additional term project on an approved topic.

503. * Physics of the Solar System (3) II (Identical with PTYS 503, which is home).

505. Applied Multispectral Imagery (3) II P, G EN 407. (Identical with G EN 505, which is home).

506L. * Conservation Biology in the Field (1) II (Identical with ECOL 506L, which is home).

506R. * Conservation Biology (3) II (Identical with ECOL 506R, which is home).

507. * Photogeology (3) I (Identical with G EN 507, which is home).

509. Advanced Petrology (3) I An advanced treatment of the topic based primarily on the principles of classical thermodynamics, reaction-, order-, disorder- and diffusion-kinetics, and heat transfer. P, GEOS 583 or consent of instructor.

510. Principles of Cosmochemistry (3) (Identical with PTYS 510, which is home).

511. * Geology of the Solar System (4) [Rpt/ 8 units] I II. (Identical with PTYS 511, which is home).

514. Late Quaternary Geology (3) I Paleoenvironment and geochronology of Late Quaternary alluvium as read from the stratigraphic records and geomorphology at key localities in North America, including selected archaeological sites. The interaction of fluvial and aeolian processes in the eastern Sahara will be evaluated using enhanced LANDSAT and Shuttle Imaging Radar. Field Trips. P, GEOS 102, GEOS 104. (Identical with ANTH 514).
516. * Field Studies in Geophysics (3) II
(Identical with G EN 516, which is home).

517. * Sedimentary Basin Analysis (3) I
Physical mechanisms of sedimentary basin formation,
including flexure, thinning and thermal contraction of the lithosphere;
isosasy; subsidence analysis; sequence stratigraphy; paleocurrents and sediment provenance;
tectonics of sedimentary basins.
Graduate-level requirements include an independent research project. P, GEOS 203 or GEOS 544.

518. * Advanced Mineralogy (3) I II
Principles of crystallography and crystal chemistry; thermodynamic and kinetic of minerals;
macroscopic treatment and atomistic basis; phase transformations;
systematic mineralogy. Graduate-level requirements include an independent research report.

519. * Physics of the Earth (3) II Fundamentals of the physics of the solid earth, including
thermodynamics, rheology, geomagnetism, gravity, and plate tectonics. Graduate-level requirements include a term paper in
publication format on some aspect of a major course topic. (Identical with PTYS 519).

520. Meteorites (3) II P, PTYS 510. (Identical
with PTYS 520, which is home).

521. * Structural Geology (4) I II Integration of geological structures created through
defomation of the Earth's crust. Emphasis on fundamental concepts and methods in
gemetric, kinematic, and dynamic analysis. Strong field component. Graduate-level
requirements include a research project.

522. Well Logging Interpretation (3) II P, consult
department before enrolling. (Identical with G EN 522, which is home).

523. * Regional Structural Geology (3) [Rpt./ 3] I Geologic mapping in a variety of
rock types and structural regimes, with
emphasis on the recognition and solution of regionally significant structural problems.
Graduate-level requirements include
additional reading assignments on structural processes and regional geology.

524. * Regional Tectonics (3) I Discussion of the geology, geophysics, petrology, and
geochemistry of different types of orogenic systems and their tectonic evolution. Methods of
tectonic regionalization and integration based on lithotectonic assemblages and terranes, and regional structural geology.
Plate tectonic regiments and kinematics. Graduate-level requirements include
additional reading assignments on structural processes and regional tectonics.

526. * Cordilleran Tectonics (3) II Geologic and tectonic evolution of the North American Cordillera based on analysis of geologic, paleomagnetic, and paleobiogeographic constraints and tectonic models. Graduate-level requirements include a final report
considering some aspect of the tectonic evolution of western North America.

527. Orogenic Systems (3) III An analysis of the geology, geophysics, and geochemistry,
and the tectonic evolution of selected world mountain systems ranging from currently active belts in both oceanic and continental
settings back through Phanerozoic, Proterozoic, and into Archean time.

528. Geologic Characteristics of Ore Occurrence (3) I Geological, geochemical and
geophysical signatures of ore occurrence at the scales of tectonic settings, provinces, districts mines. P or CR, GEOS 446 or GEOS 456.

530. * The Chemical Evolution of Earth (3) I
Chemical differentiation and evolution of Earth's mantle and crust according to major
element, trace-element and isotopic characteristics of neodymium, hafnium, strontium, lead and other isotopes. Graduate-level
requirements include an additional paper. (Identical with PTYS 530).

531. * Hydrogeology (4) I (Identical with
HWR 531, which is home).

532. * Introduction to Seismology (3-5) II Fundamentals of the generation, propagation,
and interpretation of seismic waves. Two
sections: earthquake seismology and exploration seismology. Sections meet
together for introduction then students choose one (3 units) or both (5 units) for the
remainder of the semester. Graduate-level requirements include a term paper.

533. * Mine Investment Analysis (3) I Economic factors including taxation, mineral
depletion allowance, and finance in the mining industry; includes fundamentals of
engineering economics, capital budgeting, and risk analysis. Graduate-level requirements include
an in-depth research paper on
a single aspect of mineral investment to be approved by the instructor.

535. Advanced Subsurface Hydrology (3) II P, MATH 223 or MATH 322 or MATH 422a or MATH 422b. (Identical with HWR 353, which is home).

536. Ground-Water Resource Evaluation (3) II (Identical with HWR 356, which is home).

537. * Economics of Mineral Resource Development and Production (3) II Concepts and methods of mineral econom-
ic; analyses of selected mineral and energy commodities, current economic and political
issues, and investment strategies in selected
mineral industries. Graduate-level requirements include an additional term project on
an approved topic.

538. * Biogeography (3) II (Identical with ECOL 538, which is home).

539. Analytical Methods in Geophysics (3) II Transform theory, spectral analysis, asymptotic series, special selections, probability. Applications to
gyophysical problems. P, MATH 422b.

540. * Geodynamics and Paleomagnetism (3) [Rpt./ 1] I Large-scale tectonic problems
approached by combined geophysical and
geo logic analysis in regional context.

Graduate-level requirements include a quantitative modeling project in some aspect of
tectonics and a term paper in publication
format.

541. Soil Genesis (3) II (Identical with
SWES 541, which is home).

542. Ore Deposit Petrology (3) II Orthomagnetic, porphyry base metal, skarn, and
leached capping lithologic-mineralogic studies by petrographic microscope, electron
probe, and advanced techniques.

544. Advanced Physical Sedimentology (3) II First half of course deals with the mechan-
icfs of flows and sediment transport, oscillatory and unidirectional flows, waves and
wave theory, bedforms and flow regimes, sediment gravity flows, liquefaction and fluidization.
The second half covers physical processes and facies in alluvial fan, fluvial, eolian, deltaic, nearshore, shelf, slope and
turbitide fan systems. Emphasis is on clastic systems. P, GEOS 203, MATH 254 or consent of instructor.

546. * Economic Mineral Deposits (3) II GRD Geology of metallic and nonmetallic ore
deposits. Economic considerations, processes of formation, methods of study and exploration, and description of geologic aspects and
settings of representative worldwide examples.
Field Trips, P, GEOS 304, GEOS 306. Graduate-level requirements include an
independent study project.

548. * Geophysical Exploration and Engineering (3) I (Identical with G EN 548, which is home).

549. * Mineral Exploration (3) I (Identical
with G EN 549, which is home).

550. Geomorphology (4) I Graduate-level
requirements include panel leaderships on
environmental discussions sessions, and additional lab exercise questions. (Identical with ARL 550).

552. * Strategies in Environmental Hydrogeochemistry (3) I Origin, migration, chemistry, and accumulation of petroleum; reservoir mechanics, types of traps; recovery of petroleum; oil shales and tar sands.
Graduate-level requirements include a term paper regarding some aspect of a major
course topic.

553. * Glacial and Quaternary Geology (3) I Glacial processes, landforms, and deposits.
Physical aspects of Quaternary paleoenvironmental change and effects on fluvial, eolian, lacustrine, weathering, and
mass movement processes. Graduate-level
requirements include an independent research project or term paper in publication
format.

554. Evolution of Planetary Surfaces (3) II (Identical with PTYS 554, which is home).

555. Remote Sensing of Planetary Surfaces (3) II (Identical with PTYS 555, which is home).
field trips, analytical techniques, problem solving. Field Trips. P, GEOS 446 or GEOS 450.  
651. Climatic Geomorphology (3) I Effects of climatic changes on geomorphic processes, landforms, and soils; paleoclimatic and earthquake-hazards interpretations. Field Trips.  
652. Tectonic Geomorphology (3) II Effects of tectonic movements on geomorphic processes and landforms; paleoseismology and earthquake-hazards interpretations. Field Trips.  
696. Seminar  
J. Forensic Isotopic Hydrology (1) II (Identical with HWR 696), which is home.  
900. Research (1-6) [Rpt./]  
909. Master's Report (1-9) [Rpt./]  
910. Thesis (1-6) [Rpt./]  
920. Dissertation (1-9) [Rpt./]  
930. Supplementary Registration (1-9) [Rpt./]

German Studies (GER)  
Modern Languages Building, Room 571  
Phone: (520) 621-7385  
FAX: (520) 621-7385  
WWW: http://www.coh.arizona.edu/german/

Application Questions:  
Virginia Serrano, (520) 626-8123, v_serrano@u.arizona.edu  
Advising Questions:  
Kamakshi Murti, (520) 621-3245, 586 Modern Languages, kmurti@u.arizona.edu  
Degrees Offered: M.A.  
Concentrations: German literature and culture, Pedagogy.

Professors:  
David H. Chisholm, Albrecht Classen, Max Dufner (Emeritus), Steven D. Martinson, Renate A. Schulz, David J. Woloshin (Emeritus)  
Associate Professors: Thomas Kovach, Head, Dennis I. Greene (Emeritus), Barbara Kosta, Babette Luz (Emerita), Kamakshi P. Murti, Roland Richter (Emeritus), Mary Wildner-Bassett  
Assistant Professor; Carlson L. Arnett  
Lecturer: John R. Wendel (Emeritus)  
The department offers a program leading to the Master of Arts degree with a major in German Studies. Courses are offered in the various areas of German language, literature, and culture, past and present, as well as in second-language teaching methodology, applied linguistics, theory of second-language acquisition, and testing. There are two tracks available for the M.A. in German Studies: one emphasizes literary and cultural studies, and the other combines literary and cultural studies with pedagogy and applied linguistics. Generally speaking, prerequisite for admission to the graduate program is the completion of at least 16 acceptable units of upper-division, undergraduate course work in German.  
Students working toward the Master of Arts degree must complete a minimum of 33 units of graduate work, including at least 30 units in courses offered by the Department of German Studies. GER 508 is required of all master's candidates; GER 579 is required of all graduate teaching assistants in their first semester of teaching.  

M.A. Thesis Option: Students may be permitted to write a thesis upon application to and consultation with the departmental Graduate Committee. Students approved for the thesis option must complete the 27 unit course work requirement (excluding 910). No more than 3 units may be earned for writing the thesis; thesis students enroll for GER 910.  
Students must pass both a written and an oral comprehensive examination. Prior to this examination, in the spring of their first year, students who are not native speakers of German will be required to pass either the ZOP (Zertifikat Oberstufen-prüfung) or the ZMP (Zertifikat Mittelstufenprüfung) administered by the Goethe-Institut.  

Students must pass both a written and oral comprehensive examination. Prior to this examination, in the spring of their first year, students who are not native speakers of German will be required to pass either the ZOP (Zertifikat Oberstufen-prüfung) or the ZMP (Zertifikat Mittelstufenprüfung) administered by the Goethe-Institut.  

500. Intensive Reading German for the Sciences and Humanities (4) S Rapid acquisition of reading proficiency in German. No prior knowledge of German is necessary. Proficiency certification obtained from this course fulfills graduate foreign language requirement in some departments (consult department for information). P, credit available for non-majors only.  
501. Appropriating and Reshaping the Past (3) II Examines the creative reception of cultural artifacts found in oral traditions, religion, politics, historical events and the arts in German-speaking cultures.  
502. Genre as a Category for Organizing Experience (3) I Examination of individual texts in relation to theories of genre, with attention to shifting definitions of genre and resistance to generic categories.  
503. Erziehung und Bildung in German Culture (3) II Investigates theories of education and their reflection in literary works. The Bildungsroman, for instance, discloses central elements of German culture and society.  
505. * History of the English Language (3) I II (Identical with ENGL 505, which is home).  
506. Representing the “Other” (3) II Explores narratives that construct the Other, the foreigner, and the outsider; discusses the politics of racism, sexism and exclusion using texts from various fields.  
507. Criticism and Creativity in German Culture (3) II Examines the relationship between theories of literature and literary practice, and the question of the nature of writing in general.  
508. Approaches to German Studies (3) I II  
509. Traditions and Modernism (3) I Provides a critical overview of literary and intellectual currents of the “modern” period; explores the changing status and social function of literature.  
510. Repression, Revolution, Revision (3) I Maps various movements and literatures that resist the repressing of history and stories. Focuses on narrative, memory and the construction of personal and national identities. P, 6 units of upper-division German.  
511. Communication and Miscommunication in Middle, High and Later German Literatures (3) I II Explores the way German writers have dealt with basic issues of human communications.  
520. History of the German Language (3) II Examination of the semantic, socio-historical and structural development of German from the age of migrations to the present. (Identical with ENGL 520).  
525a-525b. * Old English: (3-3) I-II 525a: Introduction to language and literature (Identical with ENGL 525a-525b, which is home).  
555. * Music and German Literature (3) I The interrelationship between music and German literature from the 18th through the 20th century. Concentrates on major works of German drama, poetry and prose, and their musical settings. Lectures in English. Readings primarily in English, some German. Graduate-level requirements include two oral reports or lectures-recitals on a specific topic. P, GER 202. (Identical with MUS 555).  
575. * Advanced German Usage (3) I CDT 579. Issues/Methods in Post-Secondary Foreign Language Teaching/ Learning (3) I II Methods of post-secondary foreign language pedagogy. Discussion of broader issues of second language acquisition learner variables, including learning styles; the history of foreign language; education standards for foreign language learning; and post-secondary teaching as a career. (Identical with EAS 579, FREN 579, LAT 579, SLAT 579, SPAN 579).
580. *Applied Linguistics for German as a Foreign Language (3) II Issues in and methods of applied linguistics with emphasis on Germanic languages. Graduate-level requirements include an in-depth research paper on an aspect of applied linguistic research. (Identical with SLAT 580).

585. Linguistic and Computer-Assisted Approaches to Literature (3) II Graduate-level requirements include an additional oral report and an in-depth research paper. (Identical with CLAS 585, FREN 585, ENGL 585, RUSS 585).

587. Testing and Evaluation in Foreign/Second Language Programs (3) I II Introduction to fundamental concepts, principles and problems of psychometric measurement relevant to FL/L2 learning. Types of tests and their uses, test construction, analysis and interpretation of results. (Identical with CLAS 587, EAS 587, ENGL 587, FREN 587, RUSS 587, SPAN 587).

594. Practicum a. Literature (1-5) [Rpt./ 5 units] I II P, competency at 4th year undergraduate level or passing departmental placement exam.
   b. L2 Acquisition and Teaching (1-5) [Rpt./ 5 units] I II P, competency at 4th year undergraduate level or passing departmental placement exam.
   c. Culture (1-5) [Rpt./ 5 units] I II P, competency at 4th year undergraduate level or passing departmental placement exam.
   d. Linguistics (1-5) [Rpt./ 5 units] I II P, competency at 4th year undergraduate level or passing departmental placement exam.
   e. Translation (1-5) [Rpt./ 5 units] I II P, competency at 4th year undergraduate level or passing departmental placement exam.

596. Seminar a. Literature (2-4) [Rpt./ 8 units] I II b. Linguistics (2-4) I II (Identical with ENGL 696b, which is home).
   c. Culture (2-4) [Rpt./ 8 units] I II d. L2 Acquisition and Teaching (2-4) [Rpt./ 8 units] I II (Identical with SLAT 696d).
   e. Translation (2-4) [Rpt./ 8 units] I II

599. Independent Study (1-5) I II

696. Seminar a. Literature (2-4) [Rpt./ 8 units] I II b. Linguistics (2-4) I II (Identical with ENGL 696b, which is home).
   c. Culture (2-4) [Rpt./ 8 units] I II d. L2 Acquisition and Teaching (2-4) [Rpt./ 8 units] I II (Identical with SLAT 696d).
   e. Translation (2-4) [Rpt./ 8 units] I II

Gerontological Studies

GERO Gerontological Studies

Application Questions: Marcia Winick, (520) 622-9092, mwinick@u.arizona.edu
Advising Questions: Geraldine S. Paier, gpaier@ix.netcom.com
Degrees Offered: M.S.
Concentrations: Family studies, public administration, psychology, and public health.

Professors: Keith E. Meredith, Chair, Audrey L. Holland (Speech and Hearing Sciences), Alfred W. Kaszniaik (Psychology), Theodore H. Koff (Public Administration and Policy), Associate Professors: Patricia C. Fairchild, Head (Physical Education), Terry Badger (Nursing), Roy B. Verdeny (Medicine), Assistant Professor: Wanda H. Howell (Nutritional Sciences), Coordinator: Geraldine Paier (Nursing)

Because of its multidisciplinary nature, gerontological studies serve several educational purposes. Graduate students may pursue a Master of Science with a major in gerontology, a doctoral minor, or a graduate certificate in gerontology. In addition to these formally structured academic programs, gerontological studies plays a facilitating role in the coordination and development of aging studies, and will guide students interested in incorporating a gerontological perspective into their own chosen field.

The doctoral minor requires 15 units and is particularly appropriate for students in areas such as education, administration, policy, social welfare, health, nutrition, and other disciplines in the social and behavioral sciences.

The Graduate Gerontology Certificate Program offers formal recognition for gerontological study in an 18-unit structured course of graduate study that offers a foundation of gerontological knowledge and theory and an opportunity for the application of knowledge in field work. The program is designed to supplement an undergraduate or graduate degree. It is particularly appropriate for individuals planning to enter or to continue in a profession that involves provision of services and/or administration of programs for the aged, and is well-suited for the working adult. Fifteen units of coursework and 3 units of practicum are required. A 3.0 grade-point average is necessary for admission.

The 46-unit Master of Science with a major in gerontology is comprised of 21 units of core courses, a concentration in a related field, internship, and electives. Students may elect to complete a thesis or a master's project. Each student's study plan is individually designed to meet the student's special interests and professional objectives. Applicants to the Master of Science program must submit scores from the Graduate Record Examination, three letters of recommendation, and a statement of intent. A 3.0 grade-point average is required.

Many courses included in the curriculum are offered in other departments. Courses identified as having content which deals specifically with elderly and with aging processes include: GERO 556, 613, 636; PA 427/527; PSYC 574; SER 555. Courses originating in gerontological studies and courses cross-listed with gerontology include:

524. Gerontology: A Multidisciplinary Perspective (3) I II (Identical with PSYC 524, which is home).
527. *Aging and Public Policy (3) II (Identical with PA 527, which is home).
530. Aging and Social Sciences (3) I Multidisciplinary overview of aging through the life course within a social, institutional and cultural context. Addresses the changing demographics, social supports and relationships, illness behavior, aging and death, work and retirement, housing and the economic status of the elderly. (Identical with PA 530).
547. Perspectives in Geriatrics (1) II P, or CR, PHPR 448 (Identical with PHSC 547, which is home).

548. Perspectives in Geriatrics (2) II (Identical with PHSC 548, which is home).

550. Biology of Aging (3) I Introductory graduate course focusing on human aging for students with backgrounds in biological sciences, psychology, social sciences, or health care. Designed to introduce current data and thinking on the biological aspects of aging in animals. Includes demographic aspects of aging: the changes occurring in aging humans; longevity and its measurement; comparative studies in animals other than people; and current theories of why all animals age.

556. Psychology of Death and Loss (3) I II Graduate-level requirements include an in-depth research paper on an aspect of psychology of death or loss. (Identical with PSYC 556).

557. * Law of the Elderly (3) II Examines law as it affects the elderly in such areas as legislation, finances, housing, death, guardianship, access to services and ethics. Focuses on the recognition/analysis of legal problems and the identification of legal resources. Graduate-level requirements include an in-depth research paper utilizing legal material and a class report on that research. (Identical with PA 557).

559. Adult Development and Aging (3) I (Identical with PSYC 559, which is home).

560A-506B. Methods in Aging Research (3) I Emphasizes understanding/ application of fundamental methodology concepts in research design, assessment and statistics as they relate to the conduct of research and program evaluation in aging. Application of concepts through the critique of articles and the development of research and evaluation projects. P, GER 560a is prerequisite to GER 560b.

570A. * Human Adaptability (3) I (Identical with ANTH 570A, which is home).

576. Communicative Aspects of Aging (1) I II (Identical with SP H 576, which is home).

589. Health of the Older Adult (3) I P, consult program before enrollment. (Identical with NURS 589, which is home).

595. Colloquium
   a. Current Topics in Aging (1) [Rpt./ 2] I II

613. Family Issues in Aging (3) II Critical analysis of selected family and social issues, and related current research in gerontology. (Identical with FS 613).

636. Economics of Aging (3) I Analysis of economic issues and policy as they affect the aging individual, family and society. (Identical with FS 636).

693. Internship (1-6)

694. Practicum (1-3) [Rpt./]

695. Colloquium
   a. Research in Gerontology (1) I II (Identical with PHSC 695a).

699. Independent Study (1-6) [Rpt./]

900. Research (1-6)

909. Master's Report (1-6)

910. Thesis (1-6)

Global Change (GC)
1439 E. Helen St.
Phone: (520) 621-9010
FAX: (520) 621-1422

Graduate Interdisciplinary Program in Global Change

The Institute for the Study of Planet Earth offers a minor in global change for students pursuing the Ph.D. degree.

530. The Climate System (3) I (Identical with GEOG 530, which is home).

572. Global Biogeochemical Cycles (3) I Study of processes affecting global chemical fluxes. Particular attention to current global concerns, i.e., ozone hole, carbon cycle, climate warming, atmospheric oxidation, hydrologic cycle. (Identical with GEOS 572, HWR 572).

597. Workshop
   a. Global Change Workshop (3) I II Integrative experience for natural and social science students with focus on local and regional consequences of global change.

Graduate Interdisciplinary Programs
Administration Building, Room 322-A
Phone: (520) 621-8368
FAX: (520) 621-8367
WWW: http://grad.admin.arizona.edu/idps/idphome.html

Application Questions:
Jolene Newburn-Gruener, (520) 621-8368, jgnip@grad.admin.arizona.edu

Graduate Interdisciplinary Programs are offered by the following committees:

American Indian Studies
Applied Mathematics
Arid Lands Resource Sciences
Biomedical Engineering
Cancer Biology
Cognitive Science
Comparative Cultural and Literary Studies
Computational Science and Engineering
Epidemiology
Genetics
Gerontological Sciences
Global Change
Insect Science
Neuroscience
Nutritional Sciences
Pharmacology and Toxicology
Physiological Sciences
Remote Sensing and Spatial Analysis
Second Language Acquisition and Teaching

For course offerings in these programs, refer to the specific program(s) elsewhere in this chapter.

Greek
(See Classics)

Health Education (HLTH)
(See Public Health)

Higher Education
(See Educational Leadership and Higher Education)

History (HIST)
Social Sciences Building, Room 215
Phone: (520) 621-5860
FAX: (520) 621-2422
WWW: http://w3.arizona.edu/~history

Application Questions:
Shelly Rao, (520) 621-5860
Advising Questions:
Karen Anderson, (520) 621-5486, karen-anderson@hs.arizona.edu

Degrees Offered: M.A., Ph.D.


Assistant Professors: Bert J. Barickman, George Brubaker (Emeritus), Julia Clancy-Smith, Linda T. Darling, Roger deLaix (Emeritus), Matt Goldish, Edwin Metcalf Gaines, Kevin Gosner, Frederick Kellogg, Jack D. Marietta, Katherine Morrissey, Susan C. Karant-Nunn, Hermann Rebel, Laura Tabili, Douglas Weiner

Graduate Interdisciplinary Programs are offered by the following committees:

American Indian Studies
Applied Mathematics
Arid Lands Resource Sciences
Biomedical Engineering
Cancer Biology
Cognitive Science
Comparative Cultural and Literary Studies
Computational Science and Engineering
Epidemiology
Genetics
Gerontological Sciences
Global Change
Insect Science
Neuroscience
Nutritional Sciences
Pharmacology and Toxicology
Physiological Sciences
Remote Sensing and Spatial Analysis
Second Language Acquisition and Teaching

For course offerings in these programs, refer to the specific program(s) elsewhere in this chapter.
The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in history.

Applicants for the graduate program must have completed the equivalent of the bachelor's degree with a major in history or related subject, and are required to submit scores on the aptitude tests of the Graduate Record Examination, a statement of purpose, official transcripts, and three letters of recommendation. Ph.D. applicants must also submit a writing sample. Application deadlines: October 15 and January 15. All Ph.D. students must participate in a formal review of their program during the first year of doctoral studies.

Master of Arts: At least 24 units must be completed in history, including 18 units in one of the following areas: Early Europe, Modern Europe, Latin America, United States, and Asia. The student who elects to submit a thesis will receive thesis credit for 6 units and will be required to complete at least 12 additional units at the 695-696 level in history. The student who elects to present two research seminar papers (6 units) in lieu of thesis is required to complete at least 18 units at the 695-696 level in history. Each student must demonstrate reading knowledge of a second language. During the first year of study, all graduate students must take History 695k, the department's course in historiography/methodology. This course cannot count as part of the 18 units required in the fields listed above, or as part of the 12 units of 695 or 696. Each student must pass a final examination in his or her major field. A total of 30 units is required for the degree.

Doctor of Philosophy: In consultation with an advisor, each beginning student will select primary and secondary areas of concentration within the history major. Each student must demonstrate a reading knowledge of two second languages. In United States history, students must demonstrate a reading knowledge of one second language. All students must take History 695k during the first year in the program.

Prior to admission to formal candidacy, each student must pass an examination covering the major and minor fields. Following this examination, the candidate must prepare and defend a dissertation, displaying mature research in original sources, competence in assembling and presenting historical data, and critical scholarship. Primary areas of concentration: Early Europe, Modern Europe, Latin America, and United States. Secondary areas of concentration: Any primary area of concentration other than the chosen one; an approved minor in another department; Asian history; comparative women's history; or comparative/world history.

501. * Ancient Mesopotamia (3) I (Identical with NES 501, which is home).
504a-505b. * History of Rome (3-3) I-II 504a: The Republic to the death of Caesar. 504b: The Empire through the Reign of Constantine the Great. Graduate-level requirements include an additional in-depth research paper.
505a-505b. * Medieval Europe (3-3) I-II Major institutions and trends in Europe from the breakup of the Roman World to the 14th century. P. 3 units of lower-division European history. Graduate-level requirements include additional work with primary and foreign language secondary sources.
506. * Medieval England (3) II From the Norman conquest to the Hundred Years War, with emphasis on political, social, and cultural developments. Graduate-level requirements include additional work with primary and foreign language secondary sources.
507a-507b. * Intellectual History of Medieval Europe (3-3) I-II: High Medieval Europe. Major medieval cultural and intellectual trends. 507a: High Medieval Europe. 507b: Late Medieval/Early Modern Europe. P. 3 units of lower-division European history. Graduate-level requirements include additional work with primary and foreign language secondary sources.
508. The Renaissance (3) I Graduate-level requirements include an in-depth research paper.
509. * The Reformation (3) I The Reformation in thought and action both from the perspective of its religious origins and political and social conditions. Analysis of its impact on sixteenth century Europe, including the spread of Protestant reformation and its companion movement, the Counter-Reformation. Graduate-level requirements include an in-depth research paper.
510. * History of Hell in Early Europe (3) II The concept of punishment after death in Western Europe from the Bible to Dante. Includes the Hebrew, Greco-Roman, Germanic, and Christian traditions. P. 3 units of European history. Graduate-level requirements include additional work with primary and foreign language secondary sources.
511. * European Social and Intellectual History to 1750 (3) I Dominant themes in European intellectual history from the end of the Middle Ages to the period of the Enlightenment. Reading and discussions of texts from Petrarch to Locke. P. 3 units of any history course. Graduate-level requirements include more advanced readings and an in-depth research paper.
512a-512b. * European Intellectual History: 1600-Present (3-3) I-II 512a: Topics include philosophy, science, Enlightenment, Romanticism, Realism, political economy. 512b: 1870 to present. Intellectual and cultural movements from the fin-de-siecle to the collapse of communism. Graduate-level requirements include an in-depth research paper.
514. * Cultural History of Germany to 1714 (3) I The political, social, economic and cultural history of Germany from the late Middle Ages to about 1800. P. 3 units of any history course. Graduate-level requirements include a research paper.
515. * Cultural History of Germany from 1714 to 1989 (3) II The political, social, economic and cultural history of Germany from the period of the French Revolution to the present. P. 3 units of any history course. Graduate-level requirements include a research paper.
518. * France Under the Old Regime (3) I French political development, institutions and culture from Henry IV to the eve of the French Revolution. Graduate-level requirements include substantial additional independent reading.
519. * The French Enlightenment (3) I Cultural history of France in the 18th century, with emphasis on the works of the philosophers. Graduate-level requirements include substantial additional independent reading.
520. * The French Revolution and Napoleon (3) II The causes and progress of the Revolution in France. Graduate-level requirements include substantial additional independent reading.
521. History of Russia: Early Period (3) I Graduate-level requirements include a research paper.
522. History of Russia: Modern Period (3) II Graduate-level requirements include a research paper.
523. Intellectual History of Russia (3) II Graduate-level requirements include a research paper.
524. The Modernization of Russia (3) I Graduate-level requirements include a research paper.
525. History of the Soviet Union (3) I Graduate-level requirements include a research paper.
527. * Work, Culture and Power (3) Labor and social history: changes in work, daily life, gender social relations and political movements, interacting with broad historical processes such as commercialization, industrialization, colonialism, and war. Graduate-level requirements include additional readings and meetings with the instructor, and more rigorous writing requirements.
531. * Colonial America (3) I The experience and evolving institutions of the North Atlantic colonists from the first landings to the end of the French and Indian War. P, 3 units of any U.S. history survey course. Graduate-level requirements include different, additional readings and reports.

532. * The Era of the American Revolution (3) II Origins, progress, and character of the struggle against Great Britain; internal political, constitutional, social, and economic developments; the problems of the "Critical Period" and the making of the Constitution. P, 3 units of any U.S. history survey course. Graduate-level requirements include different, additional readings and reports.

533. * Jefferson and the New Nation, ca. 1790-1828 (3) I Major ideological, political, economic, and social conflicts and developments, North and South, during the first decades of the American nation. P, 3 units of any U.S. history survey course. Graduate-level requirements include an additional in-depth research or historiographical paper, to be decided in consultation with the instructor.

534. * Jacksonian Era, 1828-1856 (3) I Political, economic and social developments from the "reign" of Andrew Jackson through the collapse of the Whig Party in the 1850s. P, 3 units of any U.S. history course. Graduate-level requirements include an additional, in-depth research or historiographical paper, to be decided in consultation with the instructor.

535. The Coming of the Civil War, U.S. 1845-1861 (3) I Graduate-level requirements include a research exercise.

536. Civil War and Reconstruction, U.S. 1861-1878 (3) II Graduate-level requirements include a research exercise.

537. * U.S. 1876-1919: The Gilded Age and Progressive Era (3) I II Examination of economic, social and political developments in years of rapid industrialization from the end of Reconstruction through World War I. P, 3 units of any U.S. history course. Graduate-level requirements include an additional in-depth research paper.

538. * U.S. 1918-1945: From World War I through World War II (3) I III Prosperity, Depression and the New Deal in peace and war. Graduate-level requirements include taking examinations which consist entirely of essay questions, completing a research paper on a topic chosen in consultation with the professor, assisting the professor in leading discussion groups with undergraduate students over the assigned readings, providing questions from those readings for use by the professor in formulating quizzes for undergraduates, and possibly presenting a lecture to the class if the student is nearing completion of graduate work.

539. * History of N. Africa from the Islamic Conquest to Modern Independence, 700-1962 (3) II (Identical with NES 539, which is home).

540. * United States: 1945 to Present (3) I II American society and the role of the United States in world affairs from the Yalta Conference to the present. P, 3 units of any U.S. history course. Graduate-level requirements include an in-depth research paper on a topic approved by the instructor.

541. * History of American Society and Thought: Pre-Civil War (3) I American political thought, religion, cultural and philosophical ideas as expressed in colonial, revolutionary, and anti-Civil War society. Graduate-level requirements include an in-depth research paper.

542. * History of American Society and Thought Since the Civil War (3) I II The transformation of American minds since the Civil War as expressed in literary, philosophic, religious, and other cultural forms. Graduate-level requirements include an in-depth research paper.

543. * History of American Society and Thought Since Since the Civil War (3) I II The transformation of American minds since the Civil War as expressed in literary, philosophic, religious, and other cultural forms. Graduate-level requirements include an in-depth research paper.

544. * Islamic Mysticism (3) I II Origin and development of Sufism and its impact on Muslim and non-Muslim worlds. (Identical with NES 544, RELI 544).

545. * Women in Islamic History (3) I I Examination of the roles women have played throughout Islamic history and of the changing discourse in the Islamic community about women and their roles. Graduate-level requirements include additional readings and meetings with the instructor and an additional research paper. (Identical with NES 545, W S 545).

546. * History of Arizona and the Southwest (3) I II Economic, social and political development of the state and region from Spanish times to present. Graduate-level requirements include an historiographic essay and additional readings.

547. * History of American Foreign Relations to 1914 (3) I Examines the rise of America from a struggling colony to a world class power, including its relations with Europe, Latin America and Asia. P, 3 units of any U.S. history course. Graduate-level requirements include an in-depth research paper and additional course readings.

548. * History of American Foreign Relations Since 1914 (3) II Examines the pivotal role played by the United States in world affairs since WWI, focusing on America's struggle with revolutionary movements in Europe, Asia and Latin America. P, 3 units of any U.S. history course. Graduate-level requirements include an in-depth research paper and additional course readings.

549. * History of American Foreign Relations Since 1914 (3) II Examines the pivotal role played by the United States in world affairs since WWI, focusing on America's struggle with revolutionary movements in Europe, Asia and Latin America. P, 3 units of any U.S. history course. Graduate-level requirements include an in-depth research paper and additional course readings.

550. * History of American Foreign Relations Since 1914 (3) III Examines the pivotal role played by the United States in world affairs since WWI, focusing on America's struggle with revolutionary movements in Europe, Asia and Latin America. P, 3 units of any U.S. history course. Graduate-level requirements include an in-depth research paper and additional course readings.

551. * The United States and East Asia: 1840 to the Present (3) I II An examination of American interaction with Japan and China since the Opium Wars, with special attention given to economic, cultural, and military relations and conflicts. P, 3 units of any U.S. history course. Graduate-level requirements include an in-depth research paper and additional course readings. (Identical with EAS 551).

552. American Ethnic History (3) II Graduate-level requirements include an in-depth research paper on a topic approved by the instructor.

553. * History of Women and Work (3) I II History of women and work in western and non-western nations from prehistoric times to the present. P, 3 units of any U.S. history or women's studies courses. Graduate-level requirements include writing a lengthy research paper demonstrating a familiarity with basic secondary works, as well as investigating primary sources on a pertinent topic.

554. * Spanish Inquisition (3) I The Inquisition in Spanish, European, and ethnic history; its bureaucracy and procedures; its festivities, its victims; New and Old Christians; and witches. Graduate-level requirements include an in-depth research paper and additional course readings.

555. * History of Women in Europe (3) I II History of women in Europe covering topics such as women's work in family-based economic systems and in religious, political and cultural life, and the impact of larger historical changes. Graduate-level requirements include an additional historiographical project. (Identical with W S 555).

556. * The Mexican Revolution (3) S A detailed examination of Mexico's social upheaval of 1910, and its implications for contemporary Mexican society. Graduate-level requirements include extra readings and an in-depth research paper. Offered at the UA Summer program in Guadalajara only.

557. * Topics in Comparative Women's History (3) I II International history of a topic of the instructor's choice. P, 3 units of any history or women's studies course. Graduate-level include more in-depth readings and writing.

558. * The Ethnobiography of Mesoamerica and the Andes (3) I II The Impact of conquest and Spanish rule on the native peoples of Mexico, Central American, Peru, Bolivia, and Ecuador. Topics include: conquest and ecology; land and labor; religion and culture; adaptation and resistance. P, HIST 160 or HIST 351 or HIST 368. Graduate-level requirements include an additional essay.

559. * American History (4) I II Survey of Argentine history and culture from the colonial era to the present. P, 3 units of any history or women's studies course. Graduate-level requirements include an additional essay.

560. * History of Argentina (3) I I Survey of Argentine history and culture from the colonial era to the present. P, 3 units of any history or women's studies course. Graduate-level requirements include an additional essay.

561. * History of Women and Work (3) I II History of women and work in western and non-western nations from prehistoric times to the present. P, 3 units of any U.S. history or women's studies courses. Graduate-level include more in-depth readings and writing.

562. * History of Women in Europe (3) I II History of women in Europe covering topics such as women's work in family-based economic systems and in religious, political and cultural life, and the impact of larger historical changes. Graduate-level requirements include an additional historiographical project. (Identical with W S 555).

563. * topics in Comparative Women's History (3) I II International history of a topic of the instructor's choice. P, 3 units of any history or women's studies course. Graduate-level include more in-depth readings and writing.

564. * American Ethnic History (3) II Graduate-level requirements include an in-depth research paper on a topic approved by the instructor.

565. * Spanish Inquisition (3) I The Inquisition in Spanish, European, and ethnic history; its bureaucracy and procedures; its festivities, its victims; New and Old Christians; and witches. Graduate-level requirements include writing a lengthy research paper demonstrating a familiarity with basic secondary works, as well as investigating primary sources on a pertinent topic.

566. * American Ethnic History (3) II Graduate-level requirements include an in-depth research paper on a topic approved by the instructor.
ments include additional readings and meetings with instructor to develop topics for a historiographic or bibliographic essay.

566. * History of Brazil (3) II History of Brazil from 1500 to the present. Graduate-level requirements include a paper on the role of Carlos Lacerda. (Identical with LA S 566).

567. * Contemporary Latin America (3) I Revolution, social change and reaction in Latin America from 1930 to the present. Graduate-level requirements include an in-depth paper on a topic approved by the instructor. (Identical with LA S 567).

568a-568b. * Asia and the West (3-3) I-II Processes of interaction between Europeans and the peoples and cultures of the Middle East, South Asia, and East Asia, from the Portuguese explorations to the present. Graduate-level requirements include additional research or writing. See instructor for details. (Identical with NES 568a).

569. * History of Women in Latin America (3) II Women's history in Latin America from the Conquest to the present. P, 3 units of any lower-division Latin-American history or women's studies course. Graduate-level requirements include an in-depth research paper on a topic approved by the instructor. (Identical with LA S 569).

570. Religious History of India (3) I Graduate-level requirements include additional research or writing. See instructor for details. (Identical with NES 570).

571. * History of Medieval India (3) I Survey of Indian history from the 7th century to 1750. Graduate-level requirements include additional research or writing. See instructor for details. (Identical with NES 572).

572. * History of Modern India and Pakistan: 1750-Present (3) II Survey of political, social and economic developments in South Asia from the mid-18th century to the present. Writing emphasis for India-Pakistan specialization. Graduate-level requirements include additional research or writing; see instructor for details. (Identical with NES 573).

573a-574b. * History of Japan (3) I-II Social, cultural, economic and political history of Japan. 574a: from earliest times to 1500. 574b: from 1500 to 1800. 574c: from 1800 to present. P, 3 units of any history course. Graduate-level requirements include an additional research paper. (Identical with JPN 574a).

575a-575b-575c-575d-575e. * Periods in Chinese History (3-3-3-3-3) [Rpt./ 1] I-II (Identical with CHN 575a, which is home).

576. * Modern China (3) I-II Survey of political, social, economic and cultural transformations undergone by China from ca. 1800 to the present. Provides students with a sense of both the major themes and the substance of the last two centuries of history of one of the world's major civilizations, as well as a better understanding of China's prominent position in the world today.

Graduate-level requirements include an in-depth research paper and additional readings. (Identical with CHN 576).

579. * The Ottoman Empire to 1800 (3) II History of the Ottoman Empire from its origins through the direct Western European impact, focusing on the political and social history of the empire in Europe and Asia. Graduate-level requirements include an in-depth research paper. (Identical with NES 579).

580. * The Middle East in the Twentieth Century (3) I (Identical with NES 580, which is home).

581. * Work, Motherhood, and Female Identity in America: 1945 to the Present (3) I-II (Identical with W S 581, which is home).

582. * Social History of China (3) I-II (Identical with CHN 582, which is home).

583. * Gender and African History (3) The history of men, women, gender relations, and gender meanings in sub-Saharan Africa. The importance of gender analysis, both sociological and symbolic, to understanding African history. P, 3 units of any history course or consent of instructor. Graduate-level requirements will include a research paper and additional discussion sessions. (Identical with W S 583).

584. * History of the Arab-Israeli Conflict, 1800 to Present (3) I-II (Identical with NES 584, which is home).

585a-585b. * Social, Cultural and Political History of Iran, Near East and the Muslim World: 7th Century - Present (3-3) I-II (Identical with NES 585a-585b, which is home).

588. * History of Byzantium (3) II Political, social, and cultural history of Byzantium from A.D. 325 to 1453, including the Byzantine legacy in Europe and the Middle East. Graduate-level requirements include a research paper. (Identical with CLAS 588).

589. * Women in East Asia (3) I Women in traditional China and Japan; analysis of changes occurring in the modern period. Graduate-level requirements include an additional research paper. (Identical with EAS 589).

590. * Philosophy of History (3) I Introduction to historical thinking from antiquity to the present, with emphasis on ideas in European and North American historical writings during the modern and contemporary eras. Graduate-level requirements include a research paper.

593. Internship (1-3) [Rpt./] 1. Legislative Internship (1-9) [Rpt./] I-II (Identical with LA S 593).

595. Colloquium c. * Topics in Modern European History (3) I-II P, HIST 214a or HIST 214b or consent of instructor.

e. * Struggle and Survival: Modern Mid East and North Africa, c. 1850 - Present (3) I (Identical with NES 595e).

r. * Chinese History Since 1949 (3) I (Identical with CHN 595r, which is home).

596. Seminar c. Women and the Literature of Identity in Modern Middle East and North Africa (3) II (Identical with NES 596c, W S 596c).
m. Middle East: Topics in History and Civilization (3) [Rpt./] I-II (Identical with NES 596m, which is home).

599. Independent Study (1-5) [Rpt./]

693. Internship (1-6) [Rpt./]

695. Colloquium a. Advanced Studies in United States History (3) [Rpt./] I-II

b. Advanced Studies in Latin American History (3) [Rpt./] I-II (Identical with LA S 695b).

c. Advanced Studies in European History (3) [Rpt./] I-II

e. Advanced Studies in the History of Women (3) [Rpt./] I-II GRD (Identical with W S 695e).

f. Advanced Studies in Ancient History (3) [Rpt./] I-II P, consent of department. (Identical with CLAS 695f).

g. Advanced Study in Asian History (3) [Rpt./] I-II (Identical with EAS 695g).

h. Comparative History (3) I-II

i. World History (3) I-II

k. Historiography (3) I-II P, open to majors only.

696. Seminar a. Colonial U.S. History (3) [Rpt./] I-II

b. Nineteenth-Century U.S. History (3) [Rpt./] I-II

c. Twentieth-Century U.S. History (3) [Rpt./] I-II

d. Ancient History (3) [Rpt./] I-II

e. Mediterranean Europe (3) [Rpt./] I-II

f. Early Modern Europe (3) [Rpt./] I-II P, Latin and German required.

g. Nineteenth-Century Europe (3) [Rpt./] I-II

h. Twentieth-Century Europe (3) [Rpt./] I-II

i. Latin America: Modern Period (3) [Rpt./] I-II (Identical with LA S 696j).

l. Colonial Latin America (3) [Rpt./] I-II (Identical with LA S 696l).

m. Comparative Women's History (3) [Rpt./] I-II P, consent of department. (Identical with W S 696n).

o. History and Historiography in Colonial North Africa (3) I (Identical with NES 696o).

699. Independent Study (1-6) [Rpt./]

900. Research (1-9) [Rpt./]

910. Thesis (2-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]
Hydrology and Water Resources (HWR)
Harshbarger Building, Room 122
Phone: (520) 621-5082
FAX: (520) 621-1422
WWW: http://www.hwr.arizona.edu

Application Questions:
Terrie Thompson, (520) 621-3131, program@hwr.arizona.edu

Advising Questions:
Terrie Thompson, (520) 621-3131, terrie@hwr.arizona.edu

Degrees Offered: M.S., Ph.D.
Concentrations: Surface hydrology, subsurface hydrology, water chemistry/quality, and water resources administration.

Professors: Victor Baker, Head, Thomas Maddock III, Associate Head, Roger C. Bales, Randy L. Bassett, Mark L. Brusseau (Soil, Water, and Environmental Science), Nathan Buras, Bonnie Colby (Agricultural and Resource Economics), Donald R. Davis, Stanley N. Davis (Emeritus), Robert E. Dickinson (Atmospheric Physics, Tree Ring Laboratory), Lucien Duckstein (Systems and Industrial Engineering), Martin M. Fogel (Emeritus), Barry Ganapol (Aerospace and Mechanical Engineering), Richard H. Hawkins (Watershed Management), Simon Ince (Civil Engineering), Austin Long (Geosciences), William B. Lord (Emeritus), Donald E. Myers (Mathematics), Shlomo P. Neuman, William J. Shuttleworth, Soroosh Sorooshian, Juan B. Valdes (Civil Engineering), Arthur W. Warrick (Soil, Water, and Environmental Science), Peter J. Wierenga (Soil, Water, and Environmental Science), T.-C. Jim Yeh, L.G. Wilson (Emeritus)

Associate Professors: Michael D. Bradley, Martha H. Conklin, Katherine K. Hirschboeck (Tree Ring Laboratory), Kevin E. Lansey (Civil Engineering), Marvin Waterstone (Geography and Regional Development)

Assistant Professors: Marek G. Zreda

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in hydrology. The department also participates in the State of Arizona Tri-University Master of Engineering (M. Eng.) degree program, a non-thesis based curriculum. The faculty offers competence in hydrogeology, hydrogeochemistry, hydrometeorology, hydroclimatology, environmental hydrology, ground-water hydrology, surface-water hydrology, vadose zone hydrology, mathematical and statistical methods in hydrology (including numerical modeling), water resources administration, systems/engineering, and planning, management, and administration.

Applicants need not have completed an undergraduate major in hydrology; however, previous study in a related field is beneficial. The programs have been developed to enable students with a basic science and mathematics background to enter directly. Applicants should submit Graduate Record Examination scores (general test only), a statement of purpose or career objective including specific areas of research interest, and three letters of recommendation. Doctoral applicants should submit a copy of the master's thesis abstract and a list of publications. All students are expected to acquire basic computer programming skills.

Graduate study programs (M.S., Ph.D.) are individually planned to meet the student's special interests and professional objectives. Department core courses in hydrology and water resources are required of each master's candidate unless equivalent courses have been taken elsewhere. A Master's thesis is required. Master's Thesis Professional Report and Master's Thesis Publication options are also available. Applicants for the Master of Engineering Program (M. Eng.) should contact the department for requirements.

Applicants for admission to the Doctor of Philosophy degree program should have completed the Master of Science degree with a major in hydrology, water resources, environmental sciences, environmental engineering, or a related field. Where gaps exist in background knowledge of relevant subject matter, the student may be required to take additional course work prior to the oral qualifying examination.

Applicants for admission to the Doctor of Philosophy degree program should have completed the Master of Science degree with a major in hydrology, water resources, environmental sciences, environmental engineering, or a related field. Where gaps exist in background knowledge of relevant subject matter, the student may be required to take additional course work prior to the oral qualifying examination.

The program is designed for students with special interest in the physical, chemical, and biological aspects of the hydrologic cycle, as well as operations research, administration and management, environmental studies, or the social sciences as related to water resources. Students may concentrate in one or a combination of these fields but should acquire some proficiency in all aspects of hydrology and water resources.

500. Ecosystematology for Urban Planning (3) I Introduction to conceptual tools used in complex ecosystems, particularly cities and urban areas; integration of human residents with larger natural systems (human ecology); environmental impact assessment (EIA) and statement (EIS). Water resource planning and impact on regional ecosystems; technical, legal, ethical dimensions of water transfer. (Identical with PLN 500).

503. Subsurface Fluid Dynamics (3) I Dynamics of immiscible fluids in porous and fractured media; anisotropy and scale; advective solute transport; consolidation, and land subsidence; multiphase systems; free surface flow and salt water/fresh water interfaces. P, MATH 223 or (preferably) MATH 320 or MATH 422a or MATH 422b; C E 321 or A ME 331. (Identical with C E 503).


505. Vadose Zone Hydrology (3) I Fundamentals of flow and transport in the vadose zone, including multiphase flow. Methods for characterization of hydraulic properties. Vadose zone processes contribute to ground water contamination. P, HWR 407 or HWR 503 or HWR 518.

506. Water Quality Dynamics (3) I Chemical and physical methods are used to study the quality of ground and surface waters with emphasis on organic contaminants, colloids, and surface processes including sorption phenomena. Equilibrium and dynamic models of water chemistry. P, HWR 517R and HWR 517L.

508. * Vadose Zone Monitoring (2) Laboratory and field methods for characterizing water flow and contaminant transport through unsaturated geologic media. P, HWR 407. Graduate-level requirements include an in-depth laboratory report. P, HWR 407 or HWR 503 or HWR 505 or HWR 518.


514. * Field Hydrology (Surface Water) (1) S Field methods of collection, compilation, and interpretation of data in surface water. Stream gaging, hydrography and limnology exercises; evaporation studies, micrometeorological instruments and methods; slope-area method of indirect discharge measurement; flood plain mapping; preparation of hydrologic reports. Daily field work. P, HWR 250 or HWR 423 or HWR 440 Graduate-level requirements include an in-depth report on one aspect of the field work or participation and assistance in the preparation and conduct of a field project. Daily field work. P, HWR 519.

515. * Introduction to Water Resources Policy (3) S Water resources policy including the identification of regional problems of water use, the elements of water planning, water rights, and a consideration of institutional structures and processes. Graduate-level requirements include an in-depth term paper. (Identical with GEOG 515).
516. Hydrologic Transport Processes (3) I Development and application of equations describing mass and energy transport in the subsurface environment. P, HWR 503 or HWR 535; SIE 270.

517L. Fundamentals of Water Quality Laboratory (1) I Field and laboratory methods in water quality sampling and analysis. Includes both wet chemical and instrumental methods of analysis. P, HWR 517R.

517R. Fundamentals of Water Quality (3) I Introduction to chemical processes affecting the behavior of major and minor chemical species in the aquatic environment. Physical, equilibrium, organic, and analytical principles as applied to natural waters. P, CHEM 103b, PHYS 241, MATH 129; P or CR, MATH 254.

518. Survey of Subsurface Hydrology (3) I Survey of physical, mathematical, geologic, and engineering concepts fundamental to subsurface hydrologic processes. P, P or CR, MATH 331 or C E 321; MATH 254, GEOS 101.

519. Survey of Surface Water Hydrology (3) II Survey of major topics in surface water hydrology: hydrometeorology, evaporation, rainfall-runoff, statistical and probabilistic methods, unit hydrograph method, and flood routing. P, P or CR, C E 321 or SIE 305.

520. Water Resources Management, Planning, and Rights: A Policy Approach (3) II An introduction to basic concepts and issues of water resources management and administration, emphasizing water law and rights, water resources planning, institutional and organizational arrangements, and policy processes such as adjudication and rule-making.

521. Introduction to Water Resources Systems Analysis (3) I Quantitative analytical methods in water resources planning and management; introduction to systems analysis, benefit-cost, multi-objective planning and risk assessment. P, MATH 125a.

522. Well Logging Interpretation (3) II P, consult department before enrolling. (Identical with GE 522, which is home).

523. Hydrology (3) I (Identical with C E 523, which is home).

524. Hydroclimatolology (3) I Precipitation formation processes, the surface and atmospheric branch of the hydrologic cycle, land surface-atmosphere interaction, surface energy balance, evapotranspiration, heat and moisture fluxes into the soil and atmospheric boundary layer. (Identical with ATMO 524).

525. Water Quality Modeling (3) II P, C E 321. (Identical with C E 525, which is home).

526. Water Quality Management (3) II Optimization and systems analysis techniques used in modeling; current models used in formulation and implementation of water quality policy. P, HWR 525. (Identical with C E 526).

527. * Computer Applications in Hydraulics (3) I (Identical with C E 527, which is home).

528. * Hydrogeology (4) I Hydrologic and geologic factors controlling the occurrence and dynamics of groundwater on regional and local scales. P, GEOS 251, MATH 125b. Graduate-level requirements include a research paper on a topic related to hydrogeology but not covered in lectures. (Identical with GEOS 531).

532. * Environmental Hydrogeology Lab (3) [Rpt./ 1] I II Introduction to field, lab, and office methods used in hydrogeology. Hands-on use of modern field and laboratory equipment to measure and monitor hydrogeological parameters and variables. Analysis, visualization, and interpretation of the data performed in chemistry and computer laboratories. 6L, 1R. Graduate-level requirements include lab reports, demonstrated understanding of techniques learned and experimental results clearly and concisely; creative application of techniques to other problems. 6L, 1R.

535. Advanced Subsurface Hydrology (3) II Advanced aquifer and well hydraulics; heterogeneity, unsaturated flow; natural and artificial recharge; ground-water and surface-water interaction; mass and heat transport. P, MATH 223 or MATH 322 or MATH 422a or MATH 422b. (Identical with GEOS 533).

536. Ground-Water Resource Evaluation (3) II Hydrologic and geologic techniques for evaluating aquifer systems with case studies of ground-water management on local and aquifer scales, their environmental and societal impacts; case studies of ground-water contamination. Field Trips. (Identical with GEOS 536).

540. * Advanced Surface Water Hydrology (3-4) II Theory and selected design problems from fluid dynamics, flow hydrology, flood routing, and water supply hydrology. Field Trips. P, HWR 250 or HWR 423 or C E 321. Graduate-level requirements include an in-depth paper or project. Discussion section is optional for graduate students. P, HWR 519 or HWR 523.

543. * Environmental Risk and Economic Analysis in Water Resources (3) I Environmental risk analysis, environmental economics, and quantitative benefit-cost-risk planning and regulation applied to water resources. P, MATH 125. Graduate-level requirements include a research paper on an applied aspect of the course.

545. * Statistical Hydrology (3) II Application of statistics and probability to uncertainty in the description, measurement, and analysis of hydrologic variables and processes, including extreme events, error models, simulation, sampling, P, statistics or probability theory. Graduate-level requirements include an in-depth simulation project. P, knowledge of a computer language, SIE 305 or MATH 60.

550-550b. * Environmental Hydrology (3-3) I II Chemistry of surface and subsurface water, the predominant chemical processes affecting composition. Focuses on humanity's use; classification, identification, and mobility of contaminants; introduction to chemical and transport modeling. Focuses on inorganic chemistry. P, HWR 250, CHEM 103a, CHEM 103b, MATH 129; knowledge of computer language; CR, HWR 451. Graduate-level requirements include an in-depth research paper.

551. * Environmental Hydrology Lab (1) II Laboratory procedures related to chemistry of surface and subsurface water. P, or CR, HWR 450a. Graduate-level students will conduct their experiments individually and write individual lab reports. P, or CR, HWR 550a or equivalent.

560. * Watershed Hydrology (3) I (Identical with WS M 560, which is home).

562. Soil and Groundwater Restoration (3) I P, HWR 531 or equivalent, SWES 564 or equivalent. (Identical with SWES 566, which is home).

567. * Advanced Watershed Hydrology (3) I (Identical with WS M 567, which is home).

569. Spatial Analysis of Hydrology and Watershed Management (3) II P, RNR 417 or RNR 517. (Identical with WS M 569, which is home).

570. Computer Simulation of Hydrochemical Processes (3) I Introduction to the fundamentals of solving complex water chemistry problems using computer codes as tools. Equilibrium, mass transfer, 1-D transport models with multi-element chemistry, thermodynamic concepts, and use of equations in models; placing natural chemical processes into an interpretable framework, evaluation of error and uncertainty. P, CR, HWR 506 or HWR 517R.

572. Global Biogeochemical Cycles (3) I (Identical with GC 572, which is home).

576. Advanced Natural Resource Economics (3) I P, ECON 361, MATH 113. (Identical with AREC 576, which is home).

577. Advanced Topics In the Economics of Environmental Regulation (3) I P, MATH 113, ECON 361. (Identical with AREC 577, which is home).

578. * Global Change (3) II (Identical with GEOS 578, which is home).

581. * Environmental Policy (3) II (Identical with FOL 381, which is home).

582. Applied Groundwater Modeling (3) I Graduate-level requirements include an in-depth research paper and/or project.

583. * Physical Oceanology and Limnology for Hydrologists (2) II Origin, distribution, and characteristics of oceanic water; advective and convective processes; estuarine and shoreline processes; effect on coastal aquifers; classification and hydrologic
techniques, stochastic processes, time series and frequency analysis. P, basic statistics and hydrology.

695. Colloquium
a. Hydrology and Water Resources
(1-3) [Rpt./ 6 units] II For HWR majors, research presentation only. P, consult department before enrolling.

696. Seminar
a. Advanced Topics in Groundwater
Hydrology (1-3) [Rpt./ 6 units] II
b. Advanced Topics in Vadose Zone
Hydrology (1-3) II
c. Advanced Topics in Subsurface Modeling (1-3)
e. Pollutants in the Hydrologic Environment
(1-3) [Rpt./ 3 units] II
f. Advanced Hydrologic Modeling (1-3)
[Rpt./ 6 units] II
g. Interstate Conflict Resolution (3) [Rpt./
1] II (Identical with SOL 699i, which is home).

(1-3) [Rpt./ 9 units] II (Identical
with NES 696i, POL 696i).
k. Science and Technology of Radioactive
Waste Management (1-3) [Rpt./ 6 units] II
q. Advanced Methods in Hydrometeorology /
Hydroclimatology (1-3) [Rpt./ 6 units] II
Field methods and experimental
teachers for monitoring near-surface
weather variables and the surface
exchanges of energy, water vapor, and
carbon dioxide; experience in team
presentations of research, in running and monitor-
ing research planning meetings, and in
delivering scientific seminars. Offered
once annually based on student need.

699. Independent Study (3) [Rpt./] II
190. Research (1-4) [Rpt./]
910. Thesis (1-9) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-12)
[Rpt./]

Industrial Engineering
(See Systems and Industrial Engineering)

Information Resources and Library Science (IRLS)
1515 E. First St.
Phone: (520) 621-3565
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Application Questions:
Kathryn Wilka, (520) 621-3565,
wilka@u.arizona.edu

Degrees Offered: M.A., Ph.D.

Professors: Carla Stoffle, Acting Director,
Charlie D. Hurt III, Donald C.
Dickinson (Emeritus), Margaret F.
Maxwell (Emerita), Lawrence Clark
Powell (Emeritus), Elinor C. Saltus
(Emerita), Arnulfo D. Trejo (Emeritus)
Associate Professors: Charles A. Seavey,
Acting Director, Helen M. Goebberg
(Emerita)
Assistant Professors: H. Martin Frické,
Don Fallis, Zoë Stavri

The School of Information Resources and Library Science offers a Master of Arts degree with a major in information resources and library science, which is heavily weighted in technology and emphasizes theoretical constructs of information resources. Competence and adaptability in managing information and in utilizing advancing technologies are key aims of the curriculum. The Master’s degree requires a minimum of 36 units of graduate credit. Students may elect the thesis option replacing 6 units of course work.

The School offers course work that leads toward the Doctor of Philosophy degree with a major in information resources and library science. Doctoral students must complete at least 48 hours of course work in the major, a minor subject supporting the major, and the dissertation. More detailed descriptions of the program are available from the school.

500. * Social Constructs of Information (3)
11 I Introduction to information as it is used and defined by society. Geography of
information, economics of information, and intellectual property concerns. Graduate-level
requirements involve extra readings and in-depth exams.

501. * Knowledge Structures I (3) I I
Introduction to the theories and practices used in the organization of information.
Overview of national and international standards and practices for access to
information in collections. Graduate-level
requirements include additional assignments and a higher level of performance.

504. * Foundations of Library and Information
Services (3) I II Elements of
librarianship, historical backgrounds, types of
libraries, the role of the library in American
life, current issues. Graduate-level
requirements include a greater number of assignments and a higher level of performance.

506. Research Methods I (3) I II Research
methodology, research design, and elemen-
tary statistics.
520. Ethics for Information Professionals (3) Study of the basics of ethical theory and its application to problems in information management. Application and development of ethical codes in cases studies.

524. * Information Resources Evaluation (3) Methods of evaluation of information resources in society. Development of terms and functions for evaluation. Field Trips. Graduate-level requirements involve extra readings and in-depth exams.

543. * Knowledge and Society (3) II (Identical with PHIL 543, which is home).

560. * Information Resource Development (3) Principles of identifying, selecting, acquiring, managing, and evaluating information resources for particular demographic areas. Graduate-level requirements involve extra readings and in-depth exams.

572. Government Information: Policy and Resources (3) I II To consider information policies and resources of the government of the United States and to develop an understanding of how those policies have evolved, and how they affect both the political system, the average citizen, and the overall structure of information dissemination in this country.

575. Human Factors in Information Systems (3) I II Study of the human-information system interface: computers, human-information processing, physical-psychological factors in design and operation of information systems.

581. School Library Administration and Organization (3) II Graduate-level requirements include a greater number of assignments and a higher level of performance.

587. Information Seeking Behaviors (3) I Information-seeking theories, methods, and user behaviors will be covered in order to gain an understanding of how different groups of people seek, gather and retrieve information in a variety of information environments. Information-seeking behavior draws on literature from library and information science, psychology, and communications.

588. Issues in Information Resources (3) I II Examines problems associated with current issues in information resources and other information centers.

589. Scholarly Communication (3) I II Structure and workings of scholarly communication and products in the U.S. Examines the content and technology of scholarly communication in various disciplines. (Identical with COMM 589).

593. Internship I Legislative Internship (1-9) II

600. Introduction to Graduate Studies in Music (3) I P, required of all doctoral candidates in music. (Identical with MUS 600, which is home).

601. Knowledge Structures II (3) I II Theory of classification, subject approaches to information, and advanced data coding.

606. Research Methods II (3) I II Regression and correlation techniques, analysis of variants, advanced techniques. Emphasis on research and problem solving in information agencies.

608. Planning and Evaluation of Information Centers (3) II The planning/evaluation cycle as an approach to assessing various information center services.

612. Expert Systems in Information Resources (3) II Examines the role and place of expert systems. Emphasis on development of knowledge-based systems.

613. Systems Analysis and Evaluation (3) I I Introduction to quantitative methods for the design, analysis and control of library systems.

614. Information Theory and Transfer (3) I II Nature of information in the social setting. Examines the use, value, and relevance of information as well as the dispersion of information through open and closed systems.

617. Social Epistemology and Information Science (3) I II Epistemology is the study of knowledge. Basically, epistemology is concerned with how it is that people know what they know. The focus of this course will be on social epistemology in particular.

622. Advanced Information Resources (3) I II Analysis of information needs of subjects specialists. Approaches to evaluation of information exchanges and sources.

624. Health and Medical Informatics (3) I II Information systems used in health and medical settings. Particular attention is given to the integration of traditional and nontraditional methods of information transfer.

688. Advanced Issues in Information Resources (3) I II Topics vary. Problems associated with current issues in information resources and information centers.

693. Internship (2-4)

694. Practicum (1-6)

695. Colloquium f. Theory of Classification (1-3) I II h. Children's and Youth Services and Literature (2-3) I


699. Independent Study (1-6)

796. Seminar a. Advanced Topics in Information Resources (3) (Rpt/ 10 I II

900. Research (1-9)

910. Thesis (1-6)

920. Dissertation (1-9) I II

930. Supplementary Registration (1-9) I II
The Interdisciplinary Program in Insect Science offers a graduate program leading to the Ph.D. degree that trains students broadly in insect biology, with individually designed programs suited to each student's interests and needs. Programs of study combine a broad knowledge of insects as organisms, and training in one or more specialized disciplines such as ecology, evolution, neurobiology, biochemistry, and molecular biology. Faculty members, made up of insect scientists based in seven departments, can serve as major advisors for students majoring in the Insect Science Program. Information about their research interests can be obtained from the program office. Two semesters each of biology, chemistry, physics, and mathematics are required for admission. A baccalaureate degree must be completed in some area of the biological sciences. Candidates should take the general Graduate Record Examination as well as an advanced examination in a biological field.

500a-500b. Topics in Ecology and Evolutionary Biology (4-3) I-II (Identical with ECOL 500a-500b, which is home).
503L. Parasite Laboratory (1) I (Identical with V SC 503L, which is home).
503R. Biology of Animal Parasites (3) I (Identical with V SC 503R, which is home).
505. Aquatic Entomology (4) II (Identical with ECOL 505, which is home).
507. Insect Physiology (3) II P, P or CR, ECOL 407L; biochemistry recommended. (Identical with ENTO 507, which is home).
508. Insect Toxicology (3) II P, 3 units of organic chemistry or biochemistry. (Identical with ENTO 508, which is home).
511. * Insect Behavior (4) I-II (Identical with ENTO 511, which is home).
515L. Insect Biology Laboratory (1) I P, ECOL 182. (Identical with ENTO 515L, which is home).
515R. Insect Biology (3) I P, ECOL 182. (Identical with ENTO 515R, which is home).
517. Insect Systematics (4) I 3R, 3L. (Identical with ENTO 517, which is home).
524. * Theoretical Population Genetics (3) I (Identical with ECOL 524, which is home).
544. Insect Ecology (3) I (Identical with ENTO 544, which is home).
545. Concepts in Genetic Analysis (3) I P, introductory undergraduate genetics course or biology course. (Identical with MCB 545, which is home).
552. Medical-Veterinary Entomology (4) [Rpt./3] II P, parasitology recommended. (Identical with ENTO 552, which is home).
568. Nucleic Acid (4) I P, BIOC 411 or BIOC 511, consent of instructor. (Identical with BIOC 568, which is home).
570. Biological Control (3) I P, ECOL 444 or equivalent. (Identical with ENTO 570, which is home).
588. Principles of Cellular and Molecular Neurobiology (4) I P, consult program office before enrolling. (Identical with ENTO 588, which is home).
589. Principles of Systems Neurobiology (4) II P, NRSC 588. Consult program office before enrolling. (Identical with NRSC 589, which is home).
599. Independent Study (1-4)
700. Methods in Insect Science (3) [Rpt./3] Research rotations in the laboratories of faculty members within the Insect Science program. May not be repeated with the same faculty member. P, consult department before enrolling. Open to majors only.
900. Research (1-8) [Rpt./] I II
920. Dissertation (1-9) [Rpt./] I II
930. Supplementary Registration (1-9) [Rpt./] I II

Italian
(See French and Italian)
Japanese
(See East Asian Studies)

Journalism (JOUR)
Franklin Building, Room 101-M
Phone: (520) 621-7556
FAX: (520) 621-7557
WWW: http://w3.arizona.edu/~journal/uaj

Application Questions:
Mary Mueller, (520) 621-9616, muellerm@u.arizona.edu
Advising Questions:
Rebecca A. Payne, (520) 621-5712, payner@u.arizona.edu

Degrees Offered: M.A.
Concentrations: Print journalism and press performance

Faculty: Jim Patten, Head, William G. Greer, James W. Johnson, Rebecca A. Payne, Jacqueline E. Sharkey

The department offers a program leading to the Master of Arts degree with a major in journalism. The program is designed for students dedicated to developing or improving professional skills while attaining an academic background in one or more specializations.

An undergraduate major in journalism is not necessary for admission. Students are required to complete 205, 306, and 320 as deficiencies without graduate credit.

A minimum of 30 units is required for the master's degree. Electives are chosen from journalism or related fields with the approval of the advisor. A complete program of study must be approved by the graduate advisor in the first semester, and the advisor must approve any subsequent changes. No foreign language proficiency is required, although for those interested in Latin America the department has an exchange program in Guadalajara, Mexico.

Students are required to work on one departmental newspaper and to demonstrate a high level of skill in reporting and writing courses. The program of study must include 502, 511, 513, 539 or 570, 550 or 551, and 909 or 910. Advanced-degree credit will not be given for a grade lower than B.

502. Freedom of Expression (3) II Analysis of access and barriers to information and communication at local, state, national and international levels; intensive study of the legal relationship between mass media and society. P, open to majors only.
503. * Advanced Photojournalism (3) I II Reporting and interpreting the news through photos, photo documentaries, and photo analysis. P, JOUR 301, JOUR 302. Graduate-level requirements include an intensive photo essay illustrating a social problem unique to the Southwest.
505. * The Study of News (3) [Rpt./1] I II Critical study and problem analysis of the media. Field work may include publication of conclusions. Graduate-level requirements include a major research paper on an aspect of the subject matter.
506. * Magazine Color Photography (3) S Techniques for taking and editing color photographs to illustrate magazine articles. Preparation of resumes and photo portfolios. Field Trips. Graduate-level requirements include additional readings and two additional photo assignments.
511. * News Features (3) I II Writing the basic news feature article; specialized reporting and rewriting techniques. P, JOUR 206, consent of department to enroll. Graduate-level requirements include an in-depth profile of an Arizona newsmaker.
513. * Reporting Public Affairs (3) I II Study and practice of newsgathering on executive, legislative, and judicial levels in city, county, state and federal government, with emphasis on news sources and interpretive writing. Graduate-level requirements include identification, through study and interviews,
of a major Tucson issue and completion of a series of articles that suggest resolution of the issue. P, JOUR 206, JOUR 502, and department consent required to enroll.

514. * The News Agency: Arizona News Service (1) I II Role and operations of the news agency, wire service or syndicate. Class members will form staff of the Arizona News Service to supply client newspapers from bureaus in Tucson and Phoenix. P, P or CR, JOUR 411 or JOUR 413; consent of department required to enroll. Graduate-level requirements include a research paper.

517. * Sports News Writing (3) I Students will cover sports events and write sports features. Interview and rewriting techniques. P, JOUR 206. Graduate-level requirements include a research paper concentrating on issues raised in class. P, department consent required to enroll.

521. * Advanced Editing (3) II Study of layout and typography for news, photographs, and feature articles in newspapers. P, JOUR 320, consent of department to enroll. Graduate-level requirements include assuming leadership positions such as news editor or copy desk chief during lab simulations.

522. * Publications Layout and Design (3) I Theory and practice of layout, typography, and design for magazines. P, consent of department to enroll. Graduate-level requirements include critically analyzing a major publication and redesigning it according to newest principles.

539. * Ethics and the News Media (3) I Analysis of ethical theory and how it relates to journalists' roles and responsibilities in a democratic society. Case studies involve questions of bias, accuracy, privacy and national security. Graduate-level requirements include a research paper examining a major ethical issue and providing a critique regarding how the media resolved the issue. (Identical with LA S 539).

550. * Community Journalism: The Tombstone Epitaph (3) [Rpt./ I] II Class members work as editorial staff to produce the local newspaper for Tombstone, Arizona. Intensive study of problems and responsibilities of community newspapers. P, JOUR 206, JOUR 208, discussion of preparation with instructor. Graduate-level requirements include assuming leadership roles, such as city editor or news editor, on the newspaper.

551. * Community Journalism: El Independiente (3) [Rpt./ I] II Class members work as editorial staff to produce a publication for the community of South Tucson. Intensive study of problems and responsibilities of journalism. P, discussion of preparation with instructor. Graduate-level requirements include assuming leadership roles, such as city editor or news editor, on the publication.

570. * The Press and Society (3) I II Critical study of press performance in current affairs; changing requirements for socially responsible and professional journalism in a democracy. Graduate-level requirements include an in-depth research paper addressing a modern media problem and proposing a solution to it.

571. * International Communications (3) I II Study of world news systems, including news gathering agencies, role of the foreign correspondent, the foreign press, and the factors influencing international news flow. Graduate students will be required to complete one extra research paper.

581. * Internet Business and Technology (3) I II (Identical with MIS 581, which is home).

593. Internship (1-6) [Rpt./]

594. Practicum (1-3) [Rpt./]

596. Seminar
   a. History of the Press (3) I II
   b. Latin-American Press (3) I II (Identical with LA S 596H).
   i. News Analysis (3) [Rpt/ I] II
   m. * Directions in News Technology (3) [Rpt/ I] 5

599. Independent Study (1-6) [Rpt./]

699. Independent Study (1-3) [Rpt./ I]

900. Research (2-4) [Rpt./]

909. Master's Report (1-3) [Rpt./]

910. Thesis (2-6) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

School of Landscape Architecture (LAR)

College of Architecture, Planning and Landscape Architecture
PO Box 210075, Room 104
Phone: (520) 621-1004
Fax: (520) 621-6448
E-mail: landarch@u.arizona.edu
WWW: http://architecture.arizona.edu

Application Questions:
William H. Havens, (520) 621-1004, havens@u.arizona.edu

Degrees Offered: M.L.A.

Professor: William H. Havens
Associate Professors: Mark P., Frederickson, Lauri M. Johnson
Assistant Professor: Margaret Livingston

The Master of Landscape Architecture (M.L.A.) emphasizes studies related to the planning, design, and management of the built and natural environment within the semi-arid Southwest. Areas of specialization include sustainable landscape design, planning, policy, and computer technology as applied to urban areas and natural resources of arid and semi-arid lands; landscape history; theory and criticism; tourism and recreation. (See requirements for the M.L.A. in Chapter IV of this catalog).

500. The Profession of Landscape Architecture (1) I An examination of principles and practices of the profession. Course includes a brief history of the profession as well as famous practitioners and projects.

507. The American Landscape (3) II (Identical with GEOG 507, which is home).

510. Design Studio I (4) I Development of visual and graphic skills; functional, aesthetic, environmental, and socio-cultural design ordering systems; concept-getting; form generation; and design theory and criticism. Interrelationships among design, site engineering, materials, and construction techniques.

511. Design Studio II (4) II Design processes, graphic and verbal communications, and design synthesis. Studio projects based on site ecology, inventoryanalysis, socio-cultural factors, and artistic principles of design.

512. Recreational Dimensions of Natural Resource Management (3) I (Identical with RNR 512, which is home).

520a. Plant Materials (3) I Laboratories focus on identification and description of native and select exotic landscape plants frequently used in landscape design and revegetation in the Southwest. Lectures emphasize terminology, plant care and maintenance, and influence of site conditions and requirements on plant selection.

520b. Planting Design (3) I Principles of planting design, planting design process, and functional and esthetic uses of plants in designs are discussed. Studio projects focus on development of planting plans for sites with various scopes and conditions.

531a-531b. Computer Applications in Design (2-1) I-II Two- and three-dimen- sional computer-aided design and video techniques for solving landscape architec- tural-related site problems. Use of computers for constructing high quality design solutions. Video animation for design evaluation.

542. History and Theory of Landscape Architecture (3) I Cultural, ecological, and aesthetic factors that influence design, planning, and stewardship of landscapes and how those factors and resultant landscapes have varied and evolved over time.

543. Contemporary Landscape Architecture (3) I Examination of landscape architecture in the United States from the mid 20th century, including: romantic and classical design expressions; the role of industrialization and social changes in public design; and the birth of "modernism"; the environmental movement's affect on natural system approaches to design and planning; and post-modern design experimentation.

Site Engineering (3) I Engineering aspects of landscape design and site planning. Development of technical competency in grading, storm water management, earthwork, and road alignment utilizing aesthetics and design principles as well as an understanding of ecological sensitivity. P, LAR 510.

Landscape Construction (3) II Landscape construction materials and methods, construction drawings and specifications, and construction cost estimation.

Field Methods in Environmental Psychology (3) II (Identical with PSYC 574, which is home).

Professional Practice Studio (4) I P, open to majors only.

Internship (1-6) [Rpt./]

Seminar
i. Interdisciplinary Environment-Behavior-Design (3) [Rpt/ 6 units] II P, consult college before enrolling. (Identical with PSYC 596u, which is home).

Workshop
i. Interdisciplinary Studio for Community Design (3-6) I (Identical with ARCH 597i, which is home).

Independent Study (1-5) [Rpt./]

Interdisciplinary Studio (4) I Complex landscape design and planning problems within an interdisciplinary area.

Landscape Planning Studio (4) II Theories and models in landscape planning; planning issues and methods; case studies; one major studio planning project.

Computer Applications in Planning (4) II Techniques in planning of regional landscape resources; visual simulation, computer map overlay, resource modeling, video applications, application of research into automated decision-support systems. Solving problems through the use of automated spatial modeling and analysis.

Professional Practice (2) II The practice of landscape architecture including professionalism, registration, the landscape architectural profession, services and fees, construction contract documents, bid documents and procedures, and business organization and operation.

Internship (1-8) [Rpt./] 1 II

Practicum
a. Landscape Architecture Teaching (1-2) I II
b. Landscape Architecture Professional Experiences (4) S P, LAR 511. Open to majors only or consent of instructor.

Colloquium
d. Landscape Architecture Research (2) I

Seminar
a. Landscape Architecture (1) [Rpt/ 2 units] I II

Independent Study (1-5) [Rpt./] 1 II

Research (1-8) [Rpt./]
examination of current and proposed hardware and software; survey of technological developments and trends impacting education; examination of social, psychological and educational consequences of technology in education. Graduate-level requirements include an in-depth research paper or other project.

532. Pre-Reading and Beginning Reading Development (3) I II An examination of various aspects involved in pre-reading and beginning reading development, including psychological, sociological, physiological, linguistic and educational considerations.

533. *Content Area Literacy in a Multicultural School (3) I II Prepares teachers to integrate knowledge of cultural diversity and literacy processes with their content and specialization. P, admission to the College of Education. Graduate-level requirements include an in-depth research paper or other project.

537. Classroom Diagnosis and Instruction (3) I II Procedures for diagnosing and developing reading and writing skills for pupils below-average achievement level. P, P or CR, LRC 505.

545. Research in Computer Language Arts (3) I II The role of scholarship and research in the rapidly evolving field of computer-mediated language arts teaching and learning. Analysis of research methodologies and evaluation of technology's impact on the classroom learning experience.

551. Reading, Writing and Texts: A Psychosociolinguistic Perspective (3) I II Readers and writers as users of language; reading and writing as language processes; what makes a text a text.

553. Language Acquisition and Development (3) I Study of the development of language in young children; focus on oral language and its relationship to emergent literacy; instructional strategies that build on language development.


557. Application of Miscue Analysis (3) I II Study of miscue analysis to explore the reading process, reading research, and readability, as well as to evaluate readers; applications to reading strategies and curriculum; focus on comprehension. P, or CR, LRC 551.

559. Whole Language: Curriculum and Organization (3) II Whole language pedagogy: theory, curriculum, organization, and practice. Application will be made to all levels in first and second languages. Field Trips.

570. Language Research Methodology (3) I II Investigation of procedures for conducting literacy research; examples of literacy research paradigms; critical analysis of evidence supporting literacy practices. P, LRC 507 or CR, LRC 551.

575. Anthropology and Education (3) I Intended to acquaint students with anthropological theories and methods which can have an impact on educational analysis. (Identical with ANTH 575).

576. Teacher Research (3) I II Focuses on issues and implications of the teacher research movement within education and on the research strategies and techniques used by teachers in conducting research in their own classroom settings.

578. Field Experience (3) I II Supervised experience in assessment and instruction of literacy-related practices. P, or CR, LRC 504 or LRC 505.

580. *Children's Literature in the Classroom (3) I II Analysis and discussion of classic and contemporary children's literature of all genres, and its relationship to language, reading and culture. P, admission to the College of Education. Graduate-level requirements include an in-depth research paper or other project.

581. Multilethnic Literature and Literacy (3) I Analyzes the use of multilethnic literature that fosters self-concept, acceptance, and a sense of identity to develop literacy. Includes readings from the major categories of multilethnic literature about Black, Native, Hispanic, and Asian Americans.

582. The Art of the Picture Book (4) I II A picture book conveys its meaning through the integration of art and language. This course examines visual literacy through the art of picture books by exploring art as a meaning-making process.

583. Literature Discussions (3) I II Issues related to dialogue about children's literature within a community of readers. Research, theory and practice related to literature discussion groups, text, sets, reader response and collaborative learning.

584. Literature and Literacy for Young Children (3) I Examines children's literature and its role in the literacy development of young children (preschool - 3rd grade). Explores both the types of literature and ways to bring children and books together.

585. Literature for Adolescents (3) I II This course offers teachers, librarians, and others an opportunity to explore and critique the wealth of literature written especially for young adult readers.

591. Preceptorship (1-6) [Rpt./] 1
593. Internship (1-6) [Rpt./] 1
594. Practicum (1) [Rpt./] 1
595. Colloquium a. Issues in Language, Reading and Culture (1-3) [Rpt./ 12 units] I II P, LRC 504, LRC 505.
   b. Language Learning and Reading Disabilities (3) I (Identical with SERP 595b, which is home).
   c. Issues in Educating Bilingual/Multicultural Children (1-3) [Rpt./ 9 units] I II
   d. Applications of Language and Literacy (3) [Rpt./ 2] II 5
   e. Anthropology and Education (3) I (Identical with ANTH 595e).

597. Workshop a. Southern Arizona Writing Project (3-9) [Rpt./ 12 units] (Identical with ENGL 597a, which is home).
   b. Miscue Analysis in Teacher Education (2-3) I II
   c. The Teaching of English (3) [Rpt./] 1 (Identical with ENGL 597b, which is home).

599. Independent Study (1-3) [Rpt./] 1
612. Grammatical Analysis (3) I P, ENGL 506 or an introductory linguistics course. (Identical with ENGL 612, which is home).
613. Methods of Teaching English to Speakers of Other Languages (3) I (Identical with ENGL 613, which is home).
627. Curriculum Development and Supervision in Language Arts (3) I II Organizational patterns of language arts curricula; approaches to improvement of language arts instruction; personnel relations. Designed for the language arts supervisor and school administrator. P, LRC 527.
634. Reading Comprehension: Theories, Research and Methods (3) I II Factors affecting cognitive development; methods of influencing growth in reading comprehension; examination and analysis of instructional materials; research related to comprehension and cognitive development. P, LRC 507.
635. Reading and Writing in Content Areas (3) I II Methodology appropriate for reading and writing to learn content; compatible organizational models; program implementation. P, P or CR, LRC 507, LRC 504, LRC 505 or LRC 551.
638. Reading Diagnostic Laboratory (3-6) [Rpt./ 6 units] I II Supervised practice in reading assessment; identification of factors influencing reading achievement, evaluation, construction, and administration of assessment procedures; development of interview techniques. P, LRC 507, LRC 537.
639. Reading Instructional Laboratory (3-6) [Rpt./ 6 units] I II Supervised practice in teaching reading and writing; preparing, analyzing and critiquing special instructional programs for students. P, LRC 507, LRC 537. Open to majors only.
640. Multicultural Education and Social Justice (3) I II Critical issues in multicultural education, focusing on culture, language, power, and identity, with application to the creation of more just and equitable educational systems.
653. Written Language Development (3) Study of latest research in the writing and reading development of preschool and school-aged children; relationships between reading and writing development explored through student research; applications to instruction. P, LRC 505, LRC 553.
677. History of American Indian Education (3) I II (Identical with AIS 677, which is home).
Latin American Studies

(LA S)

Douglass Building, Room 103
Phone: (520) 626-7242
FAX: (520) 626-7248
WWW: http://w3.arizona.edu/~laac

Application Questions:
Raul Saba, (520) 626-7242, rps@u.arizona.edu

Advising Questions:
Raul Saba, (520) 626-7242, rps@u.arizona.edu

Degrees Offered: M.A.

Professors: Diana Liverman, Director (Geography and Regional Development), Ellen Basso (Anthropology), William Beazley (History), Donald W. Carson (Journalism, Emeritus), Malcolm Compitello (Spanish and Portuguese), Hiber Conteris (Arizona International Campus), T. Patrick Culbert (Anthropology), Robert Dickinson (Atmospheric Sciences), Celestino Fernández (Sociology), Roger Fox (Agricultural and Resource Economics), Donna J. Guy (History), Lavin A. Gyurko (Spanish and Portuguese), Alfredo Huete (Soil, Water, and Environmental Science), Boris S. Kozolchyk (Law), Gary Libecap (Economics), Oscar J. Martínez (History), Miguel Méndez (Spanish and Portuguese, Emeritus), Michael C. Meyer (History, Emeritus), Luis Moll (Language, Reading and Culture), Eric Monke (Agricultural and Resource Economics), Andrew Nichols (Family and Community Medicine), Leland Pederson (Geography and Regional Development, Emeritus), José Promis (Spanish and Portuguese), Eliana Rivero (Spanish and Portuguese), Richard Ruiz (Language, Reading and Culture), Jacqueline Sharkey (Journalism), William Shaw (Renewable Natural Resources), Arthur Silvers (Public Administration and Policy), Charles M. Tatum (Spanish and Portuguese), Barbara Timmerman (Pharmaceutical Sciences), Juan Valdés (Civil Engineering and Engineering Mechanics), Tom Weaver (Anthropology), Edward J. Williams (Political Science), Paul N. Wilson (Agricultural and Resource Economics)

Associate Professors: Ana Alonso (Anthropology), Bert J. Barickman (History), Brian Crisp (Political Science), John Crow (Political Science, Emeritus), David Gibbs (Political Science), Kevin Gosner (History), Teresa McCarty (Language, Reading and Culture), Keith McElroy (Art), Richard Obregón (Music), Thomas Patterson (Music), Kathleen Schwartzman (Sociology), Marv Waterstone (Geography and Regional Development), Stacie Widdifield (Art), Amy Williansen (Spanish and Portuguese)

Assistant Professors: Lynn Carbon (Spanish and Portuguese), Ana Carvalho (Spanish and Portuguese), Lydia Fossa (Spanish and Portuguese), Ana Ortiz (Anthropology), David Ortiz (History), Ana Virginia Perches (Spanish and Portuguese), Nilson Rennó (Atmospheric Sciences), Raúl P. Saba (Latin American Studies), Emily Young (Geography and Regional Development)

Lecturers: Melissa Lockhart (Spanish and Portuguese), Nivea P. Parsons (Spanish and Portuguese)

Research Anthropologist: Timothy J. Finan (Director, BARA)

Associate Research Anthropologists:
James Greenberg (BARA), Helen Henderson (BARA), Thomas McGuire (BARA), Richard Stoffle (BARA), Norma Gonzalez (BARA)

Curator, Arizona State Museum: Paul Fish
Associate Curator, Arizona State Museum: Thomas Sheridan
Assistant Curator, Arizona State Museum: Suzanne Fish

Associate Research Professor: Robert Varady (Udall Center for Studies in Public Policy)

Associate Law Librarian: Francisco Avalos (Law)

Associate Librarian: Patricia Promis
Assistant Research Social Scientists: Maria Carmen Lemos (Latin American Studies), Joel Stillerman (Latin American Studies)

David Yetman (Southwest Center) Research Social Scientist: Janice Monk (Women's Studies)

The Latin American Area Center offers an interdisciplinary M.A. program with courses focusing on two fields of study, Spanish and Portuguese languages skills, a core Latin American Studies research seminar, and optional electives. The Committee on Latin American Studies is an interdisciplinary program within the College of Social and Behavioral Sciences that draws its courses and faculty from departments and colleges across the university. A number of academic professionals from programs such as anthropology, and lands, the Arizona State Museum, the Southwest Center and Women's Studies also support the teaching and research activities of the Latin American Area Center.

The student chooses one of the fields as the primary area of concentration and the other field as a secondary area of concentration. Principal areas of concentration include anthropology; art history; geography and regional development; history; language, reading and culture; political science; Portuguese; Spanish; and women's studies. An area of concentration also may include a cohesive program of related courses with a geographic focus such as Mexico studies or Brazil studies. Fields for the secondary area of concentration include agricultural and resource economics; art history; anthropology; border studies; economics; environmental studies; geography and regional development; history; indigenous cultures; journalism; language, reading and culture; law; political science; renewable natural resources; sociology; Portuguese; Spanish; and women's studies.

A total of 36 units are required for the M.A. degree. A minimum of 15 units are chosen in the area of concentration. The secondary area consists of a minimum of 9 units. The core seminar, LAS 500, is 3
units. The 9 remaining units consist of thesis credit (maximum of 6) and/or elective course work. Although not required, a thesis is strongly encouraged. It is also advisable that one or more seminars be included among the courses taken in the secondary and elective areas. Students also may elect to fulfill 3-6 units participating in approved internship programs. If a student has a regional or country focus in the area of primary concentration, he or she must take at least two courses emphasizing other areas or countries in Latin America.

Because of the interdisciplinary nature and regional emphasis of the Latin American studies program, both Spanish and Portuguese skills are required; one at the level of competence demonstrated by completing Portuguese 206 (or Portuguese 305) or Spanish 251 (with a minimum grade of B) or by an equivalency exam; the other at the level of proficiency demonstrated by completion of Portuguese 425 or Spanish 330 with a grade of B or by an equivalency exam. Students accepted into the program who do not meet one or both of the language requirements may satisfy this deficiency during the course of their graduate studies.

Applicants are asked to submit two letters of recommendation, a one-page statement of purpose or goals, and scores on the Graduate Record Examination. An admissions committee takes into consideration all factors when evaluating applicants to the graduate programs. The deadline to submit applications for Fall admission and consideration for funding is February 15.

Doctoral students in other departments may elect a minor in Latin American studies. Requirements include the core seminar and a minimum of 12 units in courses related to the student’s major and demonstrated competence, as defined above, in either Portuguese or Spanish.

Several joint degree programs and a certificate program are currently under consideration. For updated information please contact the Latin American Area Center.

500. Introduction to Latin American Studies (3) I Interdisciplinary introduction to graduate work and research in Latin American Studies. F. graduate students in Latin American Studies, M.A. or Ph.D. minor, or consent of instructor.

504. * Architecture and Planning in Mexico (3) I (Identical with ARCH 504, which is home).

508. The Mexican-American: A Cultural Perspective (3) I (Identical with MAS 508, which is home).

509. * Economic Anthropology (3) II (Identical with ANTH 509, which is home).

511. * Middle America (3) II (Identical with GEOG 511, which is home).

512. * South America (3) I (Identical with GEOG 512, which is home).

517. * Cultures of Ancient Mexico (3) S (Identical with ANTH 517, which is home).

522a-522b-522c. * Pre-Hispanic Art (3-3-3) I-II-I & II (Identical with ARH 522a-522b-522c, which is home).

523. Anthropology of Rural Mexico (3) II (Identical with ANTH 523, which is home).

529. * The U.S.-Mexican Borderlands in Comparative Perspective (3) II (Identical with POL 529, which is home).

530. Development of Spanish-American Literature: Pre-Columbian Period to Independence (3) I (Identical with SPAN 530, which is home).

531. * Civilization in the Portuguese-Speaking World (3) II (Identical with PORT 531, which is home).

537. * Democracies, Emerging and Evolving (3) I (Identical with POL 537, which is home).

539. * Ethics and the News Media (3) I (Identical with JOUR 539, which is home).

540. Development of Spanish-American Nineteenth and Twentieth-Century Literature (3) I (Identical with SPAN 540, which is home).

544. In the Wake of the Green Revolution (3) II P, consent of department. (Identical with ANTH 544, which is home).

547. * Latin-American Political Development (3) II (Identical with POL 547, which is home).

548. * Government and Politics of Mexico (3) I (Identical with POL 548, which is home).

549. * Brazilian Literature in Film (3) I (Identical with JOUR 549, which is home).

550. Development of Mexican and Mexican-American Literature (3) I (Identical with SPAN 550, which is home).

553a-553b. * Mesoamerican Archaeology (3) I (Identical with ANTH 553a-553b, which is home).

554. * Andean Archaeology (3) II (Identical with ANTH 554, which is home).

557. * Andean Archaeology (3) I (Identical with POL 557, which is home).

560. * The State of Sonora (3) II The geographical, historical, political and cultural dimensions of the Mexican state of Sonora, with a special emphasis on rural Sonora, its geography, people and economy, and on the regional relations within the state. Field Trips. Graduate-level requirements include meeting separately with instructor, discussing additional readings and writing a longer research paper. (Identical with GEOG 560).

563. * Topics in Luso-Brazilian Literature (3) I II (Identical with PORT 563, which is home).

564. * History of Argentina (3) I (Identical with HIST 564, which is home).

565. * Women in International Development (3) II (Identical with ANTH 565, which is home).

566. * History of Brazil (3) II (Identical with HIST 566, which is home).

567. * Contemporary Latin America (3) I (Identical with HIST 567, which is home).

569. * History of Women in Latin America (3) II (Identical with HIST 569, which is home).

585. Political Risk and Intelligence Analysis (3) II (Identical with POL 585, which is home).

631. Anthropology and Development (3) II (Identical with SPAN 631, which is home).

693. Internship (1-6) [Rpt./]

695. Colloquium a. Latin American Studies (3) [Rpt./ 1] I II.

d. Latin American Studies Special Topics (3) [Rpt./ 1] II.

696. Seminar a. Latin American Studies (3) [Rpt./ 1] I P, Spanish or Portuguese proficiency.

b. Latin American Press (3) I II (Identical with PORT 585, which is home).

699. Independent Study (1-4) [Rpt./] I II.

700. Research (2-4) [Rpt./]

910. Thesis (1-6) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]
Law (LAW)
1201 E. Speedway Blvd.
Phone: (520) 621 - 1373
FAX: (520) 621 - 9140
WWW: http://www.law.arizona.edu

Application Questions:
Terry Holpert, (520) 621-3477,
admissions@law.arizona.edu

Degrees Offered: J.D., L.L.M.

Concentrations: general practice, corporate, tax, Indian law, and estates and trusts.


Associate Professors: David Golove, Katherine Franke, Michael Chiorazzi (Director of Law Library)

Assistant Professor: Mona L. Hymel

The College of Law offers course work leading to the Juris Doctor (J.D.) degree and the Master of Laws in International Trade (L.L.M.), and participates in several joint degree programs. Courses leading to the Juris Doctor degree are numbered at the 600-level. For a description of College of Law courses and degree requirements, please see The College of Law Catalog. The L.L.M in International Trade may be earned by a limited number of students. For degree requirements, write David A. Gantz, Director of Graduate Studies, College of Law, The University of Arizona, 1201 E. Speedway Blvd., Tucson, AZ 85721.

The 500-level courses below identify Law-related courses offered by other departments that are cross-listed with Law. They may be taken to support special student interests or as part of a program for students seeking joint degrees. For information on joint degree programs, consult the College of Law and the departments offering the joint degrees with the College of Law (Psychology, Philosophy, Economics, American Indian Studies, Business and Public Administration). The 600-level courses listed below are open to law students and to graduate students with special permission from the College of Law and the Graduate College.

540. Correctional Policy and Theory (3) II (Identical with PA 540, which is home).
562. Mental Health Law and Policy (3) [Rpt./ 3] I II (Identical with PSYC 562, which is home).
584. Development of Federal Indian Policy (3) II (Identical with POL 584, which is home).
596. Seminar
600. Contracts (5) I
601a-601b. Introduction to Legal Process and Civil Procedure (3-2) I-II
601b. Introduction to Legal Process and Civil Procedure (2) II
602. Criminal Procedure (4) I II
603a-603b. Research and Writing: First-year student (3) I II
605. Property (5) II
606. Constitutional Law I (3) I
607. Appellate Practice and Moot Court (1) II
608. Evidence (4) I II
609. The Legal Profession (2-3) I II
610. Health Care Law (3) I II
611. Employment Law (3) I II
612. Family Law (3) II
613. Law and Medicine (3) II
614. Disability Law (2) I
615. Constitutional Law II (4) II
616. Corporations I (3) I II
617. Corporate Finance (2) II P, LAW 616.
618. Antitrust Law (3) II
619. Estates and Trusts (4) I
620. Immigration Law (3) I
621. Administrative Law (3) II
622. Law Review (1-3) I II
623. Conflict of Laws (3) II
625. American Legal History (2) I
626. Jurisprudence (2-3) I
627. Mexican Law (2) II
628. Constitutional Issues of State and Church (1) This course will address constitutional issues of church and state, including the free exercise clause of the U.S. Constitution as well as the establishment clause of the constitution.
629. Sexual Orientation (2-3) I II This course will analyze the law's effect on gay men and lesbians as a class and may include such areas of legal regulation as military, child custody, and marriage laws. Recent United States Supreme Court cases will be examined, as well as state and federal statutes relating to sexual orientation.
630. Scientific Evidence (3) I
631a-631b. Federal Indian Law I (3-3) I II (Identical with AIS 631a-631b).
632. Federal and State Taxation of Multinational Transactions (3) I P, LAW 646.
633a. UCCI Sales (Article 2) (3) I
633b. Electronic Fund Transfers and Payment Systems (Art. 3 and 4) (3) II
633c. Secured Transactions Article 9 (3-4) I II This course will cover Article 9 of the Uniform Commercial Code, which deals with secured transactions.
634. Corporations II (2-3) II P, LAW 616.
635. Insurance Law (3) I
637. Federal Criminal Law and Criminal Procedure (2-3) I
638. Real Estate (3) II
639. Community Property (2) I
640. Mining and Public Land Law (2) II
641. Water Law (3) I
642. Federal Jurisdiction (3) II
643. The Legislative Process (1) I II This course will address the congressional process of appropriations and authorizations relating to Acts of Congress.
644. Remedies (1) I
646. Federal Income Taxation (3-5) I
647. Corporate Taxation (3) II P, LAW 646.
649. Torts II (3) II
650. Criminal Law (3) II
651. Environmental Justice (2-3) I II Explures issues of justice in the context of environmental law and policy. It considers whether environmental burdens are evenly distributed; whether governmental decision makers adequately take into account the circumstances of communities of color and low income communities in setting environmental standards; and whether the institutions of environmental law and policy provide equal access to all. It examines the role of the law in remedying the inequalities of deficiencies identified.
652. Income Taxation of Estates and Trusts (2) II P, LAW 619, LAW 646.
653. Advanced Appellate Practice and Moot Court (2) II
654. Environmental Legislation (2) I II
Library Science

(See Information Resources and Library Science)

Linguistics (LING)
Douglass Bldg., Rm. 200E
PO Box 210028
Phone: (520) 621-6897
FAX: (520) 621-9424
WWW: http://wacky.ccit.arizona.edu/ling/index.htm

Application Questions: Rosemary E. Emery, emery@u.arizona.edu, 621-2113
Degrees Offered: M.A., Ph.D
The unit offers a master's degree, but initial admission is to the doctoral program only

Professors: Thomas G. Bever, Head, Diana Archangeli, Richard Demers, Merrill Garrett (Psychology), Michael Hammond, Robert M. Harnish (Philosophy), Jane Hill (Anthropology), D. Terence Langdneedon, Ofelia Zepeda
Associate Professors: Andrew Barss, Paul Bloom (Psychology), LouAnn Gerken, Eloise Jelinek, Simin Karimi (Near Eastern Studies), Cecile McKee
Assistant Professors: Andrew H. Carnie, Janet Nicol (Psychology), Feng-hsi Liu (East Asian Studies), MaryAnn Willie (American Indian Studies)

The Department of Linguistics offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in linguistics. For the doctorate, specializations are available in such areas as: syntax, phonology, semantics, morphology, Native American linguistics, Persian linguistics, cognitive science, language acquisition and development, and language processing.

The department, together with the Department of Anthropology, also offers a Doctor of Philosophy degree in Anthropology and Linguistics. The department participates in the Graduate Interdisciplinary Program in Second Language Acquisition and Teaching (SLAT).

Applicants for admission must forward to the department scores on the aptitude test of the Graduate Record Examination, three letters of recommendation from previous instructors or academic advisors, a sample work, and a departmental application form. International students must take the TOEFL Test and gain a minimum score of 550.

All students, regardless of their intended specialization or degree objective, are expected to complete the following courses: 501, 503, 504 or 505, 510, 514, 599a (two semesters), and two of the following: 532, 533, 564. These courses cover the foundations and major current developments in the phonology, morphology, syntax, and semantics of natural languages.

Master of Arts: A total of 30 units of course work is required, including all of the courses listed above. A master's examination consisting of the submission of an expanded term paper is required. The paper must be approved by a committee of the student's advisor and two other faculty members. No thesis is required.

Doctor of Philosophy: In addition to the courses listed above, students must complete 697a, two seminars, and a dissertation. Additional courses and seminars are required depending on the student's area of specialization and minor field. A minor taken within the department consists of 12 units. The written preliminary examination consists of the submission to the faculty of a research paper of the scope of a journal article, normally at the end of the fifth semester. A dissertation proposal must be approved by the student's dissertation director within 6 months of passing the oral comprehensive examination. Further information about the graduate program is provided in the Handbook of Policy for the Graduate Program in Linguistics, which is available upon request from the department and is accessible through the department's home page.

Linguistics (LING) participates in the Graduate Interdisciplinary Program in Second Language Acquisition and Teaching (SLAT).

Applicants for admission must forward to the department scores on the aptitude test of the Graduate Record Examination, three letters of recommendation from previous instructors or academic advisors, a sample work, and a departmental application form. International students must take the TOEFL Test and gain a minimum score of 550.

All students, regardless of their intended specialization or degree objective, are expected to complete the following courses: 501, 503, 504 or 505, 510, 514, 599a (two semesters), and two of the following: 532, 533, 564. These courses cover the foundations and major current developments in the phonology, morphology, syntax, and semantics of natural languages.

Master of Arts: A total of 30 units of course work is required, including all of the courses listed above. A master's examination consisting of the submission of an expanded term paper is required. The paper must be approved by a committee of the student's advisor and two other faculty members. No thesis is required.

Doctor of Philosophy: In addition to the courses listed above, students must complete 697a, two seminars, and a dissertation. Additional courses and seminars are required depending on the student's area of specialization and minor field. A minor taken within the department consists of 12 units. The written preliminary examination consists of the submission to the faculty of a research paper of the scope of a journal article, normally at the end of the fifth semester. A dissertation proposal must be approved by the student's dissertation director within 6 months of passing the oral comprehensive examination. Further information about the graduate program is provided in the Handbook of Policy for the Graduate Program in Linguistics, which is available upon request from the department and is accessible through the department's home page.

500. Linguistics for Non-majors (3) I, II Its conceptual foundations, methodology, and current theoretical frameworks. Students will carry out actual linguistic analysis. For students in the M.A. program and in fields other than linguistics. P, open to non-majors only. (Identical with SLAT 500).

501. Formal Foundations of Linguistics (3) I A survey of the aims of linguistic research and introduction to the basic mathematics of formal linguistics; logic, sets, algebra, graphs, feature structures, formal language theory. (Identical with SLAT 501).

502. * Gender and Language in Japan (3) II (Identical with JPN 502, which is home).

503. * Foundations of Syntactic Theory I (3) I Introduction to fundamental issues in the theory of syntax. Familiarizes the student with the essentials of (1) government binding theory and its precursors, and (2) standard categorical grammar and its relatives. P, LING 300. Graduate-level requirements include a greater number of problems. (Identical with SLAT 503).

504. Advanced Syntactic Theory (3) II Continuation of 503, focusing on government, control, binding, thematic relations, and the theory of logical form. (Identical with SLAT 504).


510. * Foundations of Phonological Theory I (3) I Investigation of the principles that underlie current phonological theory, concentrating on the representation of sounds and the regular patterns of sound in natural language. Topics include distinctive feature theory, syllable theory, the core skeleton, rule formulation and rule interactions. P, LING 315. Graduate-level requirements include a greater number of exercises.

511. Introduction to Japanese Linguistics (3) I, II. (Identical with JPN 511, which is home).

512. * Advanced Japanese Linguistics (3) II (Identical with JPN 512, which is home) P, JPN 511.

514. Foundations of Phonological Theory II (3) II Investigation of the evidence and arguments for non-linear representations (autosegmental and metrical) of the organization of the phonological component of grammar, including evidence for its interaction with morphological structures and rules.

515. * Phonological Phonetics (3) I Study of the acoustic and articulatory properties of sounds and patterns of sounds that occur in human language. Focus on the significance of the properties of sounds for phonological theory, in particular, distinctive feature theory. Role of psycho-acoustic studies as a source of evidence for phonological theory. P, LING 315. Graduate-level requirements include an additional project or research paper.

519. * Linguistic Structure of Modern Chinese (3) I (Identical with CHN 519, which is home).

520. * Linguistic Structure of Modern Chinese (3) II (Identical with CHN 520, which is home).
522. Linguistic Semantics and Lexicology (3) II Study of word and sentence meaning, relationship between the lexicon and the grammar, idioms, metaphor, etymology, and change of meaning. P, one course in linguistics. (Identical with PHIL 522).

525. Language Variation (3) II Study of geographical and social dialects, stylistic differences, and ideological variation and the implications of variation for writing grammars and for understanding language change. P, ANTH 276 or one course in linguistics preferably LING 101 or LING 201. Graduate-level requirements include mastery of the formalism, solving data-set problems, and a higher level of performance. (Identical with ANTH 525).

526. * Introduction to Arabic Linguistics (3) II (Identical with ARB 526, which is home).

532. * Psychology of Language (3) II Introduction to language processing. The psychological processes involved in the comprehension and production of sounds, words, and sentences. Other topics may include language breakdown and acquisition, brain and language, and bilingual processing. P, LING 101 or PSYC 101. Graduate-level requirements include more extensive readings and writing. (Identical with PHIL 532, PSYC 532).

535. Morphology (3) I Morphology is the internal structure of words and the relationship between words and the syntactic, phonological, and semantic properties of the units that include them. Course work includes the development of morphological theory.

536. * Japanese Sociolinguistics (3) I (Identical with JPN 536, which is home).

538. Computational Linguistics (3) I Fundamentals of formal language theory, syntactic and semantic processing; the place of world knowledge in natural language processing. P, LING 308 or a course in one of the following: formal languages, syntax, data structures, or compilers. Graduate-level requirements include a greater number of assignments and a higher level of performance. (Identical with C SC 538, PSYC 538).

541. * Language Acquisitions (3) II (Identical with SP H 541, which is home).

542. Topics in Psycholinguistics (3) [Rpt./ 1] I II (Identical with PSYC 542, which is home).

543. * Advanced Language Development (3) I II (Identical with PSYC 543, which is home).

544. Typology and Universals (3) I An examination of the syntactic diversity presented by natural human languages and an exploration of the issues that such diversity presents for syntactic analysis. Topics include AUX, word order, constituency, and subjects. 545a-545b. * Structures of Non-Western Languages (3-3) [Rpt./ 2] in-depth linguistic analysis of selected phonological, syntactic, and semantic problems in a non-Western language, concentrating on native languages of the Southwest area. P, LING 101 or LING 201. Graduate-level requirements include a higher level of performance. (Identical with AIS 545a-545b).

548. Topics in Language and Cognition (3) [Rpt./ 1] I II, graduate majors in linguistics and psychology or consult department before enrolling. (Identical with PSYC 548, which is home).

562. * Linguistics and the Study of Literature (3) II (Identical with ENGL 562, which is home).

563. * Philosophy of Language (3) I II (Identical with PHIL 563, which is home).

564. Formal Semantics (3) I Introduction to model-theoretic investigations of natural language interpretation, including coordination, quantification, referential relations, tense, aspect and modality. (Identical with PHIL 564).

565. * Pragmatics (3) II (Identical with PHIL 565, which is home).

568. * Speech Perception (3) I II (Identical with PHIL 568, which is home).

574. Linguistic Perspectives on Mexican-American Spanish and Bilingualism (3) I II P, SPAN 340. (Identical with SPAN 574, which is home).

576. * Language in Culture (3) II (Identical with ANTH 576, which is home).

577. * Discourse and Text (3) II (Identical with ANTH 577, which is home).

580. * Historical Comparative Linguistics (3) II (Identical with ANTH 580, which is home).

583. Sociolinguistics (3) I (Identical with ANTH 583, which is home).

589. * Areal Survey of Native North American Languages (3) I II P, ANTH 276 or LING 101. (Identical with ANTH 589, which is home).

595. Colloquium
a. * Linguistics (1) [Rpt./ 3] I II

596. Seminar
a. * Topics in Japanese Linguistics (3) [Rpt./ 2] II S (Identical with JPN 596c, which is home).

599. Independent Study (1-6) [Rpt./]

600. Current Issues in Linguistic Research (3) [Rpt./ 1] I II Current research in linguistics, with emphasis on relationships among syntax, semantics, and phonology. 696 Seminar
a. Syntax and Semantics (3) [Rpt./ 2] I II
b. Topics in Phonological Theory (3) [Rpt./ 2] I II
c. Current Issues in Syntactic Theory (3) [Rpt./ 2] I II
d. Current Issues in Syntactic Theory (3) [Rpt./ 2] I II
e. Linguistic Investigations and Applications (3) [Rpt./ 3] I II (Identical with COMM 696f, PSYC 696f).
h. Topics in Morphology (3) [Rpt./ 2]

697 Workshop
a. Linguistic Theory (3) I P, open to majors only.

Management and Policy

McClelland Hall, Rm. 405
PO Box 210108
Phone: (520) 621-1053
FAX: (520) 621-4171
WWW: http://www.bpa.arizona.edu/depts/map

Application Questions: Lois Christ, (520) 621-7463, lchrist@bpa.arizona.edu

Advising Questions: Ken Koput, (520) 621-1053

Degrees Offered: Ph.D. (major in Management)

Concentrations: Organizational theory, organizational behavior and human resource management, and judgment and decision making.

Professors: Terence Connolly, Head, Lee R. Beach, Edwin B. Flippo (Emeritus), Michael R. Gottfredson, Barbara A. Gutek, Travis W. Hirschi (Emeritus), James P. Logan (Emeritus), H. Brinton Milward, June M. Morrison (Emerita), Raymond A. Mulligan (Emeritus), Keith G. Provan, Amnon Rapoport, George W. Summers (Emeritus)

Associate Professors: Marvin Fortman (Emeritus), Stephen W. Gilliland, Kenneth W. Koput, David A. Tansik, Robert E. Tindall

Assistant Professors: Lehman Benson, III, Barry M. Goldman, Laura J. Kray, Lisa D. Ordóñez

The department participates in programs leading to the Master of Business Administration, the Master of Public Administration, and the Doctor of Philosophy degree with a major in management. For information concerning these degrees, see chapter IV, Requirements for Master's Degrees/Master of Business Administration/Master of Public Administration, and chapter VI, Requirements for Doctoral Degrees.

For admission, the applicant is expected to have completed undergraduate work in statistics and mathematics through calculus (MATH 119 and 123). Applications must submit scores on the Graduate Record Examination or the Graduate Management Admissions Test.
The program for the Doctor of Philosophy degree (with a major in Management) is designed to prepare individuals for careers in academia with an emphasis on the ability to make original and significant contributions to the disciplines of management and policy, and judgment and decision making, through high-quality research. To this end, the Ph.D. program provides strong theoretical and methodological training to doctoral program provides strong theoretical and methodological training to doctoral students.

500. Management Case Analysis and Presentation (3) I II Written analysis of cases and other reports; development of skills in analysis, decision making, and written and oral presentation, with emphasis on the total situation of each case considered.

502. Organization Theory and Behavioral Relations (3) I II

503. Human Resource Management (3) I Principles, methods, research relevant to management of an organization's human resources, with emphasis on employment psychology, training, development, compensation. P, MAP 305 or MAP 502.

506. Business Communication in Management (1) One unit of a three-course module designed to improve the oral and written communication skills of MBA students preparing for business leadership careers. In this module, students learn to prepare and deliver oral presentations and written documents which focus on effective communication in the business discipline of management. P, MBA students only; CR, MAP 502.

525. Organizational Theory (3) I II (Identical with SOC 525, which is home).

530. * Human Resources Policies (3) II An integrative, case-oriented course focusing on problems and policies in the procurement, development, compensation, and motivation of personnel. P, MAP 330, 6 units in human resource management. Graduate-level requirements include sexual harassment grievance procedure project and presentation.

532 Conflict and Cooperation in the Dyad (3) I Critical exposition of the essential ideas of two-person game theory and the findings of experimental research on strategic interactions in the dyad.

534. Industrial Analysis and New Venture Development (3) I P, ECON 500, FIN 511, MKTG 500. Open to entrepreneurship program students only. (Identical with ECON 534, which is home).

537. Finance for New Ventures (3) I P, FIN 511, MKTG 500. (Identical with FIN 537, which is home).

538. Marketing, Negotiation and Decision Tactics (3) II Development of bargaining and decision-making skills through simulated negotiations and role playing. Open only to students in the entrepreneurship program. P, ECON 500a, ECON 500b, FIN 511, MKTG 500.

539. Planning of New Ventures (3) II New venture development, financial projections, resource assessment, and long-range planning. Open only to students in the entrepreneurship program. P, ECON 500a, ECON 500b, FIN 511, MKTG 500. (Identical with FIN 539).

543. White Collar and Organizational Crime (3) I (Identical with PA 543, which is home).

545. Interactive Behavior in Small Groups (3) II Critical survey of the essential ideas of n-person game theory (n>2) and the findings of experimental research on social dilemmas, bargaining, and coalition formation.

554. Research Methodology (3) I Behavioral research techniques; bias, validity, reliability, and applicable statistical techniques; critiques of research articles and reports.

556. Gender Issues in Organizational Behavior (3) I II Reviews the research on several topics having to do with gender and organizations, including: social determinants of career choice; occupational sex segregation; perceptions of men and women as managers; gender issues in motivation, leadership, and job satisfaction; work and family issues; implications of technological change for women's employment; organizational change including affirmative action and comparable worth. (Identical with SOC 556).

557. Strategic Management for the Technology Industry (1) I To facilitate the development of a foundation of understanding of the organization as a system. Learn how to effectively integrate the concepts of Organization Theory, Organization Behavior, Strategic Management to create an organizational system that will most effectively achieve the goals of the organization's stakeholders.

558. Management of Technology (3) I Issues in formulating and implementing technology strategy as organizations and industries grow, mature and stagnate. Topics include patterns of diffusion, role of licensing and joint ventures, and the divergence between leading edge and profitable science. P, MAP 305 or MAP 502.

564. Conflict Management and Negotiation (3) I Understanding the theory and processes of negotiation as applied to a variety of settings. This course is temporary, and will be offered during the Fall of 1999 only.

565. Environmental Scanning and Business Strategy (3) I II P, MKTG 500, ECON 500, FIN 511. Open to MBA graduate students only. (Identical with MKTG 566, which is home).


579. Issues in Rural Health (3) I (Identical with NURS 579, which is home).
Management Information Systems (MIS)
McClelland Hall 430
Phone: (520) 621-2497
FAX: (520) 621-2433
WWW: http://www.bpa.arizona.edu/bpa_departments/mis/index.html

Application Questions:
Gail Warner, (520) 621-2748, gwarner@bpa.arizona.edu
MS Advising Questions:
Pam Slaten, (520) 621-7497, pslaten@bpa.arizona.edu
PhD Advising Questions:
Suzanne Weisband, weisband@bpa.arizona.edu

Degrees Offered: M.S., Ph.D. (major in Management)

Concentrations: Group decision support systems, enterprise resource planning, electronic commerce, knowledge management, data warehouse and decision support, database and interoperability, international and social IT issues, legal and security issues in IT, management of information technology, technology innovation, network of software development.

Professors: Olivia R. Liu Sheng, Head, Hsinchun Chen, Moshe Dror, Seymour Goodman, James F. LaSalle, Jay F. Nunamaker, David E. Pingry, Sudha Ram
Associate Professors: Douglas R. Vogel, Suzanne Weisband, Leon Zhao
Assistant Professors: David Meader, Matt E. Thatcher, Daniel Zeng
Assistant Dept. Head: Pamela Slaten
Research Director, Center for the Management of Information: Jay F. Nunamaker
Associate Director, Center for the Management of Information: Mari Heltne
Director, Artificial Intelligence Lab: Hsinchun Chen

To be considered for admission, applicants must have earned a competitive, acceptable score on the Graduate Management Admissions Test and a competitive undergraduate cumulative grade-point average. Applicants must also have completed preparatory work in mathematics, statistics, and business.

The program requires the completion of 30 graduate units, including a master's project (696h).

506. Business Communication in Operations Management (1) This is one unit of a three-course module designed to improve the oral and written communication skills of MBA students preparing for business leadership careers. In this module, students learn to prepare and deliver oral presentations and written documents which focus on effective communication in the business discipline of operations management. P, CR MIS 567. Open to MBA students only

507a-507b. Information Systems Architecture and Data Communications (3-3) 507a: I Fundamental concepts of software development systems. The principles of operating systems are presented, emphasizing UNIX and DOS/Windows. The role of programming languages in development environments is explored, and the C and C++ languages are introduced. The nature of the software development cycle is presented with an emphasis on software development environments P, CR MIS 567. Open to MBA students only

511. * Social Issues of Computing (3) Design of computer-based solutions to individual and organizational problems; involves an analysis of subsystems user interfaces, hardware/software selection and evaluation, and system implementation; explores interface between systems and individuals and systems and organizations. P, MIS 341 and advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper.

521. * Systems Modeling and Simulation (3) I II Topics include concepts of simulation software, model validation, selecting input, probability distribution, random variate generation, statistic analysis of output data. P, previous programming experience helpful not required: basic course in statistics. Advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper.

522. * Linear Programming and Applications (3) I Recognition, formulation and solution of linear programming models for decision making. Modeling issues illustrated using examples from systems design, manufactur-

ing, logistics, finance, etc. P, MATH 119 and advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

531a-531b. Data Structures and Database Management (3-3) 531a: I This course covers the design, implementation and analysis of data structures to be examined including stacks, queues, lists, trees, and graphs. The course will cover 40-50 different search and analysis algorithms for important information systems applications, including knowledge discovery, database management, search, and data mining. Hands-on projects involving C, C++ or Java programming are required. P, knowledge of a programming language such as C, C++, or JAVA. 531b: II Introduction to database processing in comparison with file processing. Review of file organization and relevant data structures. Detailed study of various tools needed for logical and physical design, including data flow diagrams and the entity-relationship model. Examines the Relational and Coddasyl database models. Several commercially available database management systems are reviewed. Course covers implementation. Students learn to develop database applications using Sybase or Sun/Unix machines. P, MIS 531a.

533. Data Management: Technology and Applications (3) II Introduction to fundamentals of database systems, design techniques and their use in organizations. Course covers relational database technology and focuses on design of database applications. Course covers relational database technology and focuses on design of database applications. Case studies are used to illustrate the use of database systems for strategic and operational decision making. Emerging technologies and their applications are covered. Students gain hands-on experience with state-of-the-art commercial relational and object-oriented database technology and learn to use SQL. P, basic working knowledge of computers.

541a-541b. Computer Aided Information Systems Analysis and Design (3-3) 541a: I Tools, techniques and methodologies for Business Process Re-Engineering, Information systems analysis and design. Other topics to be discussed include Enterprise Resource Planning (ERP) systems and supply chain management. Students are expected to undertake a project in a "real world" setting. (Identical with C SC 541a). 541b: II Tools, techniques and methodologies for undertaking Object Oriented Analysis and Design will be covered in detail. Students are expected to undertake a group project implementing an object oriented application. (Identical with C SC 541b).

550. * International Dimensions of Information Technologies (3) I National and regional information technology development strategies and policies; IT and national sovereignty; development and control of global "information highways"; impact of public and business policies on information systems design and use; international institutions and IT: convergence or divergence of information systems across
countries, regions and international economic sectors. P, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program and a class presentation.

551. * Advanced Business Programming (3) I Technically oriented class focusing on software engineering practices after substantial definition of user requirements. Topics may include individual and team based processes, project management, inspection processes, design verification and validation, formal methods and software economics. P, MIS 301 and advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional in-depth term paper and 30% more reading.

553. * Software Systems (3) I II Software development and software engineering; brings together the elements of programming language, operating system, and development techniques; teaches and uses the C programming language and the Unix operating system. P, MIS 301, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include the production of several medium-sized programs, with emphasis on the program life-cycle, maintainability, and life-cost. P, some knowledge of data structure.

554. Advanced Object-Oriented Programming (3) II The course provides instruction in the application of object-oriented programming for business. Students will learn how to program and de-bug JAVA and Visual C++ systems. The course may include instruction in exception handling, graphic user interface (GUI) design, multi-threading, networking and other advanced topics. P, MIS 301. Graduate-level requirements may include an additional term paper. P, MIS 531a.

555. Emerging Information Technology and Management (3) I II Topics will vary depending on student and faculty interest and recent developments in the field.

567. Design and Control of Production Systems (3) II Instruction of the basic concepts in operations management. Topics covered include quality control, process analysis, MRP, queuing theory, forecasting, and classical inventory models. P, open only to graduate students in BPA.

570. Management and Evaluation of Information Systems (3) I II The methodologies of economics and management information systems are applied to the problem of designing and evaluating information systems for a profit-maximizing firm. An MBA integrative course. P, ECON 300 or consent of instructor.

573a-573b. * Production and Operations Management (3-3) 573a: II Productive systems, including service type industries; activities entailed in selecting, designing, operating, controlling, and updating systems. Forecasting, aggregate planning, MRP, inventory models under uncertainty, scheduling. P, MIS 373, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program. 573b: Topics include project management, quality control, reliability, facility layout and decision theory. Case studies, group projects and industry speakers give students an understanding of human problems and quantitative methods. P, MIS 373, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

574. * Current Topics in Operations Management (3) II Coverage of new techniques and technologies in operations management. Examples of topics that may be covered are JIT, OPT, robotic. P, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

575. * Managing for Quality Improvement (3) Operational aspect of quality improvement. Topics include statistical process control, total quality management. P, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

576. * Management of Service Operations (3) I Explores management issues for services, which dominate our modern economy. Emphasis on design and evaluation of service systems, information system requirements through case analyses, analytical problem solving, and/or term project. P, MIS 373, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

577. * The Supply Chain and Logistics (3) I Organization, management and control of material flow processes; logistical strategies and relationships of procurement, handling, warehousing, transportation, and inventory control. P, MIS 373. Graduate-level requirements include an additional term paper or program.

578. * Project Management (3) I Projects are the preferred way to get things done today in business. Course focuses on the problems and methods of running projects; special attention to information technology and software projects. Students manage real projects, use scheduling software, study cases and analytical tools. P, MIS 373, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

579. * Computer Models for Operations Management (3) I Use of available software packages to analyze complex operations management problems. P, MIS 373, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an additional term paper or program.

580. * Knowledge Management (3) I Knowledge management is a discipline that promotes an integrated approach to identifying, capturing, retrieving, sharing, and evaluating an enterprise's information and knowledge assets. Topics include artificial intelligence, information retrieval, groupware, data warehousing, human-computer interactions and multimedia/multilingual systems. Graduate-level requirements include an additional term paper.

581. Internet Business and Technology (3) I II This course examines the information content, design, implementation, operational, managerial, business and legal issues that are essential to doing business on the Internet. Graduate-level requirements include an Internet overview and a case study analysis. (Identical with JOUR 581).


588. Systems Design for Management (3) I II Focuses on automated tools to support managers in organizations including office automation, decision support systems, GDSS; applications and methodologies for designing, implementing, and evaluating such systems and their organizational impact.

596. Seminar a. Special Topics in Management Information Systems (3) [Rpt./ 9 units] I II

597. Workshop a. * Collaboration Computing (3) I II

599. Independent Study (2-6) [Rpt./]

611a-611b. Topics in Research Methodologies in MIS (3-3) 611a: I Introduces beginning doctoral degree students and advanced master's degree students to important research and survey articles in the field of management information systems. 611b: II Provides a knowledge of research methodologies used in the MIS discipline, including experimental design, surveys, case studies, field work, and software engineering.

671. International Issues (3) I Analysis of industry successes and failures in global markets, focusing on the national characteristics, company strategies and national policies behind them. Case studies of more than 20 countries around the world (most of which will be student generated). International developments and problems. Special emphasis on international technological developments and issues related to the globalization of the information technologies.

680. Advanced Topics in Artificial Intelligence (3) I This course covers advanced and practical AI techniques such as natural language processing, cognitive modeling techniques, machine learning techniques,
neural networks, and evolutionary programming. These techniques will be discussed in the context of emerging information systems applications, including knowledge discovery, advanced visualization, virtual reality, human-computer interactions, geographic information systems, digital libraries, and Internet searching. Hands-on projects involving C, C++, or Java programming are required. P, MIS 531a. Open to all graduate students.

696. Seminar
a. Readings in MIS (3) I II
b. Group Support Systems (3) I II
c. Emerging Information Technologies (3) I II
d. Models for Quantitative Analysis (3) I II
e. Recent Advances in MIS (3) I II
f. Advanced Topics in Data Management (3) II

699. Independent Study (1-6) [Rpt./]

796. Seminar
a. Research Issues (3) [Rpt./] I II P, open to majors only.

797 Workshop
a. Research Design (3) [Rpt./] 5 I II P, MIS 796a.

799. Independent Study (1-6) [Rpt./]

900. Research (2-4) [Rpt./]

910. Thesis (6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Marketing (MKTG)**

McClelland Hall, Rm. 320
PO Box 210108
Phone: (520) 621-7479
Fax: (520) 621-7483
WWW: http://www.bpa.arizona.edu/bpa_departments/mkt/index.html

Application Questions:
Karen Griggs, (520) 621-3519, griggs@bpa.arizona.edu

Advising Questions:
Sidney J. Levy, (520) 626-2075, slevy@bpa.arizona.edu

Degrees Offered: Ph.D. (major in Management)

Professors: Sidney J. Levy, Head, Merrie L. Brucks, Susan E. Heckler, Joseph W. Newman (Emeritus), Melanie Wallendorf

Associate Professors: Shankar Ganesan, Richard A. Scott (Emeritus)

Assistant Professors: Jennifer Escalas, Kapil Jain, Kim Nelson, Aric Rindfleisch, Judi Strebel

Lecturers: Kapil Jain, Kim Nelson

The department participates in programs leading to the Master of Business Administration degree with a major in business administration and the Doctor of Philosophy degree with a major in management. A superior score on the Graduate Management Admissions Test and evidence of strong academic performance at the undergraduate level are required for admission consideration.

For information concerning these degrees see Chapter IV, Requirements for Master's Degrees/Master of Business Administration and the headnotes under Business Administration elsewhere in this chapter.

500. Marketing Management (3) I Scope, environment and nature of marketing management; customer and market analysis for product, service, price, promotion and distribution decisions. P, open only to students in the BPA graduate programs.

506. Business Communication in Marketing (1) I One unit of a three-course module designed to improve the oral and written communication skills of MBA students preparing for business leadership careers. In this module, students learn to prepare and deliver oral presentations and written documents which focus on effective communication in the business discipline of marketing. P, MKTG 500, open to MBA students only.

530. Management of Marketing Communications (3) I II Application of communications theory and research findings in advertising, sales promotion, publicity, personal selling; planning, conduct and administration of programs of information and persuasion. P, MKTG 500.

550. Consumer and Organizational Buyer Behavior (3) I Nature of the purchase decision process for goods and services. Theories, concepts and research methods and findings are examined for use in management and public policy decision making. P, MKTG 500.

552. Statistical Decision Making (3) I II Probability and statistical analysis; random variables, sampling distributions, hypothesis testing, Bayesian analysis, time series, statistical investigation. P, MIS 400 or MATH 119; MATH 123. Open only to students admitted to a BPA graduate program.

554. * Management of Sales Operations (3) I II The sales function and its relationship to the total marketing program; sales strategies and objectives; development and administration of sales organizations; control and evaluation of sales operations. P, MKTG 361, advanced standing as specified in the College of Business and Public Administration. Graduate-level requirements include an in-depth research paper.

555. Special Topics in Marketing (3) [Rpt./] I II Course addresses special topics in marketing with current managerial relevance.

Such topics could include marketing decision models, marketing and electronic commerce, direct marketing, etc. P, MKTG 500.

557. Industrial Marketing (3) I II Problems and methods of marketing decision-making in industrial, government and high-tech markets. P, MKTG 500.

559. Product Strategy (3) I II Formulating and implementing strategy for growth; analyzing and influencing market structure; developing, pricing, testing new entries; managing the portfolio. P, MKTG 500.

560. International Marketing (3) I II Marketing planning and strategies for foreign environments; cultural, political, economic factors affecting the international marketer, multinational corporation and multinational market groups. P, MKTG 500.

568. Environmental Scanning and Business Strategy (3) I II An MBA integrative course. How information from the economy can be used to develop a firm's competitive strategy. Multidisciplinary, using concepts from economics, marketing and management. Includes case method approach to problems facing top management in making and effecting a strategic plan. P, MKTG 500, ECON 500, FIN 511. Open to BPA graduate students only. (Identical with ECON 568, MAP 568).

572. Marketing Research For Managers (3) I II Specification of management information needs, evaluation of research proposals and findings, methods of gathering and analyzing data, administrative aspects of research and decisions. P, MKTG 500.

582a-582b. Multivariate Analysis I Management I Multiple, polynomial, stepwise regression including indicator variables, inference, remedial measures. P, MKTG 552. 582b: Multivariate Analysis II Analysis of variance and covariance, principal components, discriminant analysis, canonical correlation. P, MKTG 552. MKTG 582a is not prerequisite to MKTG 582b.

599. Independent Study (1-3) [Rpt./]

672. Survey and Qualitative Marketing Research Methods (3) I Survey and qualitative research for marketing management information needs; secondary data search methods; instrumentation, sampling, field work and data analysis; ethnographic, depth interview and projective methods. P, MKTG 500.

673. Experimental Research Methods in Marketing (3) I Statistical, methodological and interpretive issues in the design of laboratory and field experiments/ quasi-experiments for marketing and consumer research. P, MKTG 500.

695. Colloquium
a. Research in Marketing (1) [Rpt./] I II

696. Seminar
a. Perspectives and Principles for Research in Marketing (3) I
b. Marketing Theory (3) I II P, MKTG 696a.

c. Marketing Management and Strategy (3) I
Materials Science and Engineering (MSE)
Mines Building, Room 135
Phone: (520) 621-6070
FAX: (520) 621-8059
WWW: http://www.mse.arizona.edu

Application Questions:
Rose Evans, (520) 322-2315,
revans@aml.arizona.edu

Advising Questions:
David Lynch, (520) 621-6071,
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Degrees Offered: M.S., Ph.D.

Professors: David C. Lynch, Interim
Head, Dunbar P. Birnie, III, Paul D.
Calvert, William G. Davenport, Louis J.
Demer (Emeritus), Pierre A. Deymier, J.
Brent Hiskey, Kenneth A. Jackson, W.
David Kingery, David R. Poirier, Sri
Raghavan, Richard A. Swalin (Emeri-
tus), Terry T. Triffet (Emeritus),
Donald R. Uhlmann, Michael C.
Weinberg

Associate Professors: Brian D. Fabes,
Supapan Seraphin, Brian J.J. Zelinski
Assistant Professor: Jennifer Croissant

The Department offers programs leading
to the Master of Science and the Doctor of
Philosophy degrees with a major in
materials science and engineering.

The graduate programs in the depart-
ment are designed to provide advanced
study in the fields of materials properties,
materials structures, and materials
processing. Emphasis is placed on metals,
alloys, electronic materials, ceramics, and
composites. Courses and research are
provided in extraction, thermodynamics,
kinetics, transport, microstructural
characterization, physical properties,
processing and application.

Master of Science: The course require-
ments for the Master of Science degree are
18 units of regularly scheduled 500-level
courses specified by the Department; 4
units from a combination of colloquium,
independent study and regularly sched-
uled graduate-level courses; and 8 units of
thesis (30 units total). Precise details of
the course requirements are available from
the Department office.

The Master of Science non-thesis degree
option requires 27 units of regularly
scheduled 500-level courses specified by
the Department, and 3 units of collo-
quim, independent study, or regularly
scheduled graduate-level courses. A final
examination is required of all M.S.
candidates. Precise details of the course
and final examination requirements are
available from the Department office.

Students may transfer up to 6 units of
course work completed at other institu-
tions. A student must take a minimum of
20 units in residence.

Applicants with undergraduate
backgrounds in materials science and
engineering or in related science discipl-
ines such as chemistry, physics, or other
related engineering fields can be admitted
to the Master of Science program.
Graduate students entering the program
from other disciplines should have similar
mathematics, chemistry, and physics
backgrounds as in the undergraduate
curriculum in materials science and
engineering. Those students who are
deficient in any of these courses should
then them after admission to the Master of
Science program.

Doctor of Philosophy: A graduate
study program will be designed to ensure
that each student acquires a thorough
understanding of advanced work in the
major field as well as in an appropriate
minor. The dissertation, based on original
research, is expected to represent a distinct
contribution to materials knowledge. It
should establish the fact that the candi-
date is capable of independent, original,
and creative thinking. It is not necessary
that the research be entirely on a scientific
aspect of materials, but may include
economic and design considerations of a
process as well.

As a general policy, applicants with an
M.S. degree in materials science and
engineering or an allied field will be
admitted to the Ph.D. program. Excep-
tional B.S. applicants may be admitted
directly into the Ph.D. program. Compl-
enation of the Ph.D. program requires at least
63 units of graduate courses. These will
include: (1) 36 units of courses in the
major subject (one-half of which must be
in regularly-scheduled classes); (2) 18
units of dissertation; and (3) 10-12 units
of courses in a minor program chosen in
consultation with the dissertation director.
Up to 30 units from a completed M.S.
degree program may be credited toward the
Ph.D. Details of the Ph.D. course require-
ments are available from the Department office.

501. Planning for Discovery (3) [Rpt./ I]
Generation and organization of ideas into an
effective research program. Problem
selection, research planning, research
proposal preparation and presentation. P, a
basic course in physical chemistry. (Identical
with ENGR 501).

502. Research Proposal Preparation (3)
[Rpt./ I] Organization and planning of a
specific potential advisor. (Identical with
ENGR 502).

503. Applied Surface Chemistry (3) I
Fundamentals of surface phenomena,
characterization of solid-vapor, solid-liquid
and liquid-vapor interfaces, applications in
ceramics, electronic and biomedical materials
processing. P, a basic course in physical
chemistry.

505. * Advanced Extractive Metallurgy (3)
Hydrometallurgy: physical chemistry and
kinetics of hydrometallurgical processes
including leaching, solvent extraction and
metal recovery; flowsheet design and
optimization. Pyrometallurgy: analysis,
control and optimization of pyrometallurgical
processes. 3ED. Field Trips. P, MSE 380.
Graduate-level requirements include a
mathematical model.

509. * Transport Phenomena (3) I Principles
of momentum, energy and mass transport, as
applied to materials processing. 3ES. P, MSE
240. MATH 254. Graduate-level require-
ments include either a term paper or
computer model.

510. Thermodynamic Characterization of
Materials (3) I Advanced treatment of
thermodynamics as applied to materials.
Special topics include surfaces, interfaces,
phase transformations. P, MSE 240.

511. * Mineral Processing (3) I (Identical
with MN E 511, which is home).

512. * Physical Chemistry of Materials (3) I
Physical and chemical topics of interest to
material scientists including surface chemis-
try, electrochemistry and chemical kinetics.
3ES. P, MSE 240. Graduate-level require-
ments include a research paper or project.

523. * Electrochemistry in Materials Science
(3) I Principles and applications of electro-
chemistry in materials science with emphasis
on charge-transfer reactions at electrode-
solution interfaces; including electrodeposi-
tion, electroforming, electroless plating. 2.5
ES, 5 ED. P, MSE 240. Graduate-level
requirements include a special project.

524. * Physics and Chemistry of Ceramic
Materials (3) I Ceramic crystal structures,
crystal chemistry, phase equilibria and
sintering theory. 3ES. P, MSE 222, MSE 240
or consult department before enrolling.
Graduate-level requirements include an
advanced topic term paper.
532. Solid-Fluid Reactions (3) I P, CHEE 326 and CHEE 420, or MSE 450R and MSE 412. (Identical with CHEE 532, which is home).


534. Advanced Topics in Electronic Materials (3) [Rpt./ 2] I Topics to be selected from ferroelectrics, opto-electronics, wave guides, and semiconductor materials. (Identical with ECE 534, OPTI 534).

535. * Corrosion and Degradation (3) II The science of corrosion and degradation reactions and its application to engineering problems. 2ES, 1ED. P, MSE 331R or MSE 412; or, P or CR, CHEM 480b. Graduate-level requirements include a term paper. (Identical with CHEE 535).

540. * Thermodynamics of Condensed Phases (3) I Advanced treatment of the principles of thermodynamics with application to electronic and optical materials; emphasis on solutions, defect chemistry and modeling of multicomponent systems. P, MSE 240. Graduate-level requirements include a term paper.

542a-542b * Materials Engineering Design. 542a: (2) I Graduate-level requirements include defense of the design project before the student's research committee. 542b: (2) I Application of engineering design principles to materials applications and processes: Cost and Economic Analysis. P, MSE 360R. Graduate-level requirements include defense of the design project before the student's research committee.

544. * Design Competition (3) II Students utilize their undergraduate experience in formulating and developing a materials design project which they present and defend before a review panel. 3ED. P, MSE 442a. Students utilize their research experience in formulating and developing a materials design project for which they present and defend before a review panel. Team design and research is emphasized. Graduate-level requirements include defense of the design project before the student's research committee.

546. Semiconductor Processing (3) I Silicon and compound semiconductor materials preparation, bulk crystal growth, wafering, epitaxial growth, photolithography, doping, ion implantation, etching, oxidation, metallization, silicon and compound semiconductor device processing. (Identical with ECE 446). Graduate-level requirements include an additional research paper requiring independent research. (Identical with ECE 546).

551. Atomistic Computational Techniques in Materials Science (3) II Monte Carlo and molecular dynamics techniques; classical and quantum dynamical models; application to calculation of materials properties (structural, thermodynamic, transport, electronic properties).

552. * Nondestructive Evaluation of Materials (3) II Introduction to the nondestructive testing and evaluation of the various classes of engineering materials. Methods considered include leak detection, penetrant, electromagnetic, radiographic, ultrasonic, electronic, electrical, eddy current, acoustic emission, and thermal. 2R, 3L. 2ES, 1ED. P, or CR, MSE 331R; MSE 360R. Graduate-level requirements include a term paper.

554. Electronic Packaging Principles (3) I II (Identical with ECE 554, which is home).

555. * Physical Metallurgy and Processing of Steel (3) I Equilibrium and nonequilibrium transformations and phases, effects of alloy elements on important transformations in steel, isothermal transformation diagrams and continuous cooling diagrams. Processing aspects include heat treating, heat transfer during cooling and quenching, segregation effects, and surface hardening techniques. 2R, 3L. 2ES, 1ED. P, MSE 331R or MSE 380, and MSE 409 or A ME 442. Graduate-level requirements include a research term paper or computer model.

557. * Integrated Circuit Laboratory (3) I II (Identical with ECE 557, which is home).

560. * Materials Science of Polymers (3) II Introduction to physical properties of polymers. Microstructure, crystallization, rheology, relaxation and mechanical properties. 1.5 ES, 1.5 ED. P, MSE 331R or MSE 360R. Graduate-level requirements include additional computational and written exercises.

561. * Biological and Synthetic Materials (3) II Discussion of structure and properties of biological materials and composites, such as bone, teeth and elastin. Synthetic materials as substitutes for biological materials, biocompatibility. 1.5 ES, 1.5 ED. P, CHEM 103a. Graduate-level requirements include additional computational and written exercises.

562. * Structure and Properties of Polymers (3) I Topics of intensive current development in polymer science. In each case, the relation between molecular structure, morphology and properties will be explored. Shows how polymers can be designed and tuned to have the properties needed to fulfill specialized functions. 1.5 ES, 1.5 ED. P, MSE 460. Graduate-level requirements include additional computational and written exercises.

565. * Microelectronic Packaging Materials (3) II Design of microelectronic packaging systems based on the electrical, thermal and mechanical properties of materials. Chip, chip package, circuit board and system designs are considered. 3ED. (Identical with ECE 465). Graduate-level requirements include an additional term paper.

570. * Technology of Polymers and Ceramics (3) I Processing and properties of polymers and ceramics in a wide range of technological applications. Discussion of patent literature. 3ED. P, MSE 260 or MSE 331R. Graduate-level requirements include the writing and presentation of an additional term paper.

571. * The Formation and Structure of Glass (3) I The glass transition, Kauffmann's paradox, kinetic theory of glass formation, physics and chemistry of glass making, glass structure, thermal properties. 3ES. P, MSE 260. Graduate-level requirements include a research paper or project.


578. * Design, Production and Performance of Ceramics and Metals (3) II How design procedures and outcomes for materials and material processing depend on social and cultural compromises among performance characteristics. Graduate-level requirements include a term-long design project or design analysis. (Identical with ANTH 578).

579. * Culture and Materials Technology (3) I (Identical with ANTH 579, which is home).

580. * Experimental Methods for Microstructural Analysis (3) II An introduction, through a combination of lectures and laboratory experiences, to both established and new techniques for microstructural characterization of materials. 3ES. Graduate-level requirements include an additional term paper.

585. * Technological Forecasting (3) I Graduate-level requirements include an additional term paper.

586. * Technology and Society (3) I Graduate-level requirements include an additional term paper.

588. * Scanning Electron Microscopy (3) I Graduate-level requirements include additional lab work.


595. Colloquium a. Materials (1) [Rpt./ 5] II

596. Seminar a. Seminar in technology and social theory (3) II Seminar in technology and social theory. (Identical with ENGR 596s, SOC 596s).

599. Independent Study (1-6) [Rpt./ II]
Mathematics (MATH)
Mathematics Bldg., Rm. 108
PO Box 210089
Phone: (520) 621-6892
FAX: (520) 621-8322
WWW: http://www.math.arizona.edu
Grad@math.arizona.edu

Application Questions:
Graduate Secretary,
grad@math.arizona.edu

Degrees Offered: M.A., M.S., Ph.D.


Associate Professors: Bruce J. Bayly, Moises Brio, Marta Civil, William E. Conway, Carl L. DeVito, Samuel Evans, Gregory Eyink, Leonid Friedlander, Oma Hamara, Minhyong Kim, Theodore W. Laetsch, Jiang-Hua Lu, Daniel Madden, Robert S. Maier, Douglas M. Pickrell, Marek Rychlik, Dinesh S. Thakur, Richard B. Thompson, Douglas Ulmer, Joseph Watkins, Jan Wehr, Maciej P. Wojtkowski, Bruce Wood, A. Larry Wright, Xue Xin

Assistant Professors: Robert Beals, Alain I. Goriely, Lucas Hsu, Joceline Lega, Kenneth D. T. McLaughlin, Toniann Pitassi, Juan Restrepo

The department offers programs leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees with a major in mathematics. Concentrations are available in pure, applied, or computer mathematics, in mathematics education, or in probability and statistics. As there are no sharp boundaries between these concentrations, students are encouraged to pursue a broad range of mathematical topics. Programs are planned in consultation with faculty advisers.

To be admitted, applicants must have completed the equivalent of an undergraduate major in mathematics with at least 15 units of upper-division or higher level work including one semester each of advanced analysis at the level of Math. 425, modern algebra at the level of 415, and linear algebra at the level of 413. Applicants are asked to submit scores on the Graduate Record Examination.

Students in master's degree programs are required to pass the Computer Programming examination of the Department of Mathematics as a part of the graduate program.

Master of Arts: This program is for students who wish to combine mathematics with some other discipline. The program must include between 9 and 12 units of approved work outside the department. A thesis is required.

Master of Science: This program is for students who wish to concentrate their graduate credits in mathematics. At least one of the sequences 511a-511b, 520a-520b, 523a-523b, or 534a-534b is required, and 6 units of approved work outside the department must be included in the program. A thesis is required.

Doctor of Philosophy: The major course work consists of at least 36 graduate units. Commonly the minor, consisting of at least 12 units of approved courses, is within the department in a concentration different from the major. Six units of approved courses outside the department are required. There is a language requirement which can be satisfied in any two of the following: French, German, Russian, or computer programming. The principal component of the program is the completion of a dissertation involving original creative research. Ph.D. candidates with other majors who wish to minor in mathematics are required to take four graduate level courses in mathematics and a written examination which covers the content of those courses.

The faculty of the Department of Mathematics carries on research (and research seminars) in a variety of purely mathematical and interdisciplinary fields. In algebra and number theory, research includes finite groups, associative algebras, algebraic number theory, and primality testing. Research in analysis is being carried out on unbounded operators, quantum fields, relativity, and nonlinear problems of ecology, chemistry, and fluid dynamics. In geometry, there is work on convex sets, incidence geometry, and fibre bundles; in probability and statistics, projects involve geostatistics, reliability theory, and nonparametric inference. A detailed summary of faculty research appears yearly and is available on request.

500. History of Mathematics for Elementary School (3) II Topics will include the history of numbers, numerals, and computation, and the history of elementary geometry, algebra, statistics, probability, computing devices, and other topics appropriate to the elementary school mathematics curriculum. This course is applicable to the MA in TTE (with Specialization in Elementary Mathematics). It is not applicable to graduate degree programs in mathematics.

501a-501b. * Symbolic Logic (3-3) I-II 501a: (Identical with PHIL 501a, which is home) 501b. (Identical with PHIL 501b, which is home).


Graduate-level requirements include more extensive problem sets or advanced projects. (Identical with C SC 502, PHIL 502).

503. * Foundations of Mathematics (3) II [Taught alternate years 1999 - 2000] Topics in set theory such as functions, relations, direct products, transfinite induction and recursion, cardinal and ordinal arithmetic, related topics such as axiomatic systems, the development of the real number system, recursive functions. P, MATH 215. (Identical with PHIL 403). Graduate-level requirements include more extensive problem sets or advanced projects. (Identical with PHIL 503).

504. * History of Mathematics (3) I The development of mathematics from ancient times through the 17th century, with emphasis on problem solving. The study of selected topics from each field is extended to the 20th century. P, MATH 215 or MATH 223. Graduate-level requirements include more extensive problem sets or advanced projects. P, not applicable to M.A., M.S., or Ph.D. degrees for math majors except for the M.A. teaching option.

505. Arithmetic and Number Theory for Elementary Teachers (3) Elementary school teachers are introduced to creative mathematics through a series of exploratory problems. The problems are designed to give the teachers an insight into problem solving as well as ideas to use in their own classrooms. Solving problems using elementary arithmetic is used to examine the two main facets of mathematics: abstract thinking and concrete modeling. This course is applicable to the
MA in TTE (with Specialization in Elementary Mathematics). It is not applicable to graduate degree programs in mathematics.

506. Geometry for Elementary School (1-3) [Rpt/4 units] Various topics in geometry for elementary and middle school teachers, such as tessellations, symmetry, length, area, volume, geometric constructions, polyhedra, efficiency of shapes, scale drawings taught with a variety of tools and approaches. Students will participate in geometric problem solving by constructing models using hands-on materials, participating in laboratory activities and using computers of geometric explorations. P, certified elementary teachers with two or more years experience or consent of instructor.

507. Problem Solving in High School (3) I Exploratory problems in algebra, geometry, and number theory will be worked on, written up, and presented to the class. Students will be encouraged to work in groups. Basic principles of problem solving will be discussed throughout. P, open only to M.A. in Math (Teaching Option) and M.A. in TTE.


510. Algebra for Elementary School (3) The course aims at strengthening teachers' understanding of algebra (focusing on a study of patterns and functions), to explore algebra and pre-algebra activities appropriate for K-8 and to discuss research issues related to the learning and teaching of algebra in these grades.

51a-511b. Algebra (3-3) I II Structure of groups, rings, modules, algebras; Galois theory. P, MATH 413a and MATH 415b, or MATH 413 and MATH 415a.

512. Modern Algebra for Secondary Teachers (3) II The course studies fields, specifically the rationals, the reals and the complex numbers. Specific topics include The Fundamental Theorem of Algebra, factoring, Rolle's Theorem, Descartes' Rule of Signs and Sturm's Algorithm for root separation. P, open only to M.A. in Math (Teaching Option) and M.A. in TTE.

513. * Linear Algebra (3) I II Vector spaces, linear transformations and matrices, eigenvalues, bilinear forms, orthogonal and unitary transformations. P, MATH 323. Credit allowed for only one of the following: MATH 413, MATH 410. Graduate-level requirements include more extensive problem sets or advanced projects.

514a-514b Algebraic Number Theory (3-3) I II Dedekind domains, complete fields, class groups and class numbers, Dirichlet unit theorem, algebraic function fields. P, MATH 511b.

515a-515b. * Introduction to Abstract Algebra (3-3) I II Introduction to groups, rings, and fields. P, MATH 323. Graduate-level requirements include more extensive problem sets or advanced projects. 515b: Second Course in Abstract Algebra. A continuation of 515a. Topics may include Galois theory, linear and multilinear algebra, finite fields and coding theory. Polya enumeration. P, MATH 421a. Graduate-level requirements include more extensive problem sets or advanced projects.

517a-517b. Group Theory (3) [Rpt/4] I II Selections from such topics as finite groups, abelian groups, characters and representations. P, MATH 511b.

518. Topics in Algebra (3) [Rpt/4] I II Advanced topics in groups, rings, fields, algebras; content varies.

519. Topics in Number Theory and Combinatorics (3) [Rpt/4] I II Advanced topics in algebraic number theory, analytic number theory, class fields, combinatorics; content varies.


521. * Complex Variables with Applications (3) I II Complex numbers, analytic functions, harmonic functions, elementary functions, complex integration, Cauchy's integral theorem, series representations for analytic functions, residue theory, conformal mapping, applications to steady-state temperature and oscillating systems. P, MATH 254 or MATH 355 or MATH 250b. Graduate-level requirements include more extensive problem sets or advanced projects.


524. * Theory of Complex Variables (3) I Complex numbers, complex-valued functions, analytic functions, elementary functions, series, residues and poles, mapping by elementary functions, conformal mapping, the Schwarz-Christoffel transformation, integral formulas of Poisson type. MATH 421-422 will not be considered a two-semester course at the 400 level in the Master of Arts degree program. P, MATH 323 or consent of instructor. Graduate-level requirements include more extensive problem sets or advanced project.

525a. * Real Analysis of One Variable (3) I Continuity and differentiation of functions of one variable. Riemann integration, sequences of functions and uniform convergence. P, MATH 323. Graduate-level requirements include more extensive problem sets or advanced projects.

525b. * Real Analysis of Several Variables (3) II Continuity and differentiation in higher dimensions, curves and surfaces; change of coordinates; theorems of Green, Gauss and Stokes; exact differentials. P, MATH 425a. Graduate-level requirements include more extensive problem sets or advanced projects.


528a-528b. Banach and Hilbert Spaces (3-3) I Introduction to the theory of normed spaces, Banach spaces and Hilbert spaces, operators on Banach spaces, spectral theory of operators on Hilbert spaces, applications. P, MATH 527b or MATH 583; MATH 523a.

529. Topics in Modern Analysis (3) I II Advanced topics in measure and integration, complex analysis in one and several complex variables, probability, functional analysis, operator theory; content varies.

530. * Second Course in Geometry (3) II [Taught alternate years 2000 - 2001] Topics may include low-dimensional topology; map coloring in the plane, networks (graphs), polyhedra, two-dimensional surfaces and their classification, map coloring on surfaces (Heawood's estimate, Ringel-Young theory), knots and links or projective geometry. Graduate-level requirements include more extensive problem sets or advanced projects.

531. Algebraic Topology (3) I Poincare duality, fixed point theorems, characteristic classes, classification of principal bundles, homology of fiber bundles, higher homotopy groups, low dimensional manifolds. P, MATH 534b.

534a-534b. Topology-Geometry (3-3) I II Point set topology, the fundamental group, calculus on manifolds. Homology, de Rham cohomology, other topics. Examples are emphasized. P, MATH 415a, MATH 425b.


537a-537b. Global Differential Geometry (3-3) I II Surfaces in R3, structure equations, curvature. Gauss-Bonnet theorem, parallel transport, geodesics, calculus of variations, Jacobi fields and conjugate points, topology...
and curvature; Riemannian geometry, connections, curvature tensor, Riemannian submanifolds and submersions, symmetric spaces, vector bundles. Morse theory, symplectic geometry. P, MATH 354a, MATH 354b.

538. Topics in Geometry and Topology (3) [Rpt./ 4] I II Advanced topics in point set and algebraic topology, algebraic geometry, differential geometry; content varies.

539. Algebraic Coding Theory (3) II Construction and properties of error correcting codes; encoding and decoding procedures and information rate for various codes. P, MATH 415a. (Identical with ECE 539).

543. * Theory of Graphs and Networks (3) I Undirected and directed graphs, connectivity, circuits, trees, partitions, planarity, coloring problems, matrix methods, applications in diverse disciplines. P, MATH 323 or MATH 243 or graduate status. (Identical with CS 443). Graduate-level requirements include more extensive problem sets or advanced projects. (Identical with CS 543).


547. * Combinatorial Mathematics (3) II [Taught alternate years 2000 - 2001] Enumeration and construction of arrangements and designs; generating functions; principle of inclusion-exclusion; recurrence relations; a variety of applications. P, MATH 215 or MATH 243. Graduate-level requirements include more extensive problem sets or advanced projects.

550. Mathematical Population Dynamics (4) II 3R, 3L. P, ordinary differential equations as MATH 254 or MATH 355, full calculus sequence, univariate and multivariate calculus course (ECOL 302). (Identical with ECOL 550, which is home).

553a-553b. Partial Differential Equations (3-3) I II Theory and examples of linear equations; characteristics, well-posed problems, regularity, variational properties, asymptotics. Topics in nonlinear equations, such as shock waves, diffusion waves, and equations in Sobolev spaces. P, MATH 523b or MATH 527b or MATH 583b.


556. * Applied Partial Differential Equations (3) II Properties of partial differential equations and techniques for their solution: Fourier methods, Green's functions, numerical methods. P, MATH 322 or MATH 422. Graduate-level requirements include more extensive problem sets or advanced projects.

557a-556b. Dynamical Systems and Chaos (3-3) I II Qualitative theory of dynamical systems, phase space analysis, bifurcation, period doubling, universal scaling, onset of chaos. Applications drawn from atmospheric physics, biology, ecology, fluid mechanics and optics. P, MATH 422a-b or MATH 454.

558. Probability and Statistics (3) I The course includes mathematical modeling, measures of central tendency and dispersion, discrete probability, applications, Bayes' theorem, Chebyshev's Inequality, binomial and normal distributions, hypothesis testing, and game theory. This course is only for M.A. in Math (Teaching Option) and M.A. in TTE. P, open only to M.A. in Math (Teaching Option) and M.A. in TTE.

559a-559b. Lie Groups and Lie Algebras (3-3) I II Correspondence between Lie groups and Lie algebras, structure and representation theory, applications to topology and geometry of homogeneous spaces, applications to harmonic analysis. P, MATH 511a, MATH 523a, MATH 534a, MATH 534b or consent of instructor.

560. Elementary School Probability (1-3) [Rpt./ 3 units] Games and other activities that lead naturally to consideration of chance events and data analysis. Activities will relate to number and numeral systems, algebra, geometry and other topics in mathematics to emphasize the integrated nature of mathematics. Students work in groups to create and analyze activities. P, certified elementary teachers with two or more years experience or consent of instructor.


563a-563b. Probability Theory (3) I Introduction to measure theory, strong law of large numbers, characteristic functions, the central limit theorem, conditional expecta-


564. * Theory of Probability (3) I Probability spaces, random variables, weak law of large numbers, central limit theorem, various discrete and continuous probability distributions. P, MATH 322 or MATH 323. Graduate-level requirements include more extensive problem sets or advanced projects.

565a-565b. Stochastic Processes (3-3) I II Stationary processes, jump processes, diffusions, applications to problems in science and engineering.


568. * Applied Stochastic Processes (3) II Applications of Gaussian and Markov processes and renewal theory; Wiener and Poisson processes, queues. P, MATH 464. Graduate-level requirements include more extensive problem sets or advanced projects.

569. Nonparametric Statistics (3) II Distribution-free methods for nominal and ordinal data. Measures of association. Goodness of fit and runs tests. Analysis of one or more groups. Correlation and regression of ranked data. Rank order statistics. Applications of nonparametric statistical inference. Students will be expected to utilize standard statistical software packages for computational purposes. P, MATH 461, MATH 466 or MATH 509.


571. Design of Experiments (3) II Principles of designing experiments. Randomization, block designs, factorial experiments, response surface designs, repeated measures,
572. Statistical Consulting (3) I Course provides instruction and experience in all aspects of statistical consulting. The class is organized as a small consulting lab with instructor acting as director. Students interact with actual clients from university and local business communities. P, two semesters of statistics and consent of instructor.

573. Theory of Computation (3) II P, C SC 473. (Identical with C SC 573, which is home).

574. Introduction to Geostatistics (3) I Exploratory spatial data analysis, random function models for spatial data, estimation and modeling of variograms and covariances, ordinary and universal kriging estimators and equations, regularization of variograms, estimation of spatial averages, non-linear estimators, includes use of geostatistical software. Application of hydrology, soil science, ecology, geography and related fields. P, linear algebra, basic course in probability and statistics, familiarity with DOS/Windows, UNIX.


577. Topics in Applied Mathematics (3) I II Advanced topics in asymptotics, numerical analysis, approximation theory, mathematical theory of mechanics, dynamical systems, differential equations and inequalities, mathematical theory of statistics; content varies.

578. Computational Methods of Algebra (3) II Applications of machine computation to various aspects of algebra, such as matrix algorithms, characteristic tables and conjugacy classes for finite groups, coset enumeration, integral matrices, crystallographic groups. P, MATH 415a, knowledge of scientific computer programming language. (Identical with C SC 578).

579. * Game Theory and Mathematical Programming (3) Linear inequalities, games of strategy, minimax theorem, optimal strategies, duality theorems, simplex method. P, MATH 410 or MATH 413 or MATH 415a. Graduate-level requirements include more extensive problem sets or advanced projects. (Identical with C SC 579).

580. Calculators and Computers for Elementary Teachers (3) I II Students will use calculators and computers to explore various mathematical topics such as elementary number theory, probability, statistics, geometry, and so on. Emphasis will be placed on how and when to use technology, on becoming comfortable with both calculators and computers, on what are good and poor activities with technology, and on the importance of estimation and good judgment when using technology. Students will be introduced to computer activities using BASIC, LOGO, and appropriate pre-packaged software. This course is applicable to the M.A. in TTE (with Specialization in Elementary Mathematics). It is not applicable to graduate degree programs in mathematics.

581. * Basic Scientific Computing (2) I II Covers essentials of modern computing environment and tools, for both Windows and Unix-based environments. Course includes classroom and hands-on instruction. No computing experience necessary. Graduate-level requirements include 9 projects.


583a-583b. Principles and Methods of Applied Mathematics (3-3) I II Boundary value problems; Green's functions, distributions, Fourier transforms, the classical partial differential equations (Laplace, heat, wave) of mathematical physics. Linear operators, spectral theory, integral equations, Fredholm theory. P, MATH 421 or MATH 424 or MATH 520a.

584. Technology in Secondary School (3) II Students will use computers and/or graphing calculators to explore various mathematical topics including number theory, geometry, precalculus, and calculus. Programming capabilities of the calculator or computer will be covered as appropriate. P, open only to M.A. in Math (Teaching Option) and M.A. in TTE.

585. * Mathematical Modeling (3) I Development, analysis, and evaluation of mathematical models for physical, biological, social, and technical problems; both analytical and numerical solution techniques are required. P, MATH 242. Graduate-level requirements include more advanced projects.

586. Case Studies in Applied Mathematics (1-3) [Rpt./6 units] I II In-depth treatment of several contemporary problems or problem areas from a variety of fields, but all involving mathematical modeling and analysis; content varies.

587. Perturbation Methods in Applied Mathematics (3) I Regular and singular perturbations, boundary layer theory, multiscale and averaging methods for nonlinear waves and oscillators. P, MATH 422a-b or MATH 454.

588. Topics in Mathematical Physics (3) [Rpt./4] I II Advanced topics in field theories, mathematical theory of quantum mechanics, mathematical theory of statistical mechanics; content varies.

589. Software Tools for Computational Science and Engineering (3) I Techniques and tools useful at the interface between mathematical and technical computing on the one hand, and the Internet on the other. Topics include scripting languages such as Perl and Tcl/Tk, graphics file formats, the mathematics of raster and vector graphics, and standard libraries and applications for numerical and symbolic computing. Also, the fundamentals of computer networking from a user's point of view. P, C SC 318 and ability to program in at least one modern high-level language. (Identical with C SC 589).

593. Internship (1-3) [Rpt./] I II

595. Colloquium
a. Math Instruction (1) [Rpt./11] I II
b. Research in Mathematics (1) [Rpt./4] I II
c. Research in Applied Mathematics (1) [Rpt./4] I II

596. Seminar
a. Topics in Mathematics (1-3) [Rpt./12 units] 5
b. * Mathematical Software (3) [Rpt./1] I P, MATH 254 or MATH 355 or MATH 250b; knowledge of "C" programming language.

e. Topics in Mathematics for Secondary Teachers (3) [Rpt./4] I Mathematics appropriate for secondary mathematics teachers. Topics will vary.

599. Independent Study (1-6) [Rpt./]

636. Information Theory (3) I II P, ECE 503. (Identical with ECE 636, which is home).

697. Workshop
a. Problems in Computational Science (3) [Rpt./1] I II (Identical with PHYS 697a).
b. Applied Mathematics Laboratory (3) I II S P, applied math core or equivalent. (Identical with PHYS 697b).
Mechanical Engineering
(See Aerospace and Mechanical Engineering)

Media Arts (M AR)
Harvill Bldg., Rm. 226
PO Box 210076
Phone: (520) 621-7352
FAX: (520) 621-9662
WWW: http://arts.music.arizona.edu/
mediaarts/index.html

Application Questions:
Michael J. Little, (520) 621-5520, mlittle@u.arizona.edu
Advising Questions:
Justin Wyatt, (520) 621-7800, wyattj@u.arizona.edu
Degrees Offered: M.A.
Concentrations: critical studies of media; gender and sexuality; media industry and economics; social/cultural history; new media

Professors: Craig Caldwell, Caren J. Deming, J. Michael Gillette
Associate Professors: Mary Beth Haralovich, Head, Harry Atwood (Emeritus), Eileen R. Meehan, Beverly A. Seckinger, Justin Wyatt
Assistant Professor: Daniel Beenardi, Yuri E. Makino, David M. Mulcahy

The department offers a program leading to the Master of Arts degree with a major in Media Arts. The degree focuses exclusively on critical studies of the media including theory, criticism, and history. The degree involves no film or video production opportunities. Applicants are required to submit a statement of purpose, a sample of their writing, and three letters of recommendation. Applicants to the program may have undergraduate majors in areas other than media studies.

The Master of Arts degree with a major in Media Arts consists of 31 units. Students are required to take two 696 level seminars. All students take 10 units of required core courses and then select additional courses from such areas as gender and sexuality, media industry and economics, social/cultural history, and new media. Students have two elective courses, one of which may, with advisor approval, be taken outside the Department of Media Arts. In addition to satisfactorily completing all required coursework, students must pass a comprehensive written examination during their fourth semester in the program.

500. Graduate Study in Media Arts (1) I Responsibilities of graduate students, forms and procedures, campus resources, research tools, writing standards, and Media Arts content areas in approaches.
503. Professional Practices (1) I II Preparation for the professional expectations of working in media industries.
506. * Multimedia (3) I Principles and processes of multimedia assembly with an emphasis on interactive skills. 2R, 2S, P, M AR advanced standing. Graduate-level requirements include a research paper as basis for their final project.
521. * Cultural Theory and Criticism of Media (3) I Critical and cultural theories and their application to media arts, including mass culture, empiricism, technoculture, political economy. P, M AR 200, M AR 320. Graduate-level requirements include an additional paper and additional reading.
523. * Representation of Gender in the Media (3) II Investigation of gender as a social and cultural construct through the critical analysis of media products including television, film, and advertisements. P, M AR 200, M AR 320. Graduate-level requirements include an in-depth research paper on gender and media.
524. * Film Theory and Criticism (3) I Advanced studies in current cinematic theory and criticism. Historical examination of major film theories, including formalism, realism, classical Hollywood, structuralism, semiotics, and psychoanalytic theories. Graduate-level requirements include additional readings and an in-depth research paper on issues in film theory.
526. * Sexuality in Media Narratives (3) I Analysis of sexual representation in popular and underground film, music video and avant-garde video art. Graduate-level requirements include additional reading and writing assignments and different examinations.
527. * Feminist Media Theory (3) II Includes psychoanalysis, semiotics, materialism, race and class analysis, and feminist media production. P, M AR 200, M AR advanced standing. Graduate-level requirements include an additional paper and additional reading.
528. Current Issues in Media Theory (3) I Advanced study of major concepts, issues, and movements in contemporary film theory: psychoanalysis, semiotics, Marxism, deconstruction, postmodernism.
532. Media Political Economy (3) I II Theories and analytic techniques of political economy approaches to media arts through history of telecommunications, broadcasting, film, recorded music and cable television.
534. * Media Industries (3) I Examination of a specific topic in media industries: ownership and concentration; media markets and industrial integration. (Identical with MAP 434). Graduate-level requirements include a research paper and presentation.

535. * Hollywood Film and Television (3) I Historical examination of Hollywood-produced film and television: styles and genres, industrial processes, social context and impact. Graduate-level requirements include additional papers.
576. * Broadcast and Cable Programming (3) I Investigation of principles, techniques, and current issues in programming for radio and television stations (commercial and public) and cable systems. Graduate-level requirements include an in-depth research paper on an issue related to contemporary media programming.
593. Internship (1-5) I II S Specialized work consisting of individual training and practice in actual service in a media industry organization.
694. Practicum (1-5)
696. Seminar
b. * Special Topics (3) II The topics will change from term to term. Check with Department for current topics. Graduate-level requirements include 8 reading reports; facilitating a discussion alone; 20-22 page research paper. 2S.
699. Independent Study (1-5) [Rpt.] II
639. Methods of Media History (3) II Analysis of methods used in film and broadcast histories; theories of media history; empirical evidence and interpretation; approaches to placing a media text within its industrial and social context.
694. Practicum (1-5)
696. Seminar
b. * Special Topics (3) I II [Rpt.] 11
699. Independent Study (1-5) [Rpt.] II
694. Practicum (1-5)
909. Master's Report (1-6) [Rpt.] II
930. Supplementary Registration (1-9) [Rpt.] I II

Medical Technology (MEDT)
Medical Technology, 1435 N. Fremont Ave., Room 124, (520) 626-4064
Clinical Associate Professor: Harold L. Potter, Jr., Director
Clinical Assistant Professor: JoAnn Thomas
Clinical Instructors: Sally Littau, Deborah Wyckoff

Although no graduate degree programs are offered by the Division of Medical Technology, the graduate courses listed below are available to graduate students enrolled in related programs such as Microbiology and Chemistry, as well as...
post-baccalaureate students who meet the requirements for the professional training to become M.T. certification eligible.

571L. *Fundamental Laboratory Techniques in Clinical Hematology (2) [Rpt. / 1] II Basic laboratory techniques in clinical hematology with emphasis on manual and automated hematology procedures. Instruction includes proper procedural methodologies, quality control, the use of controls and standards, and interpretation of laboratory test results. Graduate-level requirements include a research paper relating to new laboratory methodologies applicable to clinical hematology.

571R. *Lectures in Clinical Hematology (5) [Rpt. / 1] II Lectures in basic hematology and hemotological procedures including cell structure and function, inherited and acquired anomalies, hemostasis, cell enumeration and differentiation, cytogenetics. Graduate-level requirements include a research paper on selected topics related to clinical laboratory hematology.

572L. *Fundamental Laboratory Techniques in Clinical Immunology and Immunohematology (2) [Rpt. / 1] I Basic laboratory techniques in serological procedures and blood banking. Emphasis will be placed on procedural methodologies, quality control, the use of controls and standards, and the interpretation of laboratory test results. Graduate-level requirements include a research paper relating to new laboratory methodologies applicable to clinical serology or blood banking.

572R. *Lectures in Clinical Immunology and Immunohematology (4) [Rpt. / 1] I Lectures in serological methods used in the clinical laboratory and interpretation of results; blood banking procedures. Graduate-level requirements include a research paper on selected topics relating to clinical laboratory serology or blood banking.

573L. *Fundamental Laboratory Techniques in Clinical Chemistry (2) [Rpt. / 1] II Basic laboratory techniques in clinical chemistry. Emphasis is placed on procedural methodologies, quality control, the use of controls and standards, and the interpretation of laboratory test results. Graduate-level requirements include a research paper relating to new laboratory methodologies applicable to clinical chemistry.

573R. Lectures in Clinical Chemistry (5) [Rpt. / 1] II Lectures encompassing the fundamental concepts of clinical laboratory chemistry including pathophysiology and clinical correlations. Graduate-level requirements include a research paper on selected topics relating to clinical laboratory chemistry.

574L. *Fundamental Laboratory Techniques in Clinical Bacteriology (2) [Rpt. / 1] I Basic laboratory techniques used in the isolation and identification of bacteria pathogenic for humans. Standard and specialized media/biochemical tests are utilized. Graduate-level requirements include a research paper relating to new laboratory methodologies applicable to clinical bacteriology.

574R. *Lectures in Clinical Bacteriology (5) [Rpt. / 1] II Lectures relating to laboratory techniques used to safely isolate and identify pathogenic bacteria. Special media/tests, organismal virulence factors, pathological effects occurring within the host and antibiotic susceptibility testing of bacteria are covered. Graduate-level requirements include a research paper on selected topics relating to clinical laboratory bacteriology.

575a-575b-575e. *Topics in Clinical Microbiology (2-1-1) [Rpt. / 1] 575a: Clinical Parasitology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant parasites. 575b: Clinical Virology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant viruses. 575c: Clinical mycology and mycobacteriology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant fungi and Mycobacterium sp. Graduate-level requirements include a research paper on selected topics relating to clinical laboratory parasitology, virology, mycology or mycobacteriology.

576. *Principles of Laboratory Science (3) [Rpt. / 1] II Basic principles of laboratory mathematics, biostatistics, body fluids analysis, urinalysis, quality control and laboratory safety. P, consult program director before enrolling. Graduate-level requirements include a research paper on selected topics that focus on the use of statistical analysis for biological systems, or on selected topics relating to new techniques in body fluid analysis or urinalysis.

581. *Clinical Laboratory Hematology (5) [Rpt. / 1] II 5 Clinical laboratory rotation in hematology. Graduate-level requirements include a research paper relating to advanced laboratory methodologies in clinical hematology.

582. *Clinical Laboratory Immunology and Immunohematology (5) [Rpt. / 1] I II Clinical laboratory rotation in serology and blood banking. Graduate-level requirements include a research paper relating to advanced laboratory methodologies in clinical serology or blood banking.

583. *Clinical Laboratory Chemistry (5) [Rpt. / 1] I II Clinical laboratory rotation in clinical chemistry. Graduate-level requirements include a research paper relating to advanced laboratory methodologies in clinical chemistry.

584. *Clinical Laboratory Microbiology (5) [Rpt. / 1] I II Clinical laboratory rotation in microbiology. Graduate-level requirements include a research paper relating to advanced laboratory methodologies in clinical microbiology.

599. Independent Study (1-6) [Rpt. /] I II

Medical (MED/ANES/FCM/ MEDI/NEUR/OBG/OPH/ PATH/PED/PSYI/RONC/ RADI/SURG)

Arizona Health Sciences Center, Room 2107
Phone: (520) 626-6518
FAX: (520) 626-4884

Interdepartmental (MED)

501. Preparation for Clinical Medicine (1) I II, P, formal admission to the Ph.D./M.D. program, consent of instructor.

505. Social and Behavioral Science (6) I II, P, formal admission to the Ph.D./M.D. program, consent of instructor.

596. Seminar d. Medicine and Literature: The Human Perspective (2) II


696. Seminar a. Introduction to Forensic Pathology (1-3) II, PATH 801, consent of instructor.

801. Preparation for Clinical Medicine (1) [Rpt. /] I II

805. Social and Behavioral Science (6) [Rpt. /] I II


830. Supplementary Registration (1-9) [Rpt. /] I II

891. Preceptorship i. Rural Health Professions (3-6) [Rpt. / 2] I II This course is designed to provide medical students with quality educational experiences in selected rural settings. P, open to medical students formally admitted to the Rural Health Professions Program. (Identical with MEDI 891i, OB G 891i, PED 891i, SURG 891i).
Anatomy

(See Cell Biology and Anatomy elsewhere in this chapter.)

Anesthesiology (ANES)
Arizona Health Sciences Center, Room 5304-D
Phone: (520) 626-7141
Fax: (520) 626-6943
WWW: http://www.ahsc.arizona.edu/anesth/

Professors: Steven J. Barker, Head, A. Jay Gandolfi, Stuart R. Hameroff, Charles W. Otto, Frank Porreca (Pharmacology), I. Glenn Sipes (Pharmacology and Toxicology)

Associate Professors: Edward J. Frink, Jr., Robert G. Loeb, T. Philip Malan, Jr.

Associate Professors of Clinical Anesthesiology: Bennet E. Davis, James A. DiNardo, Craig M. Palmer

Assistant Professors of Clinical Anesthesiology: Daniel P. Ferry, Martha Fielder, William B. Green, Brian McCabe, Wallace Nogami, J. Scott Polson, Gretchen Van Maren

Instructors of Clinical Anesthesiology: Brian J. Cammarata, R. Hill Johnson, Ann Jones, Rhonda L. Nieto, Cheryl Putnam

Clinical Lecturers: Stacie Noble, Alan E. Zehngut

The clinical science of anesthesiology comprises all aspects of perioperative medicine, critical care, and pain management. Anesthesiology encompasses applications of all of the basic sciences, with particular emphasis on physiology and pharmacology. The department conducts both basic and clinical research in these areas, including investigations into the mechanisms of consciousness, anesthesia, and pain. Clerkships and perceptorships stress the applications of all of the basic sciences, and pharmacology. The department employs in managed care environments and as a regulator; the operational tools used in managed care environments in managing health care outcomes and utilization; the legal duties, rights and remedies for physicians, patients and managed care organizations relative to practice in that environment; and the underlying ethical principles inherent in medical practice in general and managed care medicine in particular.

g. Epidemiologic Investigations of Chronic Diseases (2) II P, 3rd year medical school. MED 896h. Gene Therapy for Vascular Disease (2) II P, 3rd and 4th year medical school. (Identical with SURG 896h).

The Arizona Prevention Center (APC) program consolidates key prevention and public health programs in The University of Arizona Health Sciences Center for an innovative approach to prevention and health promotion. The APC is composed of the following units: Environmental and Occupational Health; Health Promotion and Disease Prevention; Native American Health; Global Health; Epidemiology, and Biostatistics. The Arizona Prevention Center applies its strengths to work collaboratively with other Centers and Programs within the University to develop new community partnerships for prevention and health promotion. The collaborating programs include the Arizona Arthritis Center, Campus Health, Arizona Cancer Center, University Heart Center, Steele Memorial Children's Research Center, Department of Anthropology, Department of Communication, Department of Nutritional Sciences, School of Family and Consumer Resources, Respiratory Sciences Center, Department of Family and Community Medicine, and Cooperative Extension. The Arizona Prevention Center encompasses several important educational programs: The Arizona Graduate Program in Public Health grants a masters in public health through a collaborative program with Arizona State University and Northern Arizona University; the Preventive Medicine Residency offers post graduate training in public health to
physicians; and the Interdisciplinary Program in Epidemiology offers a doctorate degree in epidemiology. Responding to the University's commitment to medical education, the Center is creating model curricula for prevention and health promotion which integrate multi-cultural perspectives. The graduate program is expanding its programs to address the key public health policy issues in the state. The Arizona Prevention Center has a diverse faculty with a wide range of strengths and expertise: social and behavioral program-based public health research; multi-cultural perspectives appropriate for the region; prevention and health promotion methodology and program evaluation; teaching and curriculum development for prevention.

Biochemistry
(See Biochemistry elsewhere in this chapter.)

Cancer Biology
(See Cancer Biology elsewhere in this chapter.)

Cell Biology and Anatomy
(See Cell Biology and Anatomy elsewhere in this chapter.)

Family and Community Medicine
(F CM)


Professors of Clinical Family and Community Medicine: Craig McClure, Co-Head, Frank A. Hale, Lawrence M. Moher, Augusto Ortiz

Clinical Professors: Pedro Luis Escobar, John Mattox

Associate Professors: Paul Gordon (Co-Head), Iris Bell, Louise Canfield, Kambiz Nasser (Emeritus), Richard L. Papenfuss, Arthur B. Sanders (Surgery), Catherine M. Shisslak

Associate Professors of Clinical Family and Community Medicine: Pamela Reid-Duffy, Iene Gordon

Research Associate Professors: Joel S. Meister, Janet Senf, Michael Shafer

Assistant Professors: Antonio Estrada, Scott J. Leischow

Assistant Professors of Clinical Family and Community Medicine: Tammy Bassford, Enrique S. Corvalan, Lane P. Johnson, Patricia Lebensohn-Chialvo, Myra M. Muramoto, Victoria Murrain, Robert G. Rhode

Research Assistant Professors: Jeanne Carrigan, Brenda Cartmel, Howard J. Eng


Instructor of Clinical Family and Community Medicine: Katherine E. Miller

Clinical Instructors: Elizabeth MacNeil, Brian Solan

The department emphasizes the values of family and community orientation to medical practice. By means of preceptorships, seminars, projects, lectures, community assignments, and clinics, and in collaboration with other departments, students learn family medical practice, clinical preventative medicine, occupational medicine, and the elements of epidemiology, nutrition, public health, and medical care organization.

504. * Lifestyle and Behavioral Health (2) [Rpt./ 1] II Lifestyle and behavioral health has emerged as the dominant health risk factor. This course addresses various lifestyle principles and experiential processes toward the awareness and experience of one's self as the primary source of sickness or health and quality of life. Graduate students are expected to write a scholarly paper/research project.

505. * Mind-Body, Behavioral Medicine (2) I II Critical thinking and working principles in cognitive, mind-body, behavioral aspects of sickness and health; empowerment, stress, coping, conditional/unconditional mind, decision making, addictive-abusive behaviors, communication, and relationships, self-awareness; healing and health. P. F CM 195a, upper division or graduate status. Graduate-level requirements include a research project or paper.

506. * Spirituality and Healing (2) [Rpt./ 1] I II Spirituality and healing is based on a holistic perspective that is compatible with science and medicine. The course is presented in a context of applied principles and processes that are practical and experiential. Graduate level requirements include the production of a scholarly paper/research project.

531. * Art Therapy Techniques (3) [Rpt./2] I II This course focuses on the use of visual arts to promote physical, cognitive, psychological, and emotional growth and health. Art expression is explored both as a form of non-verbal communication and as a healing agent. Students will be required to complete four major projects, read the texts, and other assigned readings. Topics for this course change annually to include special emphasis in issues related to children, adolescents, adults and older adults. P, previous course work in art and/or special education.

Graduate level requirement includes a detailed research paper and different grading criteria.

532. * Survey of Art Therapy (3) [Rpt./ 1] I The purpose of this course is to familiarize students with the history, development, and profession of art therapy in the United States. This is accomplished by acquainting students with classic literature, theories, and current trends in the field. Each class session is composed of four components: Lecture, group discussion, student presentations, and art experiences. Students are required to read the three texts, complete all art and written assignments, and participate in art journaling. Graduate level requirement includes a detailed research paper.

539. * Art, Symbolism, and Psychopathology (3) [Rpt./ 1] II The primary function of an art therapist is to facilitate image making and then to assist artist-participants in communication with those images. This course focuses on the philosophical, psychological, and cultural aspects of image-making that are necessary before interacting with an art piece and its maker. Visual images used in class and in student case studies are examples of various abnormalities as manifested.

580. Community Based Research Methodologies (3) III Research methodologies used in studying community health care issues. Students develop and write a research proposal which will address a community health issue. Student will acquire an understanding of the development of a research project and pilot test data collection instruments and procedures. P, PHL 576a, F CM 596a. (Identical with PHL 580).

581. Introduction to Community Health (3) I I The role of the public health professional in enhancing community health and well being. Analysis of current community health issues and methodologies for building community capacity to influence health, access to care, and local, state, and national policy. Community control and input into medical care and health promotion/disease prevention systems analyzed through class assignments. (Identical with PHL 581).

587. * Poverty and Health (3) I II (Identical with NURS 587, which is home).

588. Healing Systems in the Southwest (3) I II P, 9 units of behavioral science. (Identical with NURS 588, which is home).

593. Internship (1-6) [Rpt./]
596. Seminar
a. International Health: Clinical and Community Care (3) S, P, open to health majors only.
g. Occupational Disease (1-2) II P, open to medical or industrial hygiene students only, consult department before enrolling. (Identical with PHL 596g).
h. Prevention and Control of Disease (1) I P, consult department before enrolling. (Identical with PHL 596h).
i. Seminar for Clinical Educators (4) I II
(Identical with PHL 596i).
j. Health Policy: Leadership and Current Issues (2-3) II (Identical with PHL 596j).
m. Practice of Community-Oriented Medicine in Rural Areas (2) II (Identical with PHL 596m).
o. Environmental and Occupational Health (3) II P, consent of instructor.
p. Managed Health Care (3) II (Identical with PHL 596p).
q. Health Care Leadership and Medical Management (2-3) [Rpt./ 6 units] P, open to medical and graduate students only. (Identical with PHL 596q, which is home).
s. AIDS, Cancer, Nutrition Immunity (1) II (Identical with PHL 596a).
t. Tropical Disease Problems (2) I II (Identical with PHL 596t).
w. Diet and Disease Prevention (2) I II (Identical with PHL 596w).
599. Independent Study (1-12) [Rpt./]
693. Internship (1-12) [Rpt./]
e. Art Therapy (1-12) [Rpt./ P, consult department before enrolling.
g. Nutritional Biocultural Context (3) I II (Identical with PHL 696G, ANTH 696G).
800. Research (2-16) [Rpt./] I II Individual research not related to a thesis for an advanced degree. (Identical with PHL 800).
803. Clinical Clerkship (6) I II Students will develop and refine problem-solving skills in the ambulatory setting. Emphasis is on the diagnosis and management of the illnesses presented to primary care facilities. Students will learn to effectively use the health care team in patient assessment and to incorporate the principles of preventive and prospective medicine into clinical practice. A life-style curriculum is integrated into the didactic presentations. The clerkship is a required course for third year medical students.
811. Subinternship
a. Family Medicine (4-6) [Rpt./]
815. Subspecialty
a. Public Health and Community Medicine Rotations (4) [Rpt./ 1] I II
b. The Dying Patient (3) [Rpt./] I II (Identical with PHL 815b).
c. Geriatrics in Family Medicine (4) S P, consent of instructor.
d. Problems in Community Oriented Primary Care (6-12) [Rpt./] I II
e. Family Medicine (4) P, Open to medical students only.
g. Alternative Medicine Modalities in the Primary Care Office (4) Goals: 1 - Allow medical students to explore the precepts of homeopathy, naturopathy, acupuncture, and other forms of alternative medicine. 2 - Provide medical students with a multi-dimensional model of health care that restores patient well being, as well as physical function. 3 - Identify specific alternative modalities that are useful in treating specific chronic conditions and diseases that are difficult in the context of allopathic medicine. 4 - Acquaint medical students with complementary and traditional healing practices.
5 - Recognize new areas of research and development and their implications for integration in future primary care practice. 1R. P, 4th year medical student.
h. Cancer Epidemiology and Prevention (3) [Rpt./] I I (Identical with RONC 815h).
k. Special Nutrition Support (3) I II
l. Nutrition in Disease (3) [Rpt./] I II
m. Family Practice: Outpatient (4-6)
n. Family Medicine: Ambulatory (4) [Rpt./] 1 I II
o. Care of HIV-Infected Patients (4) [Rpt./] I P, required clerkship. (Identical with MEDI 815o).
q. Subspecialty: Home Health Care/Hospice Care (4) I II P, fourth year medical students only.
r. Hospice Care for the Terminally Ill (3) I II (Identical with MEDI 815r).
891. Preceptorship
a. Arizona Senior Clinical Preceptorship in Family and Community Medicine (6-12) [Rpt./] I II (outside Arizona) P, fourth year medical students only.
b. Clinical Family Medicine (3-12) [Rpt./] I II P, open to majors in medicine, public health and nursing.
c. Epidemiology at CDC (3) [Rpt./] I II
d. Verde Valley Rural Care (4-12) [Rpt./] I II P, consult department before enrolling.
e. Prison Health Care (3-6) [Rpt./] I II
f. International Health (6-12) [Rpt./] I II
g. AHEC/Border Health (3-12) [Rpt./] II P, consult department before enrolling.
h. Epidemiology and Applied Preventative Medicine with the Indian Health Service (8) [Rpt./ 16 units] I II Indian Health Service Preceptorship in Epidemiology and Applied Preventative Medicine. P, consent of course coordinator and approval needed by external site and concurrence by preceptorship coordinator.
\* JUP (Commitment to Underserved People) (3) S Students must participate in orientation training and community service.
\* Mayo Group Practices (6) [Rpt./] I II P, fourth year medical students only.
\* Indian Health Service Clinic Preceptorship in Family and Community Medicine (1-12) I II P, third year clerkship. IHS site and consent of preceptorship coordinator.
p. Emergency Room/Family Physicians in Community Hospitals (4) I. Emergency room practice at the Year IV student level, as described above, on a full-time scheduled basis. 2. Study of accepted emergency room protocols, as used throughout the United States for specific emergency conditions. 3. Preceptorship type arrangement with the practitioner in regard to accomplishment to all course goals listed above. Evaluation methods: submission of a brief narrative report of this preceptorship experience; patient log. Standard Division of Academic Resources evaluation forms utilized by site faculty. P, completion of 3rd year clerkships in family and community medicine, surgery, medicine, neurology. Completion of OB/GYN and psychiatry clerkships also strongly recommended. Consent of program director(s).
896. Seminar
a. International Health: Clinical and Community Care (3-4) S P, open to health majors only. (Identical with PHL 896a).
b. Alternative/Complementary Seminars (1-2) I II Series of seminars offered in Alternative Medicine at Maricopa Medical Center, Phoenix. P, medical students only. (Identical with MEDI 896b).
c. Principles and Practice of Home Health Care (2) I II P, consult department before enrolling. (Identical with PHL 896e).
d. Nutrition in a Bioculture Context (3) I II
\* J. Health Policy: Leadership and Current Issues (3) II The purpose of this course is to assist the student in understanding and addressing health policy issues facing our nation and our state, as well as how to manage the functions of leadership in a rapidly changing society.
e. International Nutrition (2-3) I II (Identical with PHL 896e).
g. Health Care Leadership/Medical Management (2-3) [Rpt./ 6 units] P, open to medical and graduate students only.
h. Tropical Disease Problems (2) I II (Identical with PHL 896).
899. Independent Study (1-12) [Rpt./]
\* J. In-depth studies in a special interest topic, clinical or nonclinical in nature.
900. Research (2-16) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Medicine (MEDI)


Associate Professors: Rodney Adam, John Bloom, Thomas W. Boyden, Samuel M. Butman, Sammy C. Campbell, Paul E. Fenster, Kit Lam, Alan List, Joy L. Logan, Charles W. Otto (Anesthesiology), Jacob L. Pinnas, Thomas Raya, Valery Reyna, Charles Taylor, David B. Van Wyck, Roy Verderby

Assistant Professors: Sharon Camhi, Ronnie Fass, The-Li Hsu, John D. Palmer (Pharmacology), Gregory D. Pennock, David S. Shimm (Radiation Oncology)

Clinical Professors: Robert O. Brandenburg, Todd Brodie, Kenneth Dessor, Morton Fuchs, Alan Gordon, Bernard Levine, Philip Levy, Robert Sankowsky, William Schott, David Ulmer

Research Professors: Marilyn J. Halonen (Pharmacology), Seymour Reichlin


Research Associate Professors: Robert T. Dorr (Pharmacology), Irwin Flink, Ronals Hilwig, Yei-Mei Peng


Research Assistant Professors: Joseph J. Bahl, William Bellamy, Marianne B. Broome-Powell, Brenda V. Dawson, Paul Enright, Mohamed Gaballa, Steven B. Knoper, Steven Massia, Mary O’Rourke, Yeh-Shan Peng


555. Cancer Therapeutics (3) II (Identical with CBIO 555, which is home).

599. Independent Study (3-6) [Rpt./] 699. Independent Study (1-18) [Rpt./]

800. Research

a. Clinical Research in Minority Health Issues (4-16) I II P, open to majors only.

803. Clinical Clerkship (1) [Rpt./] I II Required of all students during their first clinical year. Emphasis is placed upon learning a core curriculum and the development of clinical skills, problem solving and the provision of compassionate and humanistic medical care. Students are expected to obtain and record the complete medical histories, perform physical examinations, develop appropriate differential diagnoses and monitor the progress of assigned patients. Students will participate in diagnostic and therapeutic procedures with other members of the patient care team and attend required departmental conferences and seminars.

810. Clerkship

a. Ambulatory Care (4-8) [Rpt./] 12 units] P, completion of third year medical school.
b. Ambulatory Diagnostics and Therapy (6) [Rpt./] I II
c. Clinical Geriatrics (3-12) [Rpt./] 24 units] I II P, MEDI 803.

811. Subinternship

a. Internal Medicine (4-12) [Rpt./] I II b. Medical Subinternship (4) c. Coronary Care Unit - Acting Internship (3-4) [Rpt./] I II
d. Intensive Care Medicine (4) [Rpt./] I II P, successful completion of third year of medical school.

815. Subspecialty

a. Clinical Cardiology (4-8) [Rpt./] I II b. Clinical Dermatology (3-4) [Rpt./] c. Endocrinology (4-12) [Rpt./] I II d. Clinical Gastroenterology (3-6) [Rpt./] I II e. Hematology-Oncology (3-8) [Rpt./] I II f. Infections Diseases (4-12) [Rpt./] I II g. Pulmonary Diseases (1-6) [Rpt./] I II h. Evidence Based Medicine (3) I P, fourth year medical students only.

i. Pulmonary Laboratory and Consultation Service (3-6) [Rpt./] I II

k. Nephrology, Renal Diseases (3-6) [Rpt./] I II

l. Clinical Allergy (4-6) [Rpt./] I II P, open to majors only. (Identical with PED 8150).
m. Medical Subspecialties (4) [Rpt./] II P, MEDI 803.

n. Physical Medicine and Rehabilitation (3-6) [Rpt./] 12 units) I II P, third or fourth year medical students.

o. Care of HIV-Infected Patients (4) [Rpt./] I P, required clerkship. (Identical with F CM 8150, which is home).

p. Critical Care Medicine (1-18) [Rpt./] I II (Identical with ANES 815P, which is home).

q. Cardiology Consultation (4) [Rpt./] I II

r. Clinical Neurology (4-6) [Rpt./] I II

s. Rheumatology (4-6) [Rpt./] I II P, MEDI 803.

t. Hospice Care for the Terminally Ill (3) I I (Identical with F CM 815T, which is home).

u. Clinical Endocrinology, Metabolism and Hypertension (3-6) [Rpt./] I P, completion of required third year internal medicine clerkship.

v. Clinical Evaluation and Treatment of Sleep Disorders (3-6) [Rpt./] 15 S (Identical with NEUR 815v, PSYI 815v).
w. Women’s Health (4-6)

z. Pulmonary Function Lab (3) [Rpt./] I II P, open to majors only.

816. Subspecialty

a. Outpatient Geriatric (4-6) I II Outpatient aspects of geriatric medicine. Patient care in the outpatient setting including home visits, geriatric clinic, nursing home, and assisted/supportive residential living centers. P, MEDI 803.

b. Native American Medicine and Cardiology (4) I II Native American Medicine and Cardiology, P, third year internal medicine or fourth year medical students only.

c. Outpatient-Private Practice Primary Care (4-6) I II
d. Gerontology and Geriatric Care (3-4) I II P, medical students only.

e. Clinical Rotation in End of Life Care (4) Students will participate in patient evaluations in the inpatient hospice and palliative care unit with various team members, and homecare hospices. Students will participate in interdisciplinary team conferences, discuss significant ethical issues, and demonstrate clinical problem solving and competency at initial and ongoing consults for the hospice and palliative patient admitted. They will round daily with the team on the hospice in-patients. Direct clinical experience will be supplemented by lectures, e.g. pain management and other hospice and palliative care topics listed in curriculum, and relevant readings. The faculty will supervise all activities. P, students must complete MEDI 803.

f. Interventional Cardiology/Research/Goals: 1 - Perfect skills in cardiac interventional diagnosis and treatment. 2 - Master cardiology history and physical examination techniques. 3 - Participate in interventional procedures and both device and drug research. Current projects include gamma radiation catheter and VEG-F therapy. P, 4th year medical student.

891. Preceptorship

a. General Medicine and/or Subspecialties (3-12) [Rpt./ 36 units] I II
b. Ambulatory Internal Medicine: Clinical Problems (4-6) [Rpt./ 36 units] I II P, fourth year medical students.
c. Pulmonary Medicine (3-8) [Rpt./] P, MEDI 803.
d. Cardiology (3-8) [Rpt./] I II P, fourth year medical students.
e. Hematology/Oncology (3-8) [Rpt./] I II P, fourth year medical students.
f. Medical Toxicology/Neurological Medicine (4) [Rpt./] I II P, completion of required clerkships, fourth year medical students.
g. HIV Service (4) I II P, fourth year medical students.
h. Internal Medicine (4-8) I II P, fourth year medical students.
i. Rural Health Professions Preceptorship (3-6) [Rpt./] I II P, open to medical students formally admitted to the Rural Health Professions Program. (Identical with MEDI 8911, which is home).

896. Seminar

a. Pathophysiology/Immunology: Clinical Manifestations of Coccidioidomycosis (2) I II P, alternative/complementary Seminars (1-2) I II P, medical students only. (Identical with F CM 896b, which is home).
b. Cardiovascular Pathophysiology (2) I II P, third and fourth year medical students only. (Identical with MEDI 890u, which is home).

899. Independent Study (1-16) [Rpt./]

Microbiology and Immunology

(See Microbiology and Immunology elsewhere in this chapter.)

Molecular and Cellular Biology

(See Molecular and Cellular Biology elsewhere in this chapter.)

Neurology (NEUR)

Professors: Bruce M. Coull, Head, Carol Barnes (Psychology), William M. Feinberg, Mary J. Johnson (Pediatrics), Alfred Kaszniai (Psychology), David Labiner, Alan B. Rubens, Gary E. Schwartz (Psychology), William A. Sibley, Gary L. Wenk (Psychology)

Associate Professors: Geoffrey L. Ahern, Colin R. Bamford, David M. Labiner, Nathaniel T. McMullen (Anatomy), Erwin B. Montgomery, Jr., Naomi E. Rance (Pathology), Steven Z. Rapcask

Assistant Professors: Valerie A. Cwik, David M. Labiner, Linda Restifo (Arizona Research Laboratory, Division of Neurobiology), Scott J. Sherman

Clinical Professors: Harvey W. Buchsbaum, Robert Fisher, Barry Hendin, Jose Laguna, Oscar Reimnuth, William Shapiro, Alan Yudell

Clinical Associate Professors: Barbara S. Glessner, Ann Herring (Psychiatry), Enrique L. Labadie, Harry S. Tamm, Johan Van Dalen (Ophthalmology)

Clinical Assistant Professors: Ronnie Bergen, Robert H. Hamilton, Dinesh Tahwar

Clinical Lecturers: Jay B. Angervie (Anatomy), Wayne Bixenman, Terry D. Fife, Robert A. Foote, William H. Lawrence, Joseph J. Thomas, Jr., Richard A. Thompson, Francisco R. Valdivia

Research Assistant Professor: Lyn S. Turksra

Assistant Research Scientist: Pelage Bessons (Speech and Hearing Sciences)

515. Subspeciality


599. Independent Study (1-6) I II

625. Human Neuroscience (6) P, consent of instructor. (Identical with MEDI 625, which is home).

695. Colloquium

a. Motor Control (1-2) [Rpt./ 6 units] II (Identical with PSIO 695a, which is home).

800. Research (1-12) [Rpt./] I II P, 36 units I II P, consent required to enroll. (Identical with MEDI 825, which is home).

891. Preceptorship

a. Neurology (1-18) [Rpt./ 54 units] I II P, experience in diagnosis and management of neurological diseases by observation and study of individual patient illnesses. P, completion of 3rd year medical student rotation.

b. Neuromuscular Disorder (3-6) I II P, consent required to enroll. (Identical with MEDI 825, which is home).

899. Independent Study (3-6) [Rpt./] I II P, 3rd year medical student rotation.

Obstetrics and Gynecology (OB G)

Professors: Kenneth Hatch, Head, Wayne Heine, Kathryn Reed

Associate Professor: Thomas Purdon

Assistant Professors: Francisco A. Garcia, Timothy Gelety, Alton Hallum, John Hoffman, Karen Lesser, James Maciulla, Nickola Rogers, Hector VAMC. Students are taught a method of integrating the patient interview and neurological examination with an analytical approach to neurological diagnosis and management. Cases are presented to members of the neurological staff and discussed in detail. Weekly teaching conferences are given by the neurological faculty.

810. Clerkship

a. Neurology Consulting Service (4) [Rpt./] I II P, completion of 3rd year medical student rotation.

b. Behavioral Neurology/Higher Cortical Functions (4) [Rpt./] I II P, consent of instructor.

c. Cerebrovascular Disease (4-6) [Rpt./] I II P, consent of instructor.

d. Epilepsy Elective (4-6) [Rpt./] S P, study of individual patient illnesses. P, completion of 3rd year medical student rotation.

e. Vestibular and Eye Movement Disorders (3-4) I II P, 3rd year medical student rotation.

f. Neuromuscular Disorder (3-6) I II P, consent required to enroll. (Identical with MEDI 825, which is home).

815. Subspeciality

b. Behavioral Neurology/Higher Cortical Functions (4) [Rpt./] I II P, consent of instructor.

c. Cerebrovascular Disease (4-6) [Rpt./] I II P, consent required to enroll. (Identical with MEDI 825, which is home).

d. Epilepsy Elective (4-6) [Rpt./] S (Identical with MEDI 803.

e. Vestibular and Eye Movement Disorders (3-4) I II P, 3rd year medical student rotation.

816. Subspeciality

Neuro-Oncology (4) I II P, open to medical students only. (Identical with RONC 816d, which is home).

825. Human Neuroscience (6) I II P, consent required to enroll. (Identical with MEDI 825, which is home).

899. Independent Study (3-6) [Rpt./] I II P, opportunity for students to work with a particular faculty member in pursuit of a particular field of study in neurology.
800. Research (3-18) I II Experience in each of the following research areas is available with individually designed programs up to six weeks in length: Reproductive Diagnostic Ultrasound, Endocrine Laboratory, Perinatal Medicine, Gynecologic Oncology, Fertility Ultrasound, Endocrine Laboratory, Perinatal weeks in length: Reproductive Diagnostic with individually designed programs up to six of the following research areas is available

800. Research (3-12) I II

810. Clerkship
a. Preparation for Practice (4-6) [Rpt./] I II This elective course for fourth year students will essentially be an externship in a Phoenix or Tucson hospital to include exposure to the full gamut of obstetrical and gynecological care conducted under direct supervision of a faculty member. The elective period may be four to six weeks. P, OB G 803.

b. Preparation for Private Practice (3-6) [Rpt./] I II This elective course for Year IV students is to provide patient care experience in a rural and/or underserved area of Arizona. Closely supervised preceptorship in Ob/Gyn in a private practice setting removed from the University. P, OB G 803.

c. Gynecological Oncology (4) [Rpt./] I II P, OB G 803, one other junior clerkship.
d. Gynecological Surgery (4-6) [Rpt./] I II

811. Subinternship
a. Gynecological Oncology (3-6) [Rpt./] I II P, OB G 803.

815. Subspecialty
a. Clinical Infertility (4-6) [Rpt./] I II P, OB G 803.
b. Perinatal Medicine (3-6) [Rpt./] I II P, OB G 803.
c. High Risk Obstetrics (4-6) [Rpt./] I II P, OB G 803.
d. Gynecology-Endocrinology (3-6) [Rpt./] I II P, OB G 803.
e. Obstetrical Ultrasound (4) [Rpt./] I II P, OB G 803.
f. Medical Gynecology (3-4) [Rpt./] I II P, OB G 803.
h. Reproductive Endocrinology and Fertility (4-6) [Rpt./] I II P, OB G 803.
i. Family Planning and Communications Medicine (4) I II

891. Preceptorship
a. Obstetrics and Gynecology (1-18) [Rpt./] I II

899. Independent Study (3-12) [Rpt./] I II

Pathology (PATH)

Associate Professors: William T. Bellamy, James M. Byers III, H. Eugene Hoyme (Pediatrics), Catherine S. Perry, Naomi E. Rance, Sayed M. Sadrzadeh, Ronald B. Schifman, Catherine M. Spier

Assistant Professors: Margaret M. Briehl, Theresa R. Kramer (Ophthalmology)

Clinical Professor: Peter M. Burkholder

Clinical Associate Professors: Achyut Bhattacharyya, Karen K. Steinbrom

Clinical Assistant Professors: Maria L. Aguierre, Elimor Angel, Jerry L. Bangert, Diane K. Eklund, Guadalupe H. Manriquez, M. Andrew Sibley


501. General and Systemic Pathology (1) I II P, admission to the M.D./Ph.D. program and consent of instructor.

512. Biological Electron Microscopy (4) I II P, one college level course in each of physics, chemistry, and biology. (Identical with MCB 512, which is home.)

515. Basic Human Pathology (4) I II Biochemical, structural, and functional changes in cells, tissues, and organs, which cause and are caused by diseases. For graduate students training for a career in biomedical research. 3R, 3L, P, consent of instructor. (Identical with PCOL 515, CBIO 515).

800. Research (3-12) I II

801. General and Systemic Pathology (1) [Rpt./] I II Lectures, conferences, demonstrations and laboratory investigations relating to disease. Use of current autopsy, biopsy and clinical pathology material. P, CBA 801, 802, 805; BIOC 501/801; PSIO 601/801; P or CR, MIC 801 (medical); P or CR, PHCL 501/801; P or CR, MEDI 801.

810. Clerkship
a. Anatomic Pathology (1-18) [Rpt./] I II An intern-type program with students participating in surgical pathology, autopsies and cytopathology. Instruction is strongly clinically oriented. P, PATH 801 and 12 weeks of clinical clerkships.

b. Clinical Pathology (1-18) [Rpt./] I II An interpretive approach to the evaluation of laboratory data in the diagnosis and management of clinical disorders. Topics include bacteriology, blood component therapy, body fluid analysis, clinical chemistry, coagulation, hematology, immunohematology, mycology, toxicology, urinalysis and virology. P, 801 and 12 weeks of clinical clerkships. P, PATH 801 and 12 weeks of clinical clerkships.

c. Special Topics (1-18) [Rpt./ 36 units] I II Opportunities for intensive studies during a six-week period in one of the following fields: cytopathology, cytogentic, immunohematology, immunopathology, microbiology-virology, neuropathology, pulmonary pathology, hematopathology, clinical chemistry and oncology. May be taken more than once for credit. P, PATH 801, prior arrangement and approval by the department.

d. Anatomic/Clinical Pathology (4-6) [Rpt./] I II P, completion of basic sciences.

e. Clerkship: Laboratory Medicine and Pathology (4) I II Clerkship in laboratory medicine and pathology. P, medical students only.

815. Subspecialty
a. The Clinical Practice of Telemedicine (3-6) The goal of this elective is to introduce the student to the practice of telemedicine. Telemedicine allows for patient evaluation at a distance. By allowing the patient to remain in her/his own community, telemedicine is thought to increase access to care. Although the main focus of this elective is clinical, students interest in technology assessment, economic evaluation and patient education are encouraged. Placements at rural sites are available.

891. Preceptorship
a. Pathology (1-18) [Rpt./] 54 units I II

b. Barrow Neurological Institute Neuropathology (4-6) [Rpt./] I II P, completion of basic sciences.
896. Seminar
a. Introduction to Forensic Pathology (1-3) II P, PATH 801, consent of instructor. (Identical with MED 896a, which is home).

899. Independent Study (3-8) [Rpt./] I II

Pediatrics (PED)
Arizona Health Sciences Center, Room 3301
Phone: (520) 626-5170
FAX: (520) 626-3636


501. Molecular and Medical Genetics (3) I Provides a basic understanding of human molecular genetics and how to apply that understanding in the pathophysiology of disease. (Identical with GEN 501).

800. Research (1-18) [Rpt./] I II (See College of Medicine Electives Manual)

801. Medical and Molecular Genetics (3) I Provides a basic understanding of human molecular genetics and how to apply that understanding in the pathophysiology of disease. (Identical with MED 816a, which is home).

803. Clinical Clerkship (6) [Rpt./] I II This six-week clerkship is required of all students in their initial clinical year. Stress is placed upon acquisition and refinement of basic data collection, upon problem solving and accumulation of factual knowledge and achieving those attitudes associated with being a physician.

810. Clerkship
a. Externship in Inpatient Pediatrics (4-6) I II P, PED 803
b. Pediatric Infectious Diseases (3-6) [Rpt./] I II

c. Neurodevelopmental Follow-Up of High Risk Infants (4-6) [Rpt./] I II
d. Cardiac Ultrasound Echo and Doppler (4-6) [Rpt./] I I

e. Pediatric Cardiology (4-6) [Rpt./] I II
f. Pediatric Neurology (4-6) [Rpt./] I II
g. Pediatric Hematology/Oncology (4-6) [Rpt./] I II
h. Pediatric Orthopedics (3-6) I II P, completion of basic science.
i. Developmental and Behavioral Pediatrics (4-6) [Rpt./] I II P, pediatric clerkship.
j. Pediatric Pulmonology (4-6) [Rpt./] I II P, PED 803.
l. Pediatric Allergy (4-6) [Rpt./] I II P, open to majors only. (Identical with MED 815I, which is home).
m. Pediatric Rotations (4) I II

815. Subspecialty
a. Advanced Neonatology (4-6) [Rpt./] I II
b. Pediatric Infectious Diseases (3-6) [Rpt./] I II
c. Neurodevelopmental Follow-Up of High Risk Infants (4-6) [Rpt./] I II
d. Cardiac Ultrasound Echo and Doppler (4-6) [Rpt./] I II
e. Pediatric Cardiology (4-6) [Rpt./] I II
f. Pediatric Neurology (4-6) [Rpt./] I II
g. Pediatric Hematology/Oncology (4-6) [Rpt./] I II
h. Pediatric Orthopedics (3-6) I II P, completion of basic science.
i. Developmental and Behavioral Pediatrics (4-6) [Rpt./] I II P, pediatric clerkship.
j. Pediatric Pulmonology (4-6) [Rpt./] I II P, PED 803.
l. Pediatric Allergy (4-6) [Rpt./] I II P, open to majors only. (Identical with MED 815I, which is home).
m. Pediatric Rotations (4) I II

891. Preceptorship
a. Pediatrics (4-6) [Rpt./] I II P, PED 803
d. Chronic Illness in Childhood (4) [Rpt./] I II P, PED 803
f. Pediatric Pulmonology (4) [Rpt./] I II P, PED 803
g. BNI Pediatric Neurology (4) [Rpt./] I II P, PED 803
h. Pediatric Critical Care (4) [Rpt./] I II P, PED 803
i. Rural Health Professions Preceptorship (3-6) [Rpt./] I II P, open to medical students formally admitted to the Rural Health Professions Program. (Identical with MED 8911, which is home).

899. Independent Study (3-18) [Rpt./] I II

Pharmacology
(See Pharmacology elsewhere in this chapter. Toxicology courses are listed under Pharmacology and Toxicology.)

Physiology
(See Physiology elsewhere in this chapter.)

Prevention
(See Arizona Prevention Center elsewhere in this chapter.)

Psychiatry (PSYI)
Professors: Alan J. Gelenberg, Head, Judith V. Becker (Psychology), Richard R. Bootzin (Psychology), Henry W. Brosin (Emeritus), Pedro L. Delgado, Alfred W. Kasznia (Psychology), Alan I. Levenson, John C. Racy, Eric M. Reiman, Bruce D. Sales (Psychology), Gary E. Schwartz (Psychology), Henry I. Yamamura (Biochemistry)

Associate Professors: Harold S. Arkowitz (Psychology), Iris R. Bell, Patrick M. Burke, Pedro L. Delgado, Diane S. Fordney (Obstetrics and Gynecology), Richard D. Lane

Assistant Professors: Shirley N. Fahey, John S. Jachna, Joanna Katsanis, Rachel Marber, Daniel E. Shapiro

800. Research (1-12) [Rpt./] I II (See College of Medicine Electives Manual)

803. Clinical Clerkship (6-9) [Rpt./ 12 units] I II Students are assigned patients in inpatient clinical settings. They obtain and record a complete history, mental status and physical examination. Students are expected to study the course of their patients and record their observations in daily progress notes. They work closely with clinical staff in the diagnosis, specific treatment, ward management and discharge planning involving their patients. In addition, they are introduced to community and legal services for the chronically ill, the suicidal and the violent patient. Those students wishing to take an additional three-, four-, or six-week clerkship in psychiatry may elect to do so (PSYI 810).
810. Clerkship
   a. Clinical and Community Psychology (4-6) [Rpt./ 1 II
   b. Child Psychiatry (6) [Rpt./ I II
   c. Psychiatry (4-6) [Rpt./ I II P, PSY 803, consult department before enrolling.
   815. Subspeciality
   a. Consultation Psychiatry (4-6) [Rpt./] S P, PSY 803.
   b. Outpatient Psychiatry (4-6) [Rpt./] S P, completion of 3rd psychiatry clerkship.
   f. Forensic Psychiatry (3-6) [Rpt./] P, PSY 803.
   g. Geriatric Psychiatry (4-6) [Rpt./] S P, PSY 803, consult department before enrolling.
   h. Forensic and Correctional Psychiatry (4-6) Learning objectives include a good understanding of the role of the forensic expert, various legal standards such as competency and insanity, and an appreciation of the mentally ill patient in a jail setting. P, Completion of PSY 803 and consent of instructor.
   v. Clinical Evaluation and Treatment of Sleep Disorders (3-6) [Rpt./] S (Identical with MEDI 815v, which is home).

891. Preceptorship
   a. Psychiatry (6) [Rpt./ 2] 1 II

899. Independent Study (1-18) [Rpt./] 1 II

Public Health
   (See Public: Health elsewhere in this chapter.)

Radiation Oncology (RONC)
Arizona Cancer Center
Phone: (520) 626-7479
FAX: (520) 626-4480

Professors: James R. Oleson, Head, G. Timothy Bowden (Molecular and Cellular Biology, Pharmacology and Toxicology), Thomas C. Cetas (Electrical and Computer Engineering, Aerospace and Mechanical Engineering), Anne E. Cress (Cancer Biology), Eugene W. Gerner (Biochemistry), Hugo Villar (Surgery)
Associate Professors: Chee-Wai Cheng, David S. Shimm (Internal Medicine), Jesse Martinez, Stephen A. Sapareto, Baldassarre D. Stea
Assistant Professors: Ozer Algan, John M. Anderson, Eugene Gross, Kathy McGovern
Clinical Associate Professor: Chee Wai Cheng, Alan Hamilton (Surgery)
Clinical Assistant Professors: Bruce Lulu, Helen Fosmire
531. Molecular Mechanisms of Carcinogenesis (3) I P, consent of department. (Identical with CBIO 551, which is home).
555. Cancer Therapeutics (3) II (Identical with CBIO 555, which is home).
96. Seminar

h. Cancer Biology Series (1) [Rpt./ 2] I (Identical with CBIO 596H, which is home).
615. Subspeciality
   a. Cancer Epidemiology and Prevention (3) I P, EPI 573a (Identical with EPI 615a, which is home).
   b. Cancer Control (3) II P, EPI 615a, EPI 573a. (Identical with EPI 615b, which is home).
699. Independent Study (1-3) [Rpt./] 1 II
815. Subspeciality
   a. Introduction to Radiation Oncology (1-6) [Rpt./ I II
   b. Cancer Epidemiology and Prevention (3) [Rpt./ I (Identical with F CM 815H, which is home).
   d. Neuro-Oncology (4) I II Subspeciality in neuro-oncology. P, open to medical students only. (Identical with SURG 816d, NEUR 816d).
699. Independent Study (3-6) [Rpt./] I II

Radiology
Professors: Theron W. Ovitt, Head, Harrison H. Barrett (Optical Sciences), M. Paul Capp (Emeritus), Raymond F. Carmody, William J. Dallas (Optical Sciences, Electrical and Computer Engineering), Robert J. Gillies (Biochemistry), Arthur F. Gmitro (Optical Sciences), George W. Drach (Emeritus), John B. Fortune, Theodore J. Glattke (Speech and Hearing Sciences), Glenn Hunter, Kenneth V. Iserson, Douglas F. Larson (Pharmacology), Douglas Lindsey (Emeritus), Noel D. Matkin (Speech and Hearing Sciences), Joseph L.R. Mills, Paul F. McDonagh (Physiology), Harvey W. Meislin (Emergency Services), Joseph L. Mills, Leonard F. Peltier (Emeritus), Charles W. Putnam, Arthur B. Sanders (Family and Community Medicine), Gulshan K. Sethi, Daniel W. Spaita, Donald P. Speer (Anatomy), Robert F. Spetzler, Charles M. Tipton (Exercise and Sport Sciences, Health Related Professions), Terence D. Valenzuela, Hugo V. Villar (Radiation Oncology), Robert G. Volz (Emeritus), Stuart K. Williams (Physiology), Charles L. Witte, Marlys H. Witte, Charles F. Zukoski, III (Emeritus)
Associate Professors: Robert M. Anderson (Emeritus), Francisco Arabia, James B. Benjamin, Bruce L. Dalkin, Allan Hamilton (Radiation Oncology), Ronald Heimark, Steven B. Johnson, Steven Larson, Paul Nakazato, William D. Rappaport, Valerie F. Reyna, John B. Sullivan, Jr. (Pharmacology and Toxicology), James A. Warnke, David B. Van Wyck (Medicine), Martin E. Weinand
Assistant Professors: Kenneth A. Andreoni, David Arzouman, Bruce L. Dalkin, Michael J. Essex, Mitchell R. Gropper, Joel D. Macdonald, James A. Warnke, Carlton Young
Research Associate Professors: Janis M. Burt (Associate Professor, Physiology), Donald W. DeYoung (Chief, Experimental Surgery/Clinical Services, Veterinary Sciences, University Animal Care, Arizona Health Sciences Center), Ronald L. Misiorowski (Anatomy), David Montgomery, John A. Szivek
Assistant Professors of Clinical Surgery: Achiyuth Blatcharrya, Rienkme M. Brakema, Richard H. Carmona (Physician Consultant, Student Health Service), Catherine Cosentino, Curtis
A. Dickman, Mary Jo Ghory, Peter N. Harrington, Kenneth R. Johnson, Mazen Khayata, Samuel M. Keim, Jerry D. Morh, Neoptio L. Robles, Jerry B. Rogers, Jolyon D. Schilling, H. Thomas Sethney, Del V. Steinbronn (Radiation Oncology), Jon Wang, William L. White, Joseph M. Zabramski

Professors of Clinical Surgery: Eric G. Ramsey, Martin Schiff, Jr.

Associate Professors of Clinical Surgery: Robert B. Dzioba, Frederick A. Greenwood, Samuel M. Keim, Frederick J. Menick, Frank Walter

Assistant Professors of Clinical Surgery: Scott S. Berman, William J. Brooks, Heeten Desai, John A. Guisto, Irwin E. Harris, Sharon J. Isikoff (Family and Community Medicine), Rockwell Jackson, Christopher T. Johnson, Rebecca J. Kennedy, David Neal, John T. Ruth, Wendell B. Whitacre

Research Assistant Professors: Carl A. Boswell, Lorraine M. Manciet, Judith B. Ulreich


Research Lecturers: Stephen Harkins, Ann Kerwin (Humanities)


Research Associates: Kullervo H. Hyynen (Radiation Oncology, Aerospace and Mechanical Engineering), Arlene W. Scadron

Research Specialists: Michael J. Bernas, Peter Borgs

Specialists in Cardiac Transplant: Christianne Demissae, Suzanne N. MacDonald

Specialist in Neurosurgery: David H. Tallman

Cardiothoracic/Cardiopulmonary Perfusionists: John P. Duffy, Raymond L. Ramirez

Assistant Scientific Investigator: Xujian Shao

The Department of Surgery provides a broad general exposure to surgery during a six-week basic clinical clerkship and a three-week specialty clerkship. The specialty clerkship requirement can also be met by registering for Surgery 807 in the fourth year. The basic clerkship stresses preparative evaluation in emergency, inpatient, and ambulatory settings, proper operating room conduct and postoperative management. An awareness of the nature and management of surgical disease is developed by case-oriented small group sessions, rounds, and weekly conferences. The specialty surgery clerkship reinforces these basic skills by application to specialty areas such as urology, orthopedics, neurosurgery, cardiothoracic surgery, and otorhinolaryngology.

Elective courses in general and specialty surgery and various aspects of surgical biology are offered. Increased clinical responsibility is assured on hospital services by assigning the elective student to the patient-care team. Special courses designed around specific clinical activities and research programs in the Department of Surgery and other departments are available on an individual basis.

The graduate program in surgical sciences includes hospital training in general and specialty surgery with a strong emphasis upon the five-year graduate program. It emphasizes training of the clinical surgeon but encourages elective surgical study for future community, academic, or research surgery.

596. Seminar
   a. Molecular Cardiovascular Biology (3) [Rpt./2 I (Identical with MCB 596i, CBI 596i, CBA 596i, PSIO 596i).
   b. Cardiopulmonary Physiology (3) [Rpt./2 I (Identical with MCB 596i, CBI 596i, CBA 596i, PSIO 596i).
   c. Neurosurgery (3 - 6) [Rpt./2 I II P, 4th year medical student or completion of SURG 596.

800d. Research Techniques in Orthopedic Surgery (4-8) [Rpt./1 I II P, SURG 803.

803d. Research Techniques in Orthopedic Surgery (4-8) [Rpt./1 I II P, SURG 803.

808. Clinical Clerkship (6-9) [Rpt./1 I II Introduction to clinical surgery through hospital clerkship on surgical wards.

807. Specialty Clerkship (3) [Rpt./1 I II Introduction to clinical surgery through exposure to a surgery specialty clerkship (as assigned by the Surgery Department). P, basic science courses.

810. Clerkship
   a. General Surgery (3-8) [Rpt./1 I II
   b. Burn Care (4-8) [Rpt./1 I II P, 4th year medical student or completion of SURG 803.

811. Subinternship
   a. Boundary Neurological Surgery (4-6) [Rpt./1 I II P, 4th year medical students.

815. Subspeciality
   a. Urology (3-6) [Rpt./1 I II
   b. Urology (3-6) [Rpt./1 I II
   c. Urology (3-6) [Rpt./1 I II
   d. Fluid and Electrolyte Balance (1-3) [Rpt./6 units] I II
   e. Urology (4-6) [Rpt./1 I II P, Open to majors only.
   f. Orthopedics (3) [Rpt./1 I II
   g. Cardiac Surgery (4-6) [Rpt./1 I II
   h. Lymphatic System Health and Disability (6-12) [Rpt./1 I II
i. Surgical Critical Care (4) I II P, completion of 3rd year clerkship. Credit allowed for only one of these courses: SURG 819, NES 815.

j. Otorhinolaryngology (3) [Rpt./I II

k. Orthopedic Sports Medicine (4) [Rpt./I II

l. Orthopedic Biomechanical/Biomaterial (6) [Rpt./I I, SURG 803 or SURG 807; 9 weeks of surgery clerkship.

m. Trauma (3-8) [Rpt./I II

n. Spinal Cord Injury (3) [Rpt./I II

o. Surgical Critical Care (3-6) [Rpt./I II units] I II P, SURG 803.

p. Pediatric Orthopedic Surgery (3-6) [Rpt./I II units] I II P, rotation in pediatrics and orthopedic surgery.

q. Plastic Surgery (3-6) [Rpt./I II P, senior year in medical school.

r. Clinical Experiment Rehabilitation Medicine (1-4) [Rpt./I II

s. Vascular Clinical Management (4-6) [Rpt./I II P, completion of junior and senior rotations in surgery.

t. Emergency Medicine (3-12) [Rpt./I II

u. Head and Neck Surgery (4-6) [Rpt./I II P, completion of required clerkships.

v. Clinics in Medical Ignorance (3-4) [Rpt./I II P, junior standing.

w. Pediatric Urology (4) [Rpt./I II

x. Clinical Toxicology (4-6) [Rpt./I II P, 4th year medical students.

y. Advanced Surgery (3-6) [Rpt./I II P, general surgery.

816. Subspecialty

a. Pediatric Surgery (4) [Rpt./I II (Identical with PED 816a).

b. Hand Surgery (4) II

c. Rural Pediatric Orthopedics (3-4) (Identical with PED 816c).

d. Neuro-Oncology (4) I II P, open to medical students only. (Identical with RONC 816d, which is home).

e. Surgical Critical Care (4) Provides the student with an introduction to the management of the patient with severe multiple system disease in the intensive care unit setting. Major emphasis is placed on providing an understanding of the diagnosis and management of acute respiratory failure including ventilator management, fluid and electrolyte disorders. P, third year surgical clerkship.

g. Vascular Surgery (4) To grasp an understanding of vascular surgery by serving as a sub intern. Knowledge will be gained in clinical examination of vascular problems, interpretation of Duplex examination data as well as angiograms, patient selection for which type of revascularization procedures, the individual operative procedures by serving as a member of the surgical team, postoperative care, and long term outcome. There are also didactic sessions on the vascular lab and ultrasound as well as application of those diagnostic modalities. Endovascular approaches are likewise to be observed. Experience in methods and indications for anticoagulant therapy is provided. P, SURG 801.

a. Surgery and Subspecialties (1-18) [Rpt./I II

b. General Surgery “B” (4-12) [Rpt./I II

c. General Surgery “C” (4-12) [Rpt./I II

d. Spine and Orthopedic Reconstruction (4-12) I II

e. Rural Health Professions Preceptorship (3-6) [Rpt./I II P, open to medical students formally admitted to the Rural Health Professions Program. (Identical with MED 891I, which is home).

f. Perfusion Science (1-3) [Rpt./I II (Identical with PHCL 891I, which is home).

896. Seminar

a. Medical Ignorance (2) [Rpt./I II

b. Gene Therapy for Vascular Disease (2) II P, 3rd and 4th year medical school. (Identical with MED 896h, which is home).

u. Cardiovascular Pathophysiology (2) I II P, third and fourth year medical students only. (Identical with MED 896u, which is home).

899. Independent Study (1-3) [Rpt./I II

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**Mexican American Studies (MAS)**

Economics Building, Room 208
Phone: (520) 621-7551
FAX: (520) 621-7566
WWW: http://w3.arizona.edu/masrc/

Application Questions:
Antonio Estrada, (520) 621-5121, aestrada@u.arizona.edu

Advising Questions:
Antonio Estrada, (520) 621-5121, aestrada@u.arizona.edu

Degrees Offered: M.S.

Professor: Adela de la Torre
Associate Professor: Antonio Estrada
Assistant Professors: Arturo Gonzalez, Gilbert A. Quintero

This program provides subject and research competency on Mexican Americans. In addition, it provides applied skills for working professionals and graduate students interested in better serving the Mexican American population of the Southwest. The program is designed to provide students expertise in areas of Latino health, applied historical and culture perspectives, and public policy.

A minimum of 19 core units, 9 elective units and 6 thesis units are required for successful completion of this degree. Students are required to select one option from the three strands available in the MS program. The three strands available are: Latino Health, Historical and Applied Cultural Studies, and Public Policy. After consultation with a faculty advisor, graduate students must select 9 elective units from one of the three strand options.

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509. Mexican Immigration (3) I This course will examine immigration from Mexico to the U.S. The course focuses on current immigration issues such as the economic assimilation of immigrants, as well as other social issues.

510. Mexican American Labor (3) II Examines Mexican-Americans in the labor force. Issues covered include earnings, unionism, labor force participation, etc.


529. * The U.S.-Mexican Borderlands in Comparative Perspective (3) II (Identical with POL 529, which is home).

550. Development of Mexican and Mexican American Literature (3) I (Identical with SPAN 550, which is home).

574. Linguistic Perspectives on Mexican-American Spanish and Bilingualism (3) I II P, SPAN 340. (Identical with SPAN 574, which is home).

580. * Advanced Research Methods (4) II Designed to provide students with an exposure to qualitative and quantitative decision-making methods, focusing on the Mexican American population. 3R, 3L, P, MAS 180, MAS 280. Graduate-level requirements include a research project.

585. * Mexicana/Chicana Women's History (3) I CDT Historical survey and sociological analysis of past and present experiences of Mexicanas and Chicanas in the United States (Identical with W S 485). Graduate-level requirements include a longer writing project and an additional class presentation. (Identical with WS 585).

587. Chicana Gender Perspectives (3) II This course provides a cross-disciplinary review of theoretical, empirical, and cultural perspectives of Chicana/Latina women in the U.S. P, MAS 585.

589. Internship (1-6) [Rpt./I

596. Seminar

a. Advanced Topics in Chicano Studies (3) I P, at least 15 units of core MAS courses.

597. Workshop

a. The Border Academy (2-6) S Provides an overview of key public policy issues affecting the U.S.-Mexico border. Topics covered include: immigration, regional landscape, border health, and regional economic development.
Applicants are required to submit scores on the verbal, quantitative, and analytical sections of the Graduate Record Examination. Scores in an advanced section are recommended. At least two letters of recommendation must be submitted with an application to the M.S. or Ph.D. program.

501b. Medical Microbiology (3-3) II
The biological characteristics of microorganisms of importance in human health and disease; the reaction of the host to infectious agents and the mechanisms of host defense; diagnosis and management of infectious disease. Lectures, discussions, and laboratory experiments. This is a two-semester course with both semesters 501a - 501b required to be taken consecutively in order to receive a final grade. P, BIOC 462a, BIOC 462b or equivalent.

503L. Parasite Laboratory (1) (Identical with V SC 503L, which is home).

503R. Biology of Animal Parasites (3) I (Identical with V SC 503R, which is home).

511. Topics in Molecular Biology (1) II (Identical with MCB 511, which is home).

512. Biological Electron Microscopy (4) I II P, one college level course in each of physics, chemistry, and biology. P, with MCB 512, which is home.

517. Microbial Physiology and Gene Cloning (3) II Biochemical and physiological activities of microorganisms.


520. Pathogenic Bacteriology (3) II P, MIC 325, CHEM 241b, 243b. (Identical with V SC 520, which is home).

523. Mechanisms of Disease (5) I II (Identical with V SC 523, which is home).

525. Environmental Microbiology (3) I (Identical with SWES 525, which is home).

526. Environmental Microbiology Laboratory (2) I (Identical with SWES 526, which is home).

527L. General Mycology Lab (2) I General mycology laboratory, with emphasis on the microfungi. P, or CR, MBIM 527R.

527R. General Mycology (3) I General mycology, with emphasis on the microfungi. P, MIC 205.

529. General Virology (3) II Essential features of the viruses, including structure, gene expression and life cycle. Introduction to pathogenesis with respect to humans, other animals, and plants. P, MIC 205, CHEM 241b, CHEM 243b; MCB 411 suggested. (Identical with MCB 529, V SC 529).

530. Introduction to Biophysics (2) I (Identical with PHYS 530, which is home).

531. Biophysical Theory (2) II (Identical with PHYS 531, which is home).

532. Pathogenic Virology (3) I (Identical with V SC 532, which is home).

538. Ecology of Infectious Disease (3) II (Identical with V SC 538, which is home).

540. Biodegradation of Pollutants in Soil and Groundwater (3) II (Identical with SWES 540, which is home).

543. Research Animal Methods (3) I (Identical with V SC 543, which is home).

546. Environmental Biotechnology (2) II P, SWES 525. (Identical with SWES 546, which is home).

550L. Medical Mycology Laboratory (2) II Laboratory experiments dealing with isolation and identification of fungi of medical importance. P, or CR, MBIM 550R. (Identical with V SC 550L).


551. Molecular Mechanisms of Carcinogenesis (3) I P, consent of department. (Identical with CBIO 551, which is home).

552. Molecular Mechanisms of Microbial Pathogenesis (3) I II Review of current concepts in specific areas of microbial pathogenesis, including action of exo- and endotoxins, cell surface interactions, phagocytosis and host microbicidal functions. P, BIOC 460.

554. Host-Microbial Interactions (3) II (Identical with V SC 554, which is home).

555. Cancer Therapeutics (3) II (Identical with CBIO 555, which is home).

560. Development of the Immune System (4) I II Developmental biology of T cells and B cells. Negative selection (tolerance induction) during the differentiation of T cells and B cells as mediated by T cell receptors and immunoglobulin receptors, respectively. Development of major histocompatibility complex antigen restriction (positive selection) during differentiation of T cells in the thymus. Regulation of positive and negative selection in health and disease (autoimmunity).

561. Immunobiology (3) II Cells and cellular events involved in humoral and cell-mediated immune responses; morphologic, physiologic and biochemical characterizations of the lymphoreticular system. P, BIOC 462a.

562. Tumor Immunology (3) I The immunological mechanisms involved in host responses to tumors, with emphasis on the delineation of cellular interactions between immune cells and tumor cells that may result in tumor progression or rejection. (Identical with CBIO 562).

570. Molecular Genetics and Evolution (3) I Molecular genetics and biology of the bacterial viruses; molecular mechanisms of gene regulation, DNA replication, DNA repair, mutation and genetic recombination; current research in bacterial genetics (lysogeny, transduction, conjugation, use of transposons and gene fusions in genetic
analysis and transformation); recent advances in molecular evolution with emphasis on evolution of DNA polymerases. (Identical with GENE 570).

575. Parasite Immunology (3) II (Identical with V SC 575, which is home).

580. Molecular Virology (3) II The current status of basic research in virology at the molecular level. P, CHEM 460.

582. Immunotoxicology and Immunopharmacology (3) I P, MIC 419 or equivalent; PCOL 602a, PCOL 602b. (Identical with PCOL 582, which is home).

589. Cancer Genetics (3) [Rpt./1] I P, ECOL 320, MCB 320. (Identical with CBIO 589, which is home).

593. Internship (1-6) [Rpt./1] I II

596. Seminar
   a. Current Problems in Molecular Biophysics (1) I II (Identical with PHYS 596a, which is home).

599. Independent Study (1-6) [Rpt./1] I II

630. Experimental Methods for Research (4) I Hands-on techniques necessary for pursuing a research career in Microbiology and Immunology. P, MBIM 501a, MBIM 501b, MBIM 560 or MBIM 561; MIC 419, BIOL 460, consult department before enrolling. (Identical with V SC 630).

693. Internship (1-6) I II

695. Colloquium
   a. Readings in Microbiology (1) [Rpt./5] I II
   b. Immunopathology (1) I II
   c. Molecular and Cellular Immunology (1) I II
   d. Tumor Virology (1) II
   e. Host-Parasite Interactions (1) [Rpt./1] I II
   f. Immunology Data Analysis (1) I
   g. Readings in Immunology (1) I II

696. Seminar
   a. Research (1) [Rpt./1] I II
   b. Independent Study (1-5) [Rpt./1] I II
   c. Research (3-6) [Rpt./1] P, consent of instructor and coordinator.

801a-801b. Medical Microbiology (3-3) I II The biological characteristics of microorganisms of importance in human health and disease; the reaction of the host to infectious agents and the mechanisms of host defense; diagnosis and management of infectious disease. Lectures, discussions, demonstrations and laboratory experiments. This is a two-semester course with both semesters required to be taken consecutively (801a-801b) in order to receive a final grade. P, BIOL 462a, BIOL 462b or equivalent.

891 Preceptorship
   a. Microbiology and Immunology (3-12) [Rpt./12 units] I II

899. Independent Study (1-6) [Rpt./1] P, MBIM 501 or MBIM 801.

900. Research (1-6) [Rpt./]

909. Master's Report (1-6) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Mining & Geological Engineering (G EN/ MN E)**

Mines Building, Room 229
Phone: (520) 621-6063
FAX: (520) 621-8330
WWW: http://w3.arizona.edu/~mge

Application Questions:
Elsa Morales, (520) 621-6063, elsam@mge.arizona.edu

Advising Questions:
Elsie Nonaka, (520) 621-3006, elsie@mge.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: P. H. S. W. Kulatilake, Ben K. Sternberg, Jay C. Dotson (Emeritus), William C. Peters (Emeritus)

Associate Professors: Paul J.A. Lever, Head, Charles E. Glass, Satya Harpalani, John Kemeny, Mary Poulton

Assistant Professor: Hugh B. Miller

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in mining engineering, and in geological and geophysical engineering. Advanced work in mining engineering is directed toward research and professional development in several fields including mine planning, geomechanics, operations research, robotics, mine health and safety, and the development of new extractive techniques. Advanced work in geological engineering is directed toward the fields of geophysical engineering, ground stabilization, earthquake engineering, urban planning, remote sensing, and conservation.

Admission to graduate work normally requires the completion of an undergraduate major in these fields. Student with undergraduate majors in other engineering fields or in the physical sciences, however, are encouraged to apply because training in such fields provides an excellent background for approaching some areas of graduate study in this department. The department requires that scores on the General Graduate Record Examination be submitted by all applicants for mining engineering and geological engineering. In addition, a GPA of 3.0, a statement of purpose, three letters of recommendation, and transcripts are required. Deadline for applications are as follows: Domestic Students: June 1 (Fall Semester), October 1 (Spring Semester); International Students: February 1 (Fall Semester), August 1 (Spring Semester).

Students working toward the Master of Science degree in either mining engineering or geological and geophysical engineering will be required to complete a thesis and must pass a final examination covering both the thesis and course work. At least 15 units of course work must be completed in the major field. Programs leading to the Doctor of Philosophy degree require completion of at least 6 units of graduate-level course work in computer science, computer programming, or mathematics. Any questions regarding the qualification of a particular course in satisfying this requirement should be submitted to the department's graduate committee for clarification. Science language competency for doctoral candidates in the Department of Mining and Geological Engineering is not required. Due to the increasingly international nature of engineering and the mineral fields, however, the department recommends that doctoral candidates give serious consideration to developing communication skills in a second language.

An environmental engineering option is available. This discipline applies fundamental engineering principles to the prevention and solution of problems affecting the environment. Coursework concentration in this option covers important environmental topics such as air and water pollution, hazardous waste management, remediation and reclamation, site characterization, and environmental regulations.

There are specific course requirements for both the master's and the doctor's degrees in all majors. These requirements aligned with other policies and procedures are contained in "Guide to Graduate Study," which is available on request from the Department of Mining and Geological Engineering.

**Geological Engineering (G EN)**

502. * Probability and Statistical Concepts in Geologic Media (3-4) I Univariate probabilistic and statistical methods: data reduction, basic probability concepts, discrete and continuous probability distributions, sampling distributions, confidence intervals, goodness-of-fit tests; applications in geologic media. Introduction to a few statistical packages. 3R, 3L, 3ES, 1ED. P, MATH 223. Graduate-level requirements include an in-depth term paper on an application. (Identical with MN E 502).
503. Rock Mass Joint Geometry Modeling (3) II Sampling techniques; statistical homogeneity; delineation of joint sets; corrections for sampling biases of joint parameters; inference of statistical distributions for orientation, spacing, intensity and size; joint systems modeling and validation. P, G EN 402, SIE 270.


507. * Geophotography (3) I Use of aerial photographs in geologic mapping. 1R, 6L. 1.5 ES, 1.5 ED. P, GEOS 321. Graduate-level requirements include completion of an advanced project involving photo interpretation and field mapping. (Identical with GEOS 507).

515. * Rock Excavation (3) II (Identical with MN E 515, which is home).

516. * Field Studies in Geophysics (3) II Seismic, magnetic, electrical, and gravity exploration techniques. 3ED. P, G EN 448 or G EN 548. Graduate-level requirements include additional project work requiring a more in-depth analysis. (Identical with GEOS 516).

522. Well Logging Interpretation (3) II Basic well logging theory. Fundamentals of quantitative formation evaluation. Detailed investigation of aspects of well logging applicable to student's research interests. P, consult department before enrolling. (Identical with HWR 522, GEOS 522).

524. Fundamentals of Geotechnics (3) II Principles of hemispherical projections and rock joint surveys; application of stereo-graphic projection in mechanics of discontinuous rock; shear strength of discontinuities; introduction of Block theory and its application to surficial excavations; engineering solutions to problems of soil and rock slope stability. 2ES, 1ED. Field Trips. P, C E 340. Graduate-level requirements include an in-depth research paper on an assigned topic.

525. * Geotechnical Investigations (3) II Senior design course emphasizing the investigation and analysis of geologic factors in the design and construction of engineering projects. 1R, 6L. 3ED. Graduate-level requirements include a research project.

526. * Health and Safety in Mining (1) I (Identical with MN E 526, which is home).

527. * Geomechanics (3-4) I (Identical with MN E 527, which is home).

529. Rock Slope Analyses and Design (3) I (Identical with MN E 529, which is home).

537. Developments in Rock Mechanics (2) I P, MN E 427 or MN E 527. (Identical with MN E 537, which is home).

545. * Fundamentals of Geostatistics (3) II (Identical with MN E 545, which is home).


549. * Mineral Exploration (3) I Analysis of guides and techniques leading to location and delineation of mineral deposits. 1ES, 2ED. P, GEOS 209. Graduate-level requirements include a research report. (Identical with GEOS 549, MN E 549).

550. Earthquake Engineering (3) I Applied course in earthquake causes and effects, integrating the fields of seismology, engineering, and seismic geology. P, MATH 254.

551. Probabilistic Methods in Geotechnical Engineering (3) II P, C E 340. (Identical with C E 351, which is home).

557. * Applied Geomechanics (3) II (Identical with MN E 557, which is home).


570. * Computer Methods in Geological Engineering (3) I Use of computers to solve problems in geological engineering, including data bases, computer contouring, map filtering and enhancement, and multivariate analysis of geologic data. 3ED. P, Introductory courses in computer programming, math, and earth science. Graduate-level requirements include an additional advanced research project.

580. The Mechanics of Fracture in Rock and Other Brittle Materials (3) II (Identical with MN E 580, which is home).

587. Applied Neural Network Computing (3) II Theoretical development and applications of artificial neural networks for classification, parameter estimation, prediction, filtering, and association. Emphasis is placed on applications in science and engineering. P, knowledge of a computer programming language.

596. Seminar a. Research Seminar (1-3) [Rpt./ 6 units] I II (Identical with MN E 696a).

699. Independent Study (1-5) [Rpt./]

900. Research (1-4) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Mining Engineering (MN E)

501. * Analysis of Mine Operations (3) I Use of operations research principles and techniques to analyze various problems in mine operations. Graduate-level requirements include a project using MIS software.

502. * Probability and Statistical Concepts in Geologic Media (3-4) I (Identical with G EN 502, which is home).

503. Analysis of Mining Decisions (3) I Use of geostatistics, system simulation languages and computers to analyze various mining decisions related to reserve estimation and mine planning. P, MN E 401, MN E 402, MN E 430.

506. Fundamentals of Mine Ventilation * (3) Determination of quality and quantity of respirable air in mining operations. Thermodynamics of mine ventilation and design of ventilation systems. P, C E 321. Graduate-level requirements include a simulation project on design of an airflow system for an underground mine.

511. * Mineral Processing (3) I Physical and chemical unit operations used to separate and recover the economic minerals and metals from their ores. The modern scientific and engineering background for the operations are presented as well as economic aspects. Includes field trips to major mining operations in Tucson area. Field Trips. Graduate-level requirements include an advanced research project. (Identical with MSE 511).

515. * Rock Excavation (3) II Methods of excavation of rock in surface and underground mines and construction, ranging from the empiricism of conventional blasting practice to the application of the fundamental mechanics of rock fracture. Field Trips. P, C E 217. Graduate-level requirements include a research project. Field Trips. (Identical with G EN 515).

526. * Health and Safety in Mining (1) I (Identical with G EN 526).

527. * Geomechanics (3-4) I Mechanical behavior of rock and rock masses; response to load changes: deformations, failure, discontinuity slip; in situ stress state; rock testing; geomechanical classifications; engineering applications: slopes, pillars, tunnels, dam foundations; reinforcement design. P, C E 217, GEOS 301. Graduate-level requirements include either a research project or a research paper at the discretion of the instructor. (Identical with G EN 527).
Molecular and Cellular Biology (MCB)

Life Sciences South, Rm. 248
PO Box 210106
Phone: (520) 621-1073
FAX: (520) 621-3709
WWW: http://BMCB.biology.arizona.edu

Application Questions:
Monique Katsanis, (520) 621-1519 or
(888) 285-3028, dledegler@u.arizona.edu

Advising Questions:
Elizabeth Vierling, (520) 621-1601,
vierling@u.arizona.edu

Degrees Offered: M.S., Ph.D.

Initial admission is to the doctoral program only

Professors: Danny Brower, Head, H. Vasken Aposhian, Hans Bohnert (Biochemistry), Don Bourque (Biochemistry), George T. Bowden (Radiation Oncology), Murray Brillant (Pediatrics), Gail Burd, Vicki Chandler (Plant Sciences), Carol Dieckmann (Biochemistry), Robert P. Erickson (Pediatrics), Wayne R. Ferris (Emeritus), William Grimes (Biochemistry), Richard B. Hallick (Biochemistry), John Hildebrand (Arizona Research Laboratory, Division of Neurobiology), Christina Kennedy (Plant Pathology), Brian Larkins (Plant Sciences), John Little (Biochemistry), Neil H. Mendelson, Roger Miesfeld (Biochemistry), David W. Mount, Howard Ochman (Ecology and Evolutionary Biology), Roy R. Parker, Paul Pysherd, Hans Van Ettten (Plant Pathology), Elizabeth Vierling (Biochemistry), Samuel Ward

The Department of Molecular and Cellular Biology is a research-oriented department in which students may receive advanced training in all aspects of cellular, molecular, biochemical, and genetic research. The department will only admit graduate students whose stated objective is the Doctor of Philosophy.

In 1993, faculty members in the Departments of Biochemistry and Molecular and Cellular Biology (BMCB) formed a joint graduate program to provide students with broader training and a wider choice of research laboratories to choose for their dissertation. There are currently over 60 faculty members in the BMCB Graduate Program, including faculty representing 13 departments or interdisciplinary programs in addition to MCB and Biochemistry. Applicants to either Biochemistry or Molecular and Cellular Biology are considered jointly by the BMCB committee. Students entering either program enroll in the same core courses their first year.

Applicants for admission should be prepared in chemistry (including at least one semester of physical chemistry), physics, and mathematics in addition to biology. Scores on the aptitude tests of the Graduate Record Examination must be submitted. Applicants must communicate directly with the department regarding other admission requirements.
files for admission to the programs should be completed by January 15 to insure consideration, but late applications may be considered. All students who are accepted into the program receive full financial assistance (stipends, fees, and health insurance).

Students are expected to specialize in areas of interest to the faculty. These include regulation of gene expression, neurobiology of simple systems, cytoskeletal function and control of cell movements, cell cycle control, structure and function of nucleic acids, plant developmental and molecular biology, invertebrate developmental genetics, evolution of developmental processes, and yeast molecular biology. A listing of the faculty of the department and their research interests can be obtained from the web page or the department on request.

502. * Medical Physics (3) I (Identical with PHYS 502, which is home).

510. Plant Molecular Biology (3) II P, 5 units of undergraduate biochemistry. (Identical with PL S 510, which is home).

511. Topics in Molecular Biology (1) II Provides experience in critical thinking, making and testing hypotheses, evaluating original research papers, and expressing ideas in discussions. (Identical with MBIM 511, BIOC 511).

512. Biological Electron Microscopy (4) I II Provides theoretical background and practical experience in transmission and scanning electron microscopy that are necessary for the efficient and effective application of ultra-structural and cytochemical techniques as research tools. P, one college level course in each of physics, chemistry, and biology. (Identical with ENTO 512, BIOC 512, PATH 512, MBIM 512, PL P 512, CBA 512, AN S 512, V SC 512, PSIO 512).

516. * Bioinformatics and Genomic Analysis (3) Analysis of genome sequences for function using local and internet computer resources. IR, 3L, P, consult instructor for prerequisites before enrolling. Graduate-level requirement include a research project, written report, and a class presentation. (Identical with ECOL 516, BIOC 516, GENE 516).

529. General Virology (3) II P, MIC 205, CHEM 241b, CHEM 243b; MCB 411 suggested. (Identical with MBIM 529, which is home).

539. * Plant Cell Biology (3) I (Identical with PL S 539, which is home).

545. Concepts in Genetic Analysis (3) I Methods of genetic analysis including mutant isolation, genetic and physical mapping, reverse genetics, evolutionary mechanisms, molecular variation and genomic evolution. P, introductory undergraduate genetics course or biology course. (Identical with BIOC 545, ECOL 545, GENE 545, INSC 545).

549. Survival Skills for Students (2) I II (Identical with SP H 549, which is home).

550. Topics in Pigment Cell Biology (2) I (Identical with CBA 550, which is home).


556. Topics in Developmental Biology (2) I II P, consent of instructor and prior course in developmental biology or equivalent. (Identical with AN S 556, which is home).

557. Experiments in Developmental Biology (4) II (Identical with CBA 557, which is home).

558. Nucleic Acid (4) I P, BIOC 411 or BIOC 531, consent of instructor. (Identical with BIOC 568, which is home).

569. Topics in Gene Reconfiguration (2) I II P, BIOC 568 or consent of instructor. (Identical with BIOC 569, which is home).

572. Cell Regulation (3) II Advanced treatment of biological regulation in eukaryotic cells. Topics to be discussed include regulation of cellular metabolism, cytoskeletal dynamics, organelle function, and cell division. P, MCB 462a, MCB 462b, and consult department before enrolling. (Identical with BIOC 572).

574. Advances in Mammalian Genetics (2) [Rpt./ 1] I P, undergraduate courses in genetics and molecular biology. (Identical with BIOC 574, which is home).

575. Special Topics In Biological Imaging (2) I II (Identical with CBA 575, which is home).

576-576b. * Analysis of Biological Diversification (3-3) [Rpt./ 1] I II (Identical with GEOS 576a.-GEOS 576b., which is home).

577. Principles of Cell Biology (4) II P, consent of course coordinator. (Identical with CBA 577, which is home).

582. Topics in Neural Development (2) I P, consult program office before enrolling. (Identical with NRSC 582, which is home).

583. Topics in Neural Plasticity (2) II Reading and discussion of primary literature on molecular, cellular, biochemical, physiological, and structural changes that occur on the adult nervous system. P, course in neurobiology, consult department before enrolling. (Identical with NRSC 583, CBA 583).

584. Cellular Neurobiology (2) II P, consent of instructor, one semester of neurobiology or cell biology. (Identical with CBA 584, which is home).

585. Biological Structure I (4) II P, BIOC 462a. (Identical with BIOC 585, which is home).

586. Intracellular Messengers (2) I P, NRSC 588 or consent of instructor. (Identical with NRSC 586, which is home).

587. Biology of Neurological Disease (2) II P, graduate or medical students only. Consult program office before enrolling. (Identical with NRSC 587, which is home).

588. Principles of Cellular and Molecular Neurobiology (4) I P, consult program office before enrolling. (Identical with NRSC 588, which is home).

589. Cancer Genetics (3) [Rpt./ 1] I P, ECOL 320, MCB 320. (Identical with CBIO 589, which is home).

595. Colloquium a. Topics in Molecular Biology (1) [Rpt./ 1] P, 12 open to majors only.

596. Seminar a. Molecular and Cellular Biology (1) [Rpt/ 6] I II P, open to majors only.

g. Topics in Genetics and Evolution (1) [Rpt./ 3] II P, consent of instructor (Identical with ECOL 596G, which is home).

i. Molecular Cardiovascular Biology (3) [Rpt./ 2] I (Identical with SURG 596I, which is home).

597. Workshop a. Recombinant DNA Techniques (2) S P, open to high school biology teachers only. (Identical with BIOC 597a, which is home).

599. Independent Study (1-5) [Rpt./]

621. Molecular Plant-Microbe Interactions (3) I P, BIOC 460. (Identical with PL P 621, which is home).

623. Colloquium a. Biology Update (2) S P, open to middle and high school biology teachers only. BIOC 623a is not prerequisite to BIOC 623b. (Identical with BIOC 623a, which is home).

b. Biology Update (2) S P, open to middle and high school biology teachers only. BIOC 623a is not prerequisite to BIOC 623b. (Identical with BIOC 623b, which is home).


695. Colloquium a. Plant Biology (1) [Rpt./ 4 units] I (Identical with PL P 695a, which is home).

b. Plant Pathology (1) II (Identical with PL P 695b, which is home).

c. Science, Society, and Ethics (1) II (Identical with NRSC 695E, GENE 695E).
The School of Music and Dance currently offers a program leading to the Master of Music degree with concentrations in composition, music education, musicology, music theory, and performance (including accompanying and conducting). The School also offers a program leading to the Doctor of Musical Arts degree with concentrations in composition, conducting, and performance. In the doctoral performance major, concentrations are available in bassoon, cello, clarinet, flute, guitar, horn, harp, oboe, organ, percussion, piano, saxophone, string bass, trombone, trumpet, viola, violin, and voice. The School also offers programs leading to the Doctor of Philosophy degree with majors in music theory or music education. Additional details regarding the graduate program in the School of Music and Dance are available from the Office of Academic Student Services in Music. For further information concerning these degrees see Chapter IV: Requirements for Master's Degrees, and Chapter VI: Requirements for Doctoral Degrees.

Admission is limited to applicants who exhibit superior musical aptitude and training and who show continued growth in their chosen fields of music. Applicants are required to audition by personal interview or by submitting a tape recording. Entering graduate students must take placement tests in music theory and in music history/literature. Doctoral students are not admitted to a particular curriculum until they have passed a qualifying examination administered each semester by the School of Music.

500. * Large Conducted Ensembles (1)
   b. Marching Band (1) [Rpt./P, audition required]
   c. Campus Band (1) [Rpt./P, audition required]
   d. Wind Symphony (1) [Rpt./P, audition required]
   e. Conducted Instrumental Ensemble (1-2) [Rpt./P, audition required]
   h. Summer Chorus (1) [Rpt./S P, audition required]
   i. Symphonic Choir (1) [Rpt./P, audition required]
   j. University Singers (1) [Rpt./P, audition required]

k. University-Community Chorus (1) [Rpt./P, audition required]
   l. Chamber Choir (1) [Rpt./P, audition required]
   m. Choraliers (1) [Rpt./P, audition required]
   o. Symphony Orchestra (1) [Rpt./P, audition required]
   q. Collegium Musicum (1) [Rpt./P, audition required]
   r. Jazz Ensemble (1) [Rpt./P, audition required]
   t. Mariachi Arizona (1) [Rpt./P, audition required]

501. * Coached Ensemble (1-2) [Rpt./P]
502. * Small Conducted Ensemble (1-2) [Rpt./P]
510a-510b. Pedagogy (2-2) I II Study of methods and repertory suitable for studio teaching. P, open to music majors in their major performance area only. Graduate-level requirements include a major research project in pedagogy.
520a-520b. Counterpoint (3-3) I II Practical study of the counterpoint of the 18th century.
521. Introduction to Graduate Music Theory (3) II Introduction to graduate analysis with emphasis on the survey of analytical systems as applied to a number of stylistic periods. Both cognitive and aural procedures will be investigated. This course may not be used to fulfill doctoral requirements in music. P, open to majors only.
522a-522b. Art Song Repertory (2-2) Class performance of representative selections from the standard repertory of German, Italian, French, Russian and English language art songs; problems of accompaniment, interpretation, style and ensemble. P, registration restricted to singers and pianists. Open to majors only.
523a-523b. History of the Opera (3-3) I II Detailed study of the course of opera from its inception by the Florentine Camerata through Berg, Menotti, Stravinsky, Ginastera, Penderecki, Britten and others. P, open to majors only.
524. * History and Literature of Guitar (3) II In-depth study of the evolution of the guitar, lute, and vihuela, including repertoire, style periods, and composers. P, open to majors only. Graduate-level requirements include a major research project.
525. History and Literature of the Wind Band (3) I A research-oriented study of wind band history and literature from the Renaissance to the present.
526a-526b. * Piano Literature (3-3) Historical and stylistic study of keyboard literature, instruments and performance practices. Baroque through the early Romantic periods. P, or CR, MUS 285P. MUS 526a is not prerequisite to MUS 526b. Graduate-level requirements include a major research paper and a special class presentation.
530. Music in the Renaissance (3) II Vocal and instrumental genres from Dufay through Palestrina. P, open to majors only.
531. Music in the Baroque (3) II The age of the basso-continuo; instrumental and vocal genres from Monteverdi through J. S. Bach. P, open to majors only.
532. Music in the Classical Period (3) I The Viennese classical tradition from its origins to Beethoven. P, open to majors only.
533. Music of the Twentieth Century (3) II Contemporary idioms in music; study of genres, styles, and techniques from post-Romanticism to the present. P, open to majors only.
534. Music Since 1950 (3) III Introduction to graduate study in Music (3) I Bibliographical materials; research resources, techniques, and problems directed toward graduate study in music. P, required of all doctoral candidates in music. (Identical with IRLS 600).

501. Seminar in Music and Dance Collaboration (2) [Rpt./1] I (Identical with DNC 596c, which is home).
502. Workshop o. * Level I Orff Schulwerk (2) S.
599. Independent Study (1-3) [Rpt./]
600. Introduction to Graduate Studies in Music (3) I The management of music at all levels of education, industry, and performance.
652. Management Techniques in Music (3) I II The management of music at all levels of education, industry, and performance.
654. Psychology of Music (3) II S Music perception, physiological and psychological responses to music, basic acoustics, music pedagogy, and evaluation/measurement of music behaviors.
672. Teaching Music in Higher Education (3) II Contemporary practices in planning, organizing, and evaluating learning experiences in music for college and university students. P, open to music majors only.

693. Internship (1-6) [Rpt./]
694. Practicum (1-6) [Rpt./]
696. Seminar a. Music Education (1-6) [Rpt./9 units] I II b. Musicology (1-6) [Rpt./9 units] I II c. Music Theory (1-6) [Rpt./36 units] I II d. Composition (2) [Rpt./3] I II f. Ethnomusicology (3) I P, graduate status or consent of instructor.

699. Independent Study (1-5) [Rpt./]
900. Research (2-4) [Rpt./]
909. Master's Report (1-6) [Rpt./]
910. Thesis (2-4) [Rpt./]
915. Master's Recitals (1-2) [Rpt./]
920. Dissertation (1-9) [Rpt./]
925. Doctoral Recitals (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Performance Studies: Individual and Group Instruction (MUSI)
Piano Accompanying 685w (1-4)
Vocal Coaching 685j. (1)
Organ 580o. (1-2); 585o. (1-4), 685o. (1-4), 785o. (1-4)
Conducting 585q. (1-4); 685q. (1-4) 785q. (1-4)

String Instruments String Bass 585n. (1-2), 585n. (1-4), 685n. (1-4), 785n. (1-4)
Cello 585m. (1-2), 585m. (1-4), 685m. (1-4), 785m. (1-4)
Guitar 580g (1-2), 585g. (1-4), 685g. (1-4), 785g. (1-4)

Harp 590h. (1-2), 585h. (1-4), 685h. (1-4), 785h. (1-4)
Application Questions:
Graduate Secretary, (520) 621-8013, neareast@u.arizona.edu

Advising Questions:
Adel S. Gamal, (520) 621-5465, gamal@u.arizona.edu

Degrees Offered: M.A., Ph.D.
Concentrations: Languages (Arabic, Persian, Turkish), Islamic studies, literature, history, and politics.

Professors: Charles D. Smith, Ludwig A. Adamec, Michael E. Bonine, William G. Dever, Adel S. Gamal, Hamdi A. Qafisheh
Associate Professors: Esther Fuchs (Judaic Studies), William J. Wilson, J. Edward Wright
Assistant Professors: Simin Karimi, Senniz Nawid, Amy Newhall

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in Near Eastern Studies. Instruction is available in the languages (Arabic, Persian, Turkish), cultures, and civilizations of the Islamic Middle East. Concentrations at the doctoral level are available in the fields of languages and literature, and Islamic studies. Students wishing to concentrate in history or politics at the doctoral level must apply to the appropriate disciplinary department upon completion of the M.A.

Applicants must forward to the head of the department scores on the aptitude test of the Graduate Record Examination and two letters of recommendation from previous instructors or academic advisors. Students without previous disciplinary or language training related to the Middle East may be required to make up deficiencies without graduate credit.

Music Fees
All students registering for private instruction are charged special fees per semester according to the following schedule.

One-half hour private lesson: $80.
One-hour private lesson: $100.

A music major registering for more than one weekly lesson will pay a maximum fee of $100.

Near Eastern Studies (NES / ARB / PRS)
Franklin Building, Room 403
Phone: (520) 621-8013
FAX: (520) 621-2333
WWW: http://w3.arizona.edu/~neareast

Arabic (ARB)
503. * Advanced Arabic I (3) I II Emphasis on oral and written comprehension and expression. P, ARB 402. Graduate-level requirements include more assignments in Vol. III of the text and additional outside readings.

504. * Advanced Arabic II (3) I II Continuation of 503 with emphasis on oral and written comprehension and expression. P, ARB 503. Graduate-level requirements include more assignments in Vol. III of the text and additional outside readings.

524a-524b. * Conversational Levantine Arabic (3-3) I II Extensive oral drill with emphasis on the acquisition of facility in normal conversation and comprehension. P, ARB 101. Graduate-level requirements include the ability to speak with sufficient structural vocabulary to participate in most formal and informal conversations, requiring a mastery of at least 120 additional vocabulary items.

524a-524b. * Conversational Gulf Arabic (3-3) I II Extensive oral drill with emphasis on the acquisition of facility in normal conversation and comprehension. P, ARB 101. Graduate-level requirements include the ability to speak with sufficient structural vocabulary to participate in most formal and informal conversations, requiring a mastery of at least 120 additional vocabulary items.

526. * Introduction to Arabic Linguistics (3) II History and structure of the Arabic language in its various forms. P, LING 101. Graduate-level requirements include a research paper on any phonological, morphological, or syntactic structure of any variety of Arabic. (Identical with LING 526).

539a-539b. * Egyptian Arabic (3-3) I II Introduction to the Cairene dialect. Phonology, common greetings, basic vocabulary and grammar. P, 1 year of standard Arabic. Graduate-level requirements include a picture description, summary of taped dialogues, and short reports on Egyptian movies.

548. * Arabic Literature in English (3) I Historical survey of Arabic literature of the Middle East and Mediterranean world, with readings in English translations. Graduate-level requirements include three major exams, an additional paper and presentation.

595. Colloquium
a. * Readings in Modern Arabic Prose (3-3) [Rpt/ 1] I P, 2 years of Arabic.
   b. * Readings in Modern Arabic Prose (3-3) [Rpt/ 1] II P, 2 years of Arabic.
   c. * Readings in Classical Arabic Poetry (3) [Rpt/ 1] I II 3 years of Arabic for non-native speakers of Arabic.

599. Independent Study (1-3)

Near Eastern Studies (NES)
501. * Ancient Mesopotamia (3) I II Sumerian, Babylonian, and Assyrian civilization from the first cuneiform docu-
ments to the fall of the neo-Babylonian empire, with special attention to issues of sociopolitical organization. P, NES 171, ANTH 101, NES 110 or consult department before enrolling. Graduate-level requirements include additional readings and a research paper. (Identical with HIST 501).

502. * Economic History of the Islamic World (3) I An introduction to the economic history of the Islamic world from the seventh century to the present day.


535. * Jewish Mysticism (3) II (Identical with JUS 535, which is home).

538. * The Book of Psalms (3) I (Identical with JUS 538, which is home).

539. * History of N. Africa from the Islamic Conquest to Modern Independence, 700-1962 (3) II History of the peoples, cultures, and societies of North Africa (present-day Morocco, Algeria, Tunisia and Libya) from the Islamic conquests to the post-colonial era. Includes Islamic Spain and the Ottoman Period but focuses on the modern era and themes of imperialism, nationalism, and Islamic reform. P, NES 277a, NES 277b, or consent of instructor. Graduate-level requirements include an extensive research paper and readings. (Identical with HIST 539).

542. * Transformation of Agrarian Societies in the Middle East (3) II Dynamics, processes, and implications of rural change in the Middle East; focus on changes in peasant communities, nomadic pastoralists, rural-urban relations, and planned change. Graduate-level requirements include the submission of an expanded research paper. (Identical with A ED 542, ARL 542, POL 542).

544. Islamic Mysticism * (3) II (Identical with HIST 544, which is home).

545. * Women in Islamic History (3) I (Identical with HIST 545, which is home).

553. Advanced Hebrew (3) [Rpt./ 1] I II P, JUS 490b or JUS 509b or consent of instructor. (Identical with JUS 553, which is home).

557. * Prehistoric Mesopotamia (3) I (Identical with ANTH 557, which is home).

566. * The Middle Eastern City and Islamic Urbanism (3) I Examines the physical and socioeconomic characteristics of the city in the Middle East and North Africa; the Islamic city model, the traditional and contemporary bazaar and medina, urban evolution and transformation. P, NES 277a and NES 277b, or consent of instructor. Graduate-level requirements include additional readings and completion of an original research paper on an approved topic. (Identical with GEOG 566).

567. * Population and Development in the Middle East (3) I Review of theories and research in population, resources and socio-economic development, with emphasis on determinants and consequence of population growth and migration in contemporary Middle East. Graduate-level requirements include submission of an expanded research paper. (Identical with ARL 567, POL 567).

568a-568b. * Asia and the West (3-3) I (Identical with HIST 568a-568b, which is home).

570. Religious History of India (3) I (Identical with HIST 570, which is home).

572. * History of Medieval India (3) I (Identical with HIST 572, which is home).

573. * History of Modern India and Pakistan: 1750-Present (3) II (Identical with HIST 573, which is home).

574. * Archaeometry: Scientific Methods in Art and Archaeology (3) II (Identical with ANTH 574, which is home).

579. * The Ottoman Empire to 1800 (3) II (Identical with HIST 579, which is home).

580. * The Middle East in the Twentieth Century (3) I Political, social, and cultural developments in the Middle East, focusing on imperialism, Ottoman decline, and the rise of the modern state system following World War I. P, NES 277b or consent of instructor. Graduate-level requirements include additional readings on selected topics and an extensive research paper. (Identical with HIST 580).

581a-581b. * Archaeology of the Old Testament World (3-3) I II Survey of the Bronze and Iron Age cultures of Syria-Palestine, ca. 3500-500 B.C., with emphasis on the use of archaeological materials in historical reconstruction. Graduate-level requirements include a full-length research paper.

584. * History of the Arab-Israeli Conflict, 1800 to Present (3-3) I II Origins of Zionism, and Palestinian and other Arab nationalisms from the nineteenth century and the post-1948 Arab-Israel state conflict in the Cold War era. Graduate-level requirements include additional readings and an extensive research paper. (Identical with HIST 584).

585a-585b. * Social, Cultural and Political History of Iranian Plateau: 7th Century - Present (3-3) I II From Islamic invasions to the aftermath of the Mongol invasions. P, NES 277a, NES 277b or consent of instructor. Graduate-level requirements include additional readings and an extensive research paper. (Identical with HIST 585a).

585b: II The Iranian plateau in the modern era of western imperialism and nationalistic Islamic responses. P, NES 277a, NES 277b or consent of instructor. Graduate-level requirements include additional readings and an extensive research paper. (Identical with HIST 585b).

590. * Women in Middle Eastern Society (3) I (Identical with ANTH 590, which is home).

593. Internship (1-3) [Rpt./]

594. Practicum (1-3) [Rpt./]

595. Colloquium d. Middle East (3) [Rpt./ 1] I II e. * Struggle and Survival: Modern Mid East and North Africa, c. 1850 - Present (3) I (Identical with HIST 595e, which is home).

f. Ancient Near East (3) [Rpt./ 4] I II (Identical with JUS 595f).

596. Seminar b. * Special Topics in Near Eastern Studies (3) [Rpt./ 4] I II c. Women and the Literature of Identity in Modern Middle East and North Africa (3) II (Identical with HIST 596c, which is home).

d. Mediterranean Cities in 15th-16th Centuries: Cairo, Istanbul, Florence & Venice (3) II g. Islamic Law and Society (3) II Graduate-level requirements include at least one in-class presentation of the assigned readings for the week, including distribution of an outline and active leading of subsequent discussion.

m. Middle East: Topics in History and Civilization (3) [Rpt./ 1] I II (Identical with HIST 596m).

q. Near Eastern Archaeology (3) [Rpt./ 1] I II (Identical with ANTH 596q).

w. * Feminist Approaches in the Bible (3) II (Identical with JUS 596W, which is home).

599. Independent Study (1-3) [Rpt./]

696. Seminar b. Cultural Anthropology (1-3) [Rpt./ 12 units] I II (Identical with ANTH 696b, which is home).

i. International Water Resource Management (1-3) [Rpt./ 9 units] I (Identical with HWR 696i, which is home).

o. History and Historiography in Colonial North Africa (3) I (Identical with HIST 696o, which is home).

y. Islam, Ethnicity and Nationalism (3) II Examines the development of conceptions of ethnicity and nation and social movements, 19th-century-present.

699. Independent Study (1-3) [Rpt./]

799. Independent Study (1-3) [Rpt./]

900. Research (2-4) [Rpt./]

908. Case Studies (3) [Rpt./]

909. Master's Report (1-6)

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Persian (PRS)**

503. * Advanced Persian I (3) [Rpt./ 8 units] I II CDT Readings in Persian, with the objective of preparing the student for independent research. P, PRS 402. Graduate-level requirements include additional readings and translations.
504. Advanced Persian II (3) [Rpt./ 1] I II
CDT Readings in Persian, with the objective of preparing the student for independent research. P, PRS 403. Graduate-level requirements include additional readings and translations.

599. Independent Study (1-6) [Rpt./] I II

Neuroscience (NRSC)
Gould-Simpson Building, Room 611
Phone: (520) 621-830
FAX: (520) 621-8282
WWW: http://www.neurobio.arizona.edu

Graduate Interdisciplinary Program in Neuroscience
Application Questions: neurosc@manduca.neurobio.arizona.edu
Advising Questions: Graduate Student Advisory and Progress Committee, Life Sciences North, Room 442, (520) 626-2553, neurosc@manduca.neurobio.arizona.edu
Degrees Offered: M.S., Ph.D.

Initial admission is to the doctoral program only

Professors: Leslie P. Tolbert, Chair (Arizona Research Laboratories, Division of Neurobiology), Carol A. Barnes (Psychology), Thomas G. Bever (Cognitive Science), James R. Bloedel (Physiology), Richard Bootzin (Psychology), Gail D. Burd (Molecular and Cellular Biology), Thomas P. Davis (Pharmacology), Velma Dobson (Ophthalmology), Merrill F. Garrett (Pharmacology), Velma Dobson (Ophthalmology), Alfred W. Kasznai (Psychology), Richard B. Levine (Arizona Research Laboratories, Division of Neurobiology), Ronald J. Lukas (Pharmacology), Bruce L. McNaughton (Psychology), Lynn Nadel (Psychology), L. Claire Parsons (Nursing), Frank Porreca (Pharmacology), William R. Roeseke (Internal Medicine), Alwyn C. Scott (Mathematics), Robert S. Sloviter (Pharmacology), Robert F. Spetzler (Neurosurgery), Nicholas J. Strausfeld (Arizona Research Laboratories, Division of Neurobiology), Douglas G. Stuart (Physiology), Gary L. Wenk (Psychology), Henry I. Yamamura (Pharmacology)

Associate Professors: Geoffrey L. Ahern (Neurology), John J.B. Allen (Psychology), Ralph E. Fregosi (Physiology), Herman Gordon (Cell Biology and Anatomy), Jeannette D. Hoit (Speech and Hearing Sciences), Josephine Lai (Pharmacology), T. Philip Malan (Anesthesiology), Nathaniel T. McMullen (Cell Biology and Anatomy), Naomi E. Rance (Pathology), John W. Regan (Pharmacology and Toxicology), Linda L. Restifo (Neurobiology), Paul A. St. John (Cell Biology and Anatomy), Cyma Van Petten (Psychology)

Assistant Professors: Julie M. Barkmeier (Speech and Hearing Sciences), Andrew Puglevand (Physiology), Mani Ramaswami (Molecular and Cellular Biology), Scott B. Selleck (Molecular and Cellular Biology), Scott J. Sherman (Neurology), Fraser A.W. Wilson (Psychology), Andrea Yool (Physiology), Richard S. Zemel (Psychology)

The graduate interdisciplinary program in Neuroscience offers a graduate program leading to the Doctor of Philosophy degree with a major in neuroscience, as well as a graduate minor in neuroscience. A Master of Science degree is offered only in rare instances when students who have already passed the M.S. evaluation requirement are unable to continue in the doctoral program. The program comprises faculty members from several departments in the colleges of Arts and Sciences, Engineering and Mines, Medicine, Nursing, and Pharmacy, as well as the Arizona Research Laboratories. The members of the Committee on Neuroscience are the principal faculty of the graduate program and thus may serve as major advisors for students majoring in neuroscience. In addition, the program fosters research and communication in interdisciplinary neuroscience throughout the University. Research interests of the faculty range from molecular mechanisms of synaptic transmission to human neurological disorders. Faculty groups focus upon cognitive neuroscience, developmental neurobiology, human speech and hearing, insect neurobiology, neuropeptides, neuroparmacology, and motor control. Information about the research interests of the faculty can be obtained from the program office.

503a. * Principles of Mammalian Systems Neurophysiology (3) I (Identical with PSYC 503a, which is home).

503b. * Laboratory in Mammalian Systems Neurophysiology (3) I II (Identical with PSYC 503b, which is home).

506. Neural Encoding: Memory and Comprehension of Mammals (3) I P, PSYC 507b. (Identical with PSYC 506, which is home).

524. Gerontology: A Multidisciplinary Perspective (3) I II (Identical with PSYC 524, which is home).

530. Neural Basis of Language (3) I P, graduate status. (Identical with PSYC 530, which is home).

582. Topics in Neural Development (2) I An in-depth analysis of the cellular and molecular basis of neural development. Students will read and discuss journal articles dealing with the development of neurons and their synaptic connections. P, consult program office before enrolling. (Identical with CBA 582, MCB 582, PSIO 582).

583. Topics in Neural Plasticity (2) I P, course in neurobiology, consult department before enrolling. (Identical with MCB 583, which is home).

584. Cellular Neurobiology (2) I P, consent of instructor, one semester of neurobiology or cell biology. (Identical with CBA 584, which is home).

585. Neural Mechanisms of Behavior (2) I II Discussion of the neural mechanisms of behavior; the control of movement; and integrative mechanisms and plasticity. Examples from vertebrates and invertebrates. (Identical with PSIO 585).

586. Intracellular Messengers (2) I Intracellular messenger systems in the nervous system, description of salient features of each mechanism, and discussion of a particular system which uses that messenger. P, NRSC 588 or consent of instructor. (Identical with BIOC 586, MCB 586).

587. Biology of Neurological Disease (2) I II Emphasis on reading, discussing and presenting the primary literature pertaining to scientific investigation of neurological diseases, e.g., multiple sclerosis, stroke, epilepsy. P, graduate or medical students only. Consult program office before enrolling. (Identical with MCB 587).


594. Practicum (1-6) [Rpt./] I II

595. Colloquium
d. * Brain, Behavior and Computation (1) [Rpt/ 6] I II
Nuclear Engineering
(See Aerospace and Mechanical Engineering)

Nursing (NURS)
Nursing Building, Room 109
Phone: (520) 626-6154
FAX: (520) 626-2211
WWW: http://www.nursing.arizona.edu

Application Questions:
(520) 621-6154
Degrees Offered: M.S., Ph.D.

Professors: Suzanne Van Ort, Dean,
Agnes M. Aamodt (Emerita), Eleanor E. Bauwens (Emerita), Carrie Jo Braden, Pearl P. Coulter (Emerita), Sandra Ferketich, JoAnn Glittenberg, Margarita A. Kay (Emerita), Joann E. Kropp, Alice J. Longman (Emerita), Beverly A. McCord (Emerita), Ida M. Moore, L. Claire Parsons, Linda R. Phillips, Arlene M. Putt (Emerita), Pamela Reed, Gladys E. Sorensen (Emerita), Joyce Verran, Anne Woodliff

Associate Professors: Terry Badger, Evelyn M. DeWalt (Emerita), Julie Erickson, Rose Gerber, Joan E. Haase, Mary E. Hazzard (Emerita), Elaine B. Jones, Lillian Lynch (Emerita), Kathleen May, Betty J. McCracken (Emerita), Virginia Miller (Emerita), Alice Noyes (Emerita), Jessie V. Pergrin (Emerita), Lois E. Prosser (Emerita), Lee Sennott-Miller, Jacqueline J. Sherman, Gayle A. Traver, Mary J. Welty (Emerita), Mary O.

Wolanin (Emerita)
Assistant Professors: Elaine J. Amella, Judith A. Berg, Sandra Cromwell, Jean Davis, Judith Effken, Mary Jo Gagan, Mary S. Koithan, Paula Meek, Carrie Merkle

The College of Nursing offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in nursing. The graduate curriculum is currently under review. Prospective students should consult the College of Nursing for current information.

The College of Nursing graduate program BSN to Ph.D. is designed for a minimum 4½ years and 108 units of graduate credit. Thirty-three units of credit are required for admission to doctoral standing. A student who elects to exit with a Master's degree will complete a thesis and graduate with a minimum of 36 units. If the nurse practitioner option is selected, a total of 42-46 units is required. This includes an internship of 5 units. Students progressing directly through the doctoral program are not required to complete a master's thesis.

Applicants for all degree programs are required to submit (1) evidence of completion of an undergraduate program in nursing substantially equivalent to the Bachelor of Science in Nursing degree program at The University of Arizona, (2) a current license to practice as a registered nurse in Arizona, (3) references attesting to potential as a graduate student.

Admission is based upon the evaluation of the criteria mentioned above as well as the following: undergraduate cumulative grade point average of at least 3.00 or B; Graduate Record Examination minimum scores of 500 each on the verbal, quantitative, and analytical portions of the aptitude test; and references attesting to potential as a graduate student.

Doctor of Philosophy: The major purpose of the doctoral level of the graduate program is to prepare nursing researchers. At the Ph.D. level, students choose to major in one of three areas: Community-Based Interventions, Health Systems, and Chronic and Disabling Conditions.

A minor area of study which includes a minimum of 12 credits is required. The area of study may be selected from nursing or various other areas including anthropology, philosophy, physiology, psychology, communications, management and policy, gerontology, or sociology.

Admission is based upon the evaluation of criteria mentioned above as well as the following: evidence of the completion of a baccalaureate degree or both baccalaureate and master's degrees substantially equivalent to those nursing programs at The University of Arizona; undergraduate cumulative grade point average of at least 3.00 or B; graduate grade point average of at least 3.50; Graduate Record Examination minimum scores of 550 each on the verbal, quantitative, and analytical portions of the aptitude test; references attesting to potential for doctoral study; copies of published materials or research reports; and an evaluation of professional record and experience. A personal interview may be requested after all application materials are available.
Upon completion of the M.S. or Ph.D. degree, a student will have met the following objectives: devise, negotiate, implement, and evaluate alternative solutions for health problems affecting client populations; expand and communicate the body of nursing knowledge; and generate solutions for society's health concerns through collaboration with the broader scientific and health communities.

504. Conceptual Models (3) I S Theory and research surrounding conceptual models with emphasis on description of conceptual models.

506. Ethics and Ethical Decision Making for Health Care (3) I A critical examination of the epistemology of moral reasoning models of ethical reasoning, and the application of decision making models throughout a variety of health care contexts. Specific moral dilemmas and issues related to scientific advances are examined such as genetic manipulation, euthanasia, research with human subjects and organ transplantation. Relational ethics in the day-to-day provision of health care at the individual and societal levels is also emphasized.

517. * Information Technology (3) I II Introduction to finding, organizing, evaluating, using and creating electronic information resources. Both high technology information systems in networked environments and minimal connectivity in rural environments will be covered. The Internet, PowerPoint, and learning tools will be investigated. Graduate-level students must make two presentations and create a professional web page.

530. Methods in Nursing Research (3) II Critical examination of selected problems and methods in the nursing research process. Consideration is given to both qualitative and quantitative methods. (Identical with PHL 530).

572. Adult Pharmacotherapeutics (3) I Clinical pharmacology course that provides the student with knowledge about common medications used to treat adults. Primary focus is drug management of chronic and self-limiting acute diseases. Covers representative drugs of a pharmacologic group, indications for use, drug selection, titration of dosage, key adverse effects, monitoring of therapy, alternate drugs and special concerns in prescribing to the older adult. P, or CR, NURS 580.

574. * Family Health and Deafness (3) II An ecological framework organizes the study of family response to deafness/hearing impairment of a family member. Students consider family members who become deaf/hearing impaired at varying points in their life, from infants to seniors, their relationships with family, and strategies for influencing individual and family health across the lifespan. The ecological framework includes concepts of environment, soma, psyche, family, culture, society, and health. P, one lower division course in Social Science (e.g. Psychology). Graduate-level requirements include conducting a project. NURS 575. Teaching the Older Adult (3) II (Identical with GERO 575, which is home).

577. * Pain Management: IDIS Team Approach (3) I II Theory, application, and evaluation of basic pain management strategies within an interdisciplinary framework. Graduate-level requirements include a scholarly paper regarding a pain theory or management topic. (Identical with PCOL 577).

579. Issues in Rural Health (3) II Topics include: community assessment, planning and evaluation; interdisciplinary practice; health care issues for southwestern ethnic minority populations. (Identical with PPHR 579, PHL 579, MAP 579, PSTC 579).

580. * Advanced Physiology (3) S Selected physiologic functions and adaptive changes which occur in health and illness. Cellular physiology, the immune system, neurophysiology, cardiovascular, pulmonary, renal, and endocrine physiology. P, undergraduate physiology. Graduate-level requirements include a comprehensive paper.

587. *Poverty and Health (3) II Study of the relationship between poverty and health. Concepts and theories from anthropology, psychology and sociology will be used to analyze problems associated with poverty. Writing Emphasis Course. P, 6 units of social science. Graduate-level requirements include an in-depth research paper on an aspect of poverty. (Identical with PHL 587F, CM 587).

588. Healing Systems in the Southwest (3) I II Application of principles from anthropological theory to the actual practice of patient care, with emphasis on culture content of groups living in the greater Southwest. P, 9 units of behavioral science. (Identical with F CM 588, ANTH 588).

589. Health of the Older Adult (3) I Current research of the aging process including physical and mental alterations; emphasis on physiological changes. P, consult college before enrolling. (Identical with GERO 589).


601. Pathophysiologic Alterations (3) I Examination of selected alterations in physiologic mechanisms including alterations in immunologic function, gas exchange and transport, fluid transport and balance and pertinent cellular mechanisms. Process of application to clinical care of individuals will be incorporated. P, or CR, NURS 580 or 3 hours of graduate level physiology.

602. Academic Faculty Role: Theory and Application (3) S Nursing education examined in relation to faculty roles, education issues, impact of higher ed. system & future trends.

603. Public Health Science (3) I Health promotion and primary prevention in communities and populations, epidemiology and legal/political issues in advanced public health nursing. Nursing and public health theories synthesized. P, to majors only. (Identical with PHL 603).

604. Developmental Concepts in Nursing (3) II Examination of the principles and philosophy of the lifespan developmental framework and other models of development, particularly as related to understanding a variety of nursing phenomena in practice and research.

605. Issues in Family Relations (3) II Examination of issues in providing care to families using theory and research from nursing and related fields. Concepts included will apply to the young, developing, and mature family. P, to majors only.

607. Cross-Cultural Nursing (3) S Focus on a synthesis of theories from nursing and related fields to explore cultural variations in response to actual or potential problems of health or illness. The methods for caring and treating culturally influenced responses will be examined. P, to majors only. (Identical with PHL 607).

608. Cognitive Alterations (3) S Client problems related to the processing of sensory information including etiological factors. Research-based nursing interventions for clients with cognitive alterations are examined. P, open to majors only.

609. Health Assessment (3-4) I Advanced health assessment and health promotion for adult and geriatric age groups. Students will learn advanced techniques in interviewing, history taking, physical examination, risk appraisal, and data base compilation. P, open only to master's students in the NP options or consent of instructor.

610. Care of Childhood Families (4) I To cover conception, OB, the neonatal period and early childhood to age five. Course will address family dynamics related to pregnancy and the incorporation of a new member as well as the clinical experience of providing prenatal care, well-child care, early childhood acute illnesses and identifying chronic illnesses. P, NURS 580; CR, NURS 609, NURS 694; admission to MS level, FNP option.

611. Advanced Care of the Family (5) I II Third of 3 clinically focused courses preparing FNP's. Focus on assessment, diagnosis, and management of selected complex and/or urgent/emergent acute, chronic and terminal health conditions in individuals and families across the age continuum.
620. Advanced Care of the Adult (5) I II
Basic concepts and knowledge needed to assess and manage common chronic and emergent health problems and end of life problems prevalent in adults and the aged are covered.

625. Advanced Role Development (3) I Exploration of models of advanced practice during (APN) roles in the health care system. Emphasizes factors that influence process of defining and implementing advanced practice nursing roles. P, NURS 580. Open to majors only.

626. Primary Care of Adults (4-5) I II
Basic concepts and knowledge needed to assess and manage therapeutically common acute and chronic health problems prevalent in adults. Emphasis will be placed on pathophysiology, abnormal aging, principles of pharmacology and medication use as therapeutic adjuncts, and the use of diagnostic procedures as aids to clinical decision making. P, NURS 609, open to majors only.

627. Advanced Psychiatric Mental Health Nursing II (4) I Focus on concepts of personality development using psychodynamic and cognitive/behavioral theories oriented to the practice of mental health nursing: employing individual, family and group nursing therapeutic techniques for the amelioration of problem. P, NURS 600a, graduate standing in nursing.

628. Advanced Care of the Older Adult (5) I II Integrates a primary care model of practice for older adults in a variety of settings. Emphasizes diagnosis and management of common health problems and syndromes.

630. Statistics for the Health Sciences (3) [Rpt./ 1] I II Techniques that describe, compare and relate variables in the health sciences. Techniques include exploratory, descriptive, comparative, correlational and inferential statistics. Parametric and non-parametric techniques are presented.

631. Advanced Statistics for the Health Sciences (3) [Rpt./ 1] I Advanced statistical techniques including multivariate analysis of variance, multiple regression, structural equations modeling, log-linear modeling, factor analysis and discriminant analysis. Students will analyze large data sets using PC and mainframe statistical software to learn techniques. P, NURS 630 or graduate-level statistics course.

632. Research Utilization (3) S Development and use of models and tools for facilitating the use of research in science-based nursing practice within organizational settings. 2R, 3L, P, NURS 530.

633. Evaluation Research (3) I Development and use of models and tools for assessing nursing processes, programs and performances. Approaches to and psychological reactants of evaluation are explored. Issues and development of market packages with cost consideration are discussed along with program grant preparation. (Identical with PHIL 633).

634. Data Management in Health Care Systems (3) II Acquisition and utilization of large data bases, how data bases are structured, computer applications for large data sets. Emphasis on use of data bases and their contents for evaluation of health care systems. P, NURS 530, NURS 630. (Identical with PHIL 634).

636. Care of Family Members (4) II The basic concepts and knowledge needed to assess and manage common acute and chronic health problems prevalent in family members. 6L, 3R.

640. Nursing Case Management I (4) II, P, graduate standing.

641. Nursing Case Management II (3) II Health care financing, delivery of nursing case management and health services in a managed-care environment and related professional issues. P, NURS 640, graduate standing.

642. Health Care Systems Measurement and Analysis (3) S Strategies for measurement of structure, process, and outcomes indicators within a health care system. Methods for evaluating instruments and/or global measures. P, NURS 630 or equivalent, NURS 530.


650. Theory of Systems Management (3) S Theories of systems management and system analysis; project management; critical decision making and problem solving; cost-benefit analysis and resource allocation. Content is presented with application to health care settings.

651. Systems Management Application (3) S Focus is on the role of the systems manager and provides an opportunity for immersion into the role and for application of content from previous systems management courses. Two of the three hours of credit will be devoted to a clinical practicum and preceptorship in a nursing system’s environment and one hour will be a seminar to discuss clinical experiences in the role. P, NURS 650, NURS 645, NURS 633, NURS 603.

652. Health Care Informatics Application (3) S Focuses on the role of the informatics specialist and provides an opportunity for immersion into the role and for application of content from previous informatics and system management courses. 2R, 3L, P, NURS 650.

687. Health of Rural and Underserved Populations (3) II Concepts and theories from nursing, sociology, anthropology, psychology, and health policy are used to analyze health problems encountered by rural, ethnic and underserved populations.

693. Internship (2-4) [Rpt./]

694. Practicum (1-6) [Rpt./]

696. Seminar a. Nursing Theory (1-3) II
b. Predictive Modeling (3) II, P, NURS 730 or consent of instructor.

c. Advanced Predictive Modeling (3)
d. Qualitative Data Collection Management and Analysis (1-3) [Rpt./ 4 units] P, or consent of instructor.

699. Independent Study (1-4) [Rpt./]
Nutritional Sciences (N SC)

Shantz Building, Room 309
Phone: (520) 621-1187
FAX: (520) 621-9446
WWW:http://ag.arizona.edu/NSC/nsc.html

Application Questions:
David K. Y. Lei, (520) 621-5352
nuscgidp@u.arizona.edu

Advising Questions:
David K. Y. Lei, (520) 621-5352
nuscgidp@u.arizona.edu

Degrees Offered: M.S.
Concentrations: Dietetics, nutritional biochemistry

Professors: Fred Wolfe, Head, Ronald E. Allen, David J. Harts horne, Darrel E. Goll, Linda Houtkooper, David K.Y. Lei, John Marcello
Associate Professors: Parker B. Antin (Nutritional Sciences), Wanda H. Howell, Ralph L. Price
Assistant Professors: Ann A. Jerkins, Scottie Misner, Joy Winzerling

Associate Research Scientists: Scott Going, Scott Reaves, Connie Temm-Grove

Senior Lecturer: Kent Campbell, Charles Gerba, Anna Giuliano, Iman Hakim, Tim Lohman, Neil Mendelson, William Stini, Doug Taren, Nicky Teufel, Roy Verdery


The department offers programs leading to the Master of Science degree in nutritional sciences as well as a concentration in dietetics. Graduate study prepares students for careers in academia, health care, industry, and government. The department also participates through the Committee on Nutritional Sciences in programs leading to the Doctor of Philosophy in nutritional sciences. (See the following heading, Graduate Interdisciplinary Program in Nutritional Sciences).

Prerequisites for admission include: one semester of analytical chemistry with lab, one year each (or its equivalent) of physics, organic chemistry with laboratory, biochemistry and physiology, and mathematics (calculus recommended).

Graduate students must complete at least 30 units including an approved thesis to receive the M.S. in nutritional sciences. Students are encouraged to select an advisor and two additional faculty members for their graduate committee as soon as possible. The program of study must include N SC 520 or N SC 540; 2 units of N SC seminar, 1-6 units of thesis; 6 units of N SC 500- or 600-level electives; 3 units of statistics; 4 or more units of biochemistry.

508. Human Nutrition (3) I Graduate-level requirements include an in-depth research paper on a current topic.

510. Cell Signals and Nutrition (3) II This course will deal with a basal signaling mechanisms used in mammalian cells and their involvement in processes important to (human) nutrition. P. MCB 572, NRSC 306.

520. Advanced Nutritional Science (3) I Advanced physiology and biochemistry of nutrients with emphasis on present knowledge and current research topics in nutritional sciences. P. BIOC 460 or BIOC 462a.

540. Advanced Dietetics (3) I Nutrition and metabolism in patient care as applied by the advanced-level practitioner. P. Open to majors in nutritional sciences only.

541. *Therapeutic Nutrition (4) II Therapeutic principles of nutrient acquisition and utilization, including modification of the diet, for selected disease and/or deficiency states; factors of importance in client/patient care, rehabilitation and education. P. N SC 408. Graduate-level requirements include an in-depth research paper on a current topic.

547. Perspectives in Geriatrics Lab (1) II P, or CR. PHPR 448 (Identical with PHSC 547, which is home).

560. International Nutrition (2-3) II (Identical with FHL 560, which is home).

593. Internship (1-6) [Rpt./ 5] I II

595. Colloquium

599. Independent Study (1-5) [Rpt.] I


602. Metabolic Integration (3) II Analysis of current knowledge regarding the interactions between the intake, absorption, transport, processing, storage, catabolism and excretion of nutrients and the regulation of metabolic homeostasis in the intact organism. Emphasis areas include interrelationships between protein, carbohydrate and fat metabolism and their regulation by dietary, hormonal and genetic factors in humans. P. BIOC 460 or BIOC 462a-BIOC 462b.

609. Nutritional Biochemistry Techniques (3) II Biochemical methods for evaluating metabolic functions of nutrients. 1R, 6L. P. CHEM 324 or CHEM 325 and CHEM 323 or CHEM 328; N SC 408. (Identical with AN S 609).

615. Chemistry and Metabolism of Lipids (3) II Chemistry and structure of lipids and their digestion, adsorption, transport and utilization; current research in lipid metabolism and the role of lipids in certain disease states. (Identical with AN S 615).

620. Vitamins (2) I The chemistry and metabolism of vitamins. P. N SC 408.

622. Mineral Metabolism (2) II Chemistry, metabolism and biological function of minerals; current research in mineral requirements and toxicity. P. N SC 408. (Identical with AN S 622).

628. Steroid and Lipoprotein Chemistry and Metabolism (2) II Biochemistry and metabolism of sterols and lipoproteins in mammalian systems; regulation of the biosynthesis and catabolism of sterols and lipoproteins in health and abnormalities related to disease; and dietary regulators of sterol and lipoprotein metabolism as related to cardiovascular disease risk and prevention. P. BIOC 460 or BIOC 462a-BIOC 462b, N SC 602.

640. Field Methods in Human Nutrition (3) II Case-oriented approach to nutritional assessment, diagnosis, prescription, plan and prognosis; application of dietary, clinical and biochemical methods. P. Open to majors in nutritional and other health sciences areas only.

665. Analysis and Purification of Proteins (3) II P. BIOC 462a; BIOC 460. (Identical with AN S 665, which is home).

693. Internship

696. Seminar

699. Independent Study (1-5) [Rpt./ 5] I II

700. Research (1-4) [Rpt.] I

709. Master's Report (1-8) [Rpt.] I II

710. Thesis (1-6) [Rpt.] I

720. Dissertation (1-9) [Rpt.] I II

730. Supplementary Registration (1-9) [Rpt.]
Nutritional Sciences (NUSC)
Shantz Building, Room 308
Phone: (520) 621-5630
FAX: (520) 621-5630
WWW: http://www.opt-sci.arizona.edu

Graduate Interdisciplinary Program in Nutritional Sciences

Application Questions:
NUSC Office, (520) 621-5630, nusc@ag.arizona.edu
Advising Questions:
NUSC Office, (520) 621-5630, nusc@ag.arizona.edu

Degrees Offered: Ph.D.
Concentrations: Human nutrition, nutritional biochemistry

Professors: Darrel E. Goll, Chair (Nutritional Sciences and Biochemistry), David S. Alberts (Medicine and Pharmacology), Ronald E. Allen (Animal Sciences), Harris Bernstein (Microbiology and Immunology), Carlos "Keni" Campbell (Public Health), David L. Earnest (Internal Medicine), Charles Gerba (Soil and Water Science), Fayez Ghishan (Pediatrics), David Hartshorne (Nutritional Sciences and Biochemistry), Mary Ann Kight (Nutritional Sciences, Emeritus), Otakar Koldovsky (Pediatrics), David K.Y. Lei (Nutritional Sciences), Timothy G. Lohman (Exercise and Sport Sciences), James Marshall (Family and Community Medicine), Anthony F. Philippus (Pediatrics), William A. Stini (Anthropology), William A. Stini (Anthropologist), Marc E. Tischler (Biochemistry), Charles W. Weber (Nutritional Sciences, Emeritus), Fred Wolfe (Nutritional Sciences)

Associate Professors: Parker B. Antin (Nutritional Sciences), Larry C. Clark (Epidemiology), Carlos Flores (Pediatrics), Wanda H. Howell (Nutritional Sciences), Donald V. Lightner (Veterinary Science), Ralph L. Price (Nutritional Sciences), Edward T. Sheehan (Nutritional Sciences, Emeritus), Douglas Taren (Family and Community Medicine), David Van Wyck (Medicine) Roy Verdery (Medicine, Emeritus)

Assistant Professors: Iris R. Bell (Psychiatry), Ann A. Jerkins (Nutritional Sciences), Joy Winzerling (Nutritional Sciences)

Research Professors: Cleamond D. Eskelson (Chemistry), Ronald R. Watson (Family and Community Medicine)

Research Associate Professor: Helen Gensler (Radiation Oncology)
Research Assistant Professors: Anna A. Giuliano (Family and Community Medicine), Iman Hakim (Arizona Prevention Center), Maria Elena Martinez (Family and Community Medicine), Bethene N. Stewart (Nutritional Sciences), Nicolette Teufel (Family and Community Medicine)
Associate Specialists: Linda Houtkooper (Nutritional Sciences), Scottie I. Misner, (Nutritional Sciences)
Assistant Research Scientist: Scott Going (Nutritional Sciences)

Lecturer: Lucinda Rankin (Physiology and Molecular and Cellular Biology)

The graduate interdisciplinary program in Nutritional Sciences administers a campus wide Ph.D. program. It includes faculty members from the Colleges of Agriculture, Arts and Sciences, and Medicine. Areas of emphasis include human nutrition (clinical or community) and nutritional biochemistry.

Requirements for admission include undergraduate preparation in mathematics and one year each of general biology, organic chemistry with laboratory, and physics. Application for admission must include a statement of purpose, three letters of recommendation, official transcripts, GRE scores, and TOEFL scores for international applicants.

Doctor of Philosophy: The student's program of study consists of course work in human nutrition, nutritional research methods, biochemistry, seminar, statistics, dissertation, and research. The nutritional biochemistry emphasis requires additional work in biochemistry. The human nutrition specialization requires additional course work in physiology. A total of 63 units must be completed for the Ph.D. degree: 36 units for the major, 9 units for the minor, and 18 units of dissertation. A maximum of 8 units of individual studies (599, 699, 900) will be counted toward requirements for the degree.

A student's program of study should meet the unique background and interests of that student. Decisions regarding the inclusion or exclusion of specific courses in a student's program of study are the responsibility of the student's graduate committee. Following completion of all course work, a student is required to pass a comprehensive written and oral examination before the final oral defense of the dissertation.

Possible minors include (but are not limited to) anthropology, animal science, biochemistry, cancer biology, education, epidemiology, exercise and sport sciences, family and community medicine, international health, microbiology, molecular and cellular biology, nursing, pharmacy, physiology, and statistics.

599. Independent Study (1-5) [Rpt.]
605. Methods in Nutritional Research (3) II Survey of experimental approaches to nutrition research in the areas of food safety, animal nutrition, nutritional biochemistry and human nutrition.

696. Seminar
   b. Nutrition (1) [Rpt./ 5] I II (Identical with N SC 696B, which is home).

699. Independent Study (1-5) [Rpt./] II 900. Research (1-4) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Optical Sciences (OPTI)
Optical Sciences Center, Room 401
Phone: (520) 621-4111
FAX: (520) 621-6778
WWW: http://www.opt-sci.arizona.edu

Application Questions:
Didi Lawson, (520) 621-4111, didi.lawson@opt-sci.arizona.edu
Advising Questions:
Richard L. Shoemaker, (520) 621-4111

Degrees Offered: M.S., Ph.D.
Concentrations: Optical engineering, applied optics, optical physics, and many subspecialties within each of these areas.

Professors: James C. Wyant, Director (Electrical and Computer Engineering), J. Roger P. Angel (Astronomy), Neal Armstrong (Chemistry), George H. Atkinson (Chemistry), Harrison H. Barrett (Radiology), Peter H. Bartels (Pathology), James J. Burke (Emeritus), William J. Dallas (Radiology), Eustace L. Dereniak (Electrical and Computer Engineering), Charles M. Falco (Physics), B. Roy Frieden, Jack D. Gaskill (Electrical and Computer Engineering), Hyatt M. Gibbs, John E. Greivenkamp (Ophthalmology), Bobby R. Hunt (Electrical and Computer Engineering), Kenneth A. Jackson (Materials Science and Engineering), Stephen F. Jacobs (Emeritus), Willis E. Lamb, Jr. (Physics), H. Angus Macleod (Emeritus), Masud Mansuripur, Arvind S. Marathay, Aden B. Meinel (Emeritus), Pierre Meystre, Jerome V. Moloney
(Mathematics), Dennis D. Patton
(Radiology), Nasser Peyghambarian
(Materials Science and Engineering),
Richard C. Powell (Materials Science
and Engineering), John A. Reagan
(Electrical and Computer Engineering),
Ralph M. Richard (Emeritus), Dror
Sarid, Glenn Sincerbox, Bernard O.
Seraphin (Emeritus), Roland V. Shack,
Robert R. Shannon (Emeritus), Richard
L. Shoemaker (Radiology and Chemis-
try), Philip N. Slater (Emeritus),
Orestes N. Stavroudis (Emeritus),
Donald R. Uhmann (Materials Science
and Engineering), William H. Wing
(Physics), William L. Wolfe, Jr.
(Emeritus), Ewan M. Wright (Physics)

Associate Professors: Arthur F. Gmitro
(Radiology), Poul S. Jessen, Galina
Khitrnova, Raymond K. Kostuk
(Electrical and Computer Engineering),
Stuart Marsh (Arid Lands), Sumitendra
Mazumdar (Physics), Joseph Miller
(Ophthalmology), Jose Sasian, Robert
R. Schowengerd (Electrical and
Computer Engineering, Arid Lands
Resource Sciences), Robin N.
Strickland (Electrical and Computer
Engineering)

Associate Research Professor: Tom Milster
Assistant Professors: Rudolf H. Binder,
James H. Burge, Michael R. Descour,
Mahmoud Fallahi, Bernard J. Kippelen,
Mark A. Neifeld (Electrical and
Computer Engineering), Kurtis J.
Thome

Assistant Research Professor: Jim Palmer

Optical Sciences offers programs leading
to the Master of Science and the Doctor of
Philosophy degrees with a major in optical
sciences. Areas in which research is
currently being conducted include optical
systems design, interferometry and optical
testing, infrared technology, radiometry,
remote sensing, optical detector systems,
thin film deposition, image processing,
scanning tunneling microscopy, nuclear,
x-ray and MRI medical imaging, optical
data storage, diffractive and binary optics,
polymer optics and other novel optical
materials, adaptive optics, nonlinear optics,
optical trapping and cooling of atoms,
semiconductor and solid state laser
physics. Interdisciplinary programs in
progress involve the departments of
Electrical and Computer Engineering,
Mathematics, Materials Science and
Engineering, Ophthalmology, Physics,
and Radiology, as well as the Steward
Observatory.

Applicants should hold a bachelor’s
degree in engineering, mathematics, or
physics. Applicants must submit one
complete set of transcripts and at least two
letters of recommendation to the Associate
Director, Academic Affairs, Optical
Sciences Center, University of Arizona,
P.O. Box 210094, Tucson, Arizona 85721-
0094. Scores on the general test and one
subject (engineering, mathematics, or
physics) test of the Graduate Record
Examination are usually required.

Students are normally admitted to begin
their studies in optical sciences during the
fall semester. The deadline for submission
of all application materials is February 1
for international admission, March 1 for
domestic admission with assistantship,
and March 15 for domestic admission
without assistantship.

Master of Science: There is no core
requirement for the Master of Science
degree, and students are allowed
considerable freedom in planning their study
programs. Students may elect either of
two options:

Thesis option: A minimum of 32 units
of graduate credit in optics or optics-
related courses, including 8 units of 910
(thesis), at least 2 units of optics labora-
tory courses, and a final oral examination
based primarily on the thesis.

Non-thesis option: A minimum of 35
units of graduate credit in optics or optics-
related courses, including at least 2 units
of optics laboratory courses; 3 units credit
for demonstrated competence in written
communication (either by writing an
acceptable Master’s Report or successful-
ly completing an appropriate 3-unit graduate
level course in technical writing); and a
final oral examination, based on the
subject matter of the courses taken.

In addition, the Master of Science degree
may be awarded to prospective candidates
for the Doctor of Philosophy degree upon
successful completion of the compre-
sensive examination.

Doctor of Philosophy: A minimum of
54 units of graduate credit in optics or
optics-related courses is required, includ-
ing at least 2 units of optics laboratory
courses. A core curriculum, including
courses 501, 502, 504, 505, 506, 507, 508,
has been developed to help doctoral
students prepare for the comprehensive
examination. These courses are not
required but students are expected to
know the material presented in them.

There is no foreign language requirement
for the Doctor of Philosophy major in
optical sciences. Students must include
at least 2 units of optical laboratory courses.
At the discretion of the committee,
doctoral students with majors in optical
sciences, as well as those majoring in
other disciplines, may elect a minor in
optical sciences. Such students must
complete, for the minor, 12 units of
course work with a grade of B or better in
optical sciences or obtain approval for the
equivalent in transferred course work. No
more than 3 of these units may be
awarded to prospective candidates
for international admission, March 1 for
domestic admission with assistantship,
and March 15 for domestic admission
without assistantship.

Master of Science: There is no core
requirement for the Master of Science
degree, and students are allowed
considerable freedom in planning their study
programs. Students may elect either of
two options:

Thesis option: A minimum of 32 units
of graduate credit in optics or optics-
related courses, including 8 units of 910
(thesis), at least 2 units of optics labora-
tory courses, and a final oral examination
based primarily on the thesis.

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units of graduate credit in optics or optics-
related courses, including at least 2 units
of optics laboratory courses; 3 units credit
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communication (either by writing an
acceptable Master’s Report or successful-
ly completing an appropriate 3-unit graduate
level course in technical writing); and a
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of graduate credit in optics or optics-
related courses, including 8 units of 910
(thesis), at least 2 units of optics labora-
tory courses, and a final oral examination
based primarily on the thesis.

Non-thesis option: A minimum of 35
units of graduate credit in optics or optics-
related courses, including at least 2 units
of optics laboratory courses; 3 units credit
for demonstrated competence in written
communication (either by writing an
acceptable Master’s Report or successful-
ly completing an appropriate 3-unit graduate
level course in technical writing); and a
final oral examination, based on the
subject matter of the courses taken.

In addition, the Master of Science degree
may be awarded to prospective candidates
for the Doctor of Philosophy degree upon
successful completion of the compre-
sensive examination.

Doctor of Philosophy: A minimum of
54 units of graduate credit in optics or
optics-related courses is required, includ-
ing at least 2 units of optics laboratory
courses. A core curriculum, including
courses 501, 502, 504, 505, 506, 507, 508,
has been developed to help doctoral
students prepare for the comprehensive
examination. These courses are not
required but students are expected to
know the material presented in them.

There is no foreign language requirement
for the Doctor of Philosophy major in
optical sciences. Students must include
at least 2 units of optical laboratory courses.
At the discretion of the committee,
doctoral students with majors in optical

508. Probability and Statistics in Optics (3) I
II Probability theory, stochastic processes, optical applications, hypothesis testing and estimation. P. OPTI 504 or OPTI 512; OPTI 501.

510L. Fundamentals of Applied Optics Laboratory (1) II Optical systems; (2A) Gaussian optics, aberrations, radiometry, sources, detectors, optical engineering. P. OPTI 506.


511L. Lasers and Solid-State Devices Laboratory (1) II Gas and semiconductor lasers, modes and beats, modelocking, spectrum analysis, extons and quantum wells, noise, modulators and detectors, second-harmonic generation. P. OPTI 503 or OPTI 511; CR, OPTI 507.

512. Introduction to Fourier Optics (3) I Mathematical background, convolution, the Fourier transform, linear filtering, two-dimensional operations, diffraction, image formation. P. PHYS 241 or OPTI 142; MATH 223.

512L. Mathematical Optics Laboratory (1) I Laboratory in support of 504, 508 and 512. P, OPTI 504 or OPTI 512 and C SC 227 or SCI 270.

513. Optical Testing (3) I Fringe analysis, wavefront aberrations and analysis, measurement of optical components, surface figure, surface finish, length, refractive index and transfer functions. P. OPTI 505; OPTI 506.

513L. Optical Testing Laboratory (1) I Laboratory in support of 513. P. or CR, OPTI 513.

514. Aberration Theory (3) I Aberration theory; geometrical image formation; diffraction; pupil, spread, and transferfunctions; random wavefront perturbations; system effects; image evaluation; image processing. P. OPTI 506.

517. Lens Design (4) I Fundamentals of optical system layout and design; exact and paraxial ray tracing; aberration theory; chromatic and monochromatic aberrations; use of computer programs in lens design. P. OPTI 502.

518. Introduction to Aberrations (3) II Advanced first-order tools, chromatic aberrations, monochromatic aberrations, sources of aberration, computation, simple systems. P. OPTI 502.

525. Wave Optics (3) II Students should gain a conceptual understanding of interference, coherence, diffraction, and the Abbe Theory of image formation through the use of phenomenological examples and simple models. Several in-class demonstrations and computer simulations are presented.

527. Holography (3) I Historical background; the Gabor hologram; the hologram as a zone plate; Fresnel, image, Fourier-transform, and reflection holograms; practical holography; limitations. P. OPTI 505. (Identical with ECE 527)


531. Image Processing Laboratory for Remote Sensing (3) I (Identical with ECE 531, which is home).

532. Computer Vision (3) I P. ECE 340. (Identical with ECE 532, which is home).

533. Digital Image Processing (3) II P. ECE 340, ECE 503, ECE 592. (Identical with ECE 533, which is home).

535. Advanced Topics in Electronic Materials (3) [Rptr/2] I (Identical with MSE 534, which is home).

538. Medical Optics (3) I Imaging methods in radiology, ultrasound, NMR, thermography, planar x-rays, classical tomography, computed tomography, gamma ray emission methods, positron imaging, digital radiography, xerographic methods. P. OPTI 512.


541. Introduction to Lasers (3) II Laser theory, properties of lasers, stimulated emission, dispersion theory, gain saturation and rate equations, optical resonators, mode locking, survey of laser types and mechanisms. P. PHYS 371.

545. Quantum Mechanics for Optical Physics (3) I Elements of quantum mechanics used in laser physics, semiconductor and quantum optics. Mathematical formalism of quantum mechanics. Harmonic oscillators, molecular vibrations, normal mode theory, and point groups. This course is temporary, and will be offered during the Fall of 1999 only.


550. Fundamentals of Remote Sensing (3) I Historical development of remote sensing, the sun and the electromagnetic spectrum, radiometry, radiometry of optical systems, spectroscopic instruments; reflectance, definitions and measurement; atmospheric properties, measurements and effects; satellite optical sensors; radiometric calibration of sensors; atmospheric correction.

552. Introduction to Polymer Optics (3) I Organic, molecular, and polymeric materials emerging in various photonic applications, including plastic optical elements, fast electro-optic modulators and plastic optical fibers for telecommunication, holographic storage, and optical processors. This course is temporary and will be offered during the Fall of 1999 only.

559. Imaging and Infrared Techniques (3) I Radiometry review; the radiant environment; black body and other radiation; properties of materials; detectors; optical systems; scanners; system design techniques and examples.

561. Physics of Semiconductors (3) I P. PHYS 570 or OPTI 507 recommended but not formally required, PHYS 460. (Identical with PHYS 561, which is home).

563. Photoelectronic Imaging Devices (3) II Intensifiers; camera tubes; storage tubes; specifications; evaluation; applications, electronic optics, human visual process, photon detection. P. PHYS 132.

566. Optical Detectors (3) II Photodetectors, thermal and photoemitters: detectors, signal and noise mechanisms; figures of merit; limitations on the sensitivity of detectors; Infrared detectors; BLIP; ionizing radiation detection. P. OPTI 502, OPTI 506, OPTI 507.

568. Solid-State Imaging Devices (3) II Charge transfer devices, monolithic and hybrid focal planes, photoconductive, photovoltaic, and pyroelectric detectors, figures of merit, time-delay integration (TDI), fat zero, transfer efficiency, MTF, double-correlated sampling, input techniques, output techniques, buried channel vs. surface channel devices. Composite video characteristics. P. OPTI 507.

572. Scanning Probe Microscopies (2) I II Scanning tunneling microscopy (STM): principles of operation, theoretical approaches and experimental results relating to surfaces of semiconductors, metals and superconductors and absorbed molecules such as bucky balls. P. undergraduate quantum mechanics and solid state physics courses.

573. * Atomic and Molecular Spectroscopy for Experimentalists I (3) I (Identical with PHYS 573, which is home).

574. * Atomic and Molecular Spectroscopy for Experimentalists II (3) II (Identical with PHYS 574, which is home).

576. Thin Film Optics (3) I Provides an understanding of some significant physical mechanisms involved in the growth, structure and optical properties of thin films. Content includes: basic electromagnetic theory of multilayer thin films with application to coating including antireflection, reflection, beam splitters, dichroic filters, and bandpass filters. Examples range from the visible to soft x-rays.

578. WDM Components and Systems (2) I Wavelength division multiplexing is considered the key technology to increase the
information transmission capacity in fiber optic communication systems. A successful development and implementation of WDM systems requires a number of components and their implementation in a network environment. This course will cover the fundamentals of WDM systems and look at various optoelectronic components required for the system. Latest developments and trends will be discussed. This course is temporary, and will be offered during the Fall of 1999 only.

587. * Fiber Optics Laboratory (3) II Fiber characteristics; fiber preparation; single and multimode fibers; sources; coupling; communication systems; multiplexing techniques; fiber-optic sensors. P, ECE 456. Graduate-level requirements include performance of a more advanced set of experiments and demonstration of a deeper knowledge of the subject. (Identical with ECE 587).

590. * Remote Sensing for the Study of Planet Earth (3) II (Identical with REM 590, which is home).

595. Colloquium
a. Current Subjects in Optical Sciences (1) [Rpt./] I II

596. Seminar
e. Issues in Science and Technology Policy (3) II (Identical with PHYS 596E, which is home).

597. Workshop
a. Optical Shop Practices (3) II

599. Independent Study (1-5) [Rpt./] 1 R


625. Optical Zingers (2) II GRD A collection of simple-minded explanations or “The fine art of handwriting.”

626. Diode Lasers and Optoelectronics (3) I This course gives an understanding of the physics and technology of diode lasers, wave guides and photogenic components. The main focus is on the operation and design concept of semiconductor lasers, various diode lasers and their performance. Recent developments in laser diodes and active photogenic components are covered. Included are the state-of-the-art technology for monolithic integration of diode lasers with other optoelectronic components, and their application for optical communication. P, OPTI 501.

627. Computer Generated Holography (3) II CGH is the optical element most directly associated with the computer. The course will emphasize mathematical tools while exploring the theory and some practice of computer holography. P, OPTI 527 or consent of instructor.

637. Principles of Image Science (3) II Mathematical description of imaging systems and noise; introduction to inverse problems; introduction to statistical decision theory; prior information; image reconstruction; and radon transform; image quality; applications in medical imaging; other imaging systems. P, OPTI 504 or OPTI 512; OPTI 508.

638. Advanced Medical Imaging (3) II Describes the physical principles behind the medical cross-sectional imaging modalities of magnetic resonance imaging (MRI), computed tomography (CT), ultrasound (US), positron emission tomography (PET), and single photon emission computed tomography (SPECT). P, OPTI 504 or OPTI 512 or equivalent.

656a. Atmospheric Radiation and Remote Sensing (3) I P, MATH 254. (Identical with ATMO 656a, which is home).

656b. Atmospheric Radiation and Remote Sensing (3) II P, MATH 254. (Identical with ATMO 656b, which is home).

670. Principles of Optical Data Storage (3) II Optics of polarized light in systems of high numerical aperture; automatic focusing and tracking schemes; interaction of light with magnetic media; readout enhancement through multilayering; physical mechanisms of optical recording in ablative, phase-change, thermomagnetic and dye-polymer media; sources of noise in optical recording; data encoding schemes. P, consent of instructor.

674. Optical Analysis with DIFFRACT (1) II How to use the DIFFRACT program for the design and analysis of optical systems that are beyond the capabilities of ordinary ray-trace programs. P, familiarity with theory of diffraction polarized light optics, thin-film multilayer structures, and the theory of Fourier-transforms.

680. Microcomputer Interfacing in the Optics Laboratory (3) II Design, construction and use of microcomputer interfaces and assembly language software drivers. Laboratory exercises include interfaces with switches, relays, motors, terminals, A-to-D converters and D-to-A converters. P, C SC 115 or equivalent.

690. Introduction to Opto-Mechanical Design (2) II GRD The principles of opto-mechanical design are reviewed and illustrated in several case studies. Optomechanics is emerging as an indispensable field to those involved in optical engineering. Every optical component in a system must be mounted and integrated into a structure in such a way that optical characteristics and physical integrity are preserved in the presence of a variety of physical influences. P, OPTI 502, PHYS 141.

696. Seminar
a. Advanced Lens Design (2) I P, OPTI 517.

697. Workshop
a. Y, Y Bar Workshop (1) I Basic principles, application to simple systems, layout given prescription deriving system for given requirements, construction points and lines, application to complex systems. 3L, 1R. P, understanding 1st order properties of optical systems.

900. Research (1-8) [Rpt./]
909. Master's Report (1-3) [Rpt./]
910. Thesis (1-8) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Pathobiology (See Veterinary Science)

Pharmaceutical Sciences (PHSC)
Pharmacy Building, Room 313
Phone: (520) 626-5730
FAX: (520) 626-7355
WWW: http://www.pharmacy.arizona.edu
Application Questions:
Belinda Badger, (520) 626-4351, badger@pharmacy.arizona.edu
Advising Questions:
Pharmaceutical Economics and Outcomes Research: Emily R. Cox, yalkowsky@pharmacy.arizona.edu
Pharmacokinetics/Pharmaceuticals: Samuel Yalkowsky, yalkowsky@pharmacy.arizona.edu
Medicinal Chemistry/Natural Products: Barbara Timmermann, btimmer@pharmacy.arizona.edu

Degrees Offered: M.S., Ph.D.

Associate Professors: Edward P. Armstrong, Brian L. Erstad, Martin D. Higbee, David E. Nix, Paul E. Nolan, Jr.
Assistant Professors: Emily Cox, Kathryn L. Grant, Richard N. Herrier, Brenda R. Motheral

The Department of Pharmaceutical Sciences includes the academic disciplines of pharmaceutical chemistry/pharmacognosy, biopharmaceutics/pharmacokinetics, pharmacometrics, and social and administrative science. It offers programs leading to a Master of Science and Doctor of Philosophy degrees with a major in pharmaceutical sciences.
Concentrations within the major include: (1) pharmaceutical economics and outcomes research, (2) pharmacokinetics/pharmaceutics, and (3) medicinal chemistry/natural products.

A bachelor's degree in pharmacy or Pharm.D. degree is generally required for the pharmaceutical economics and outcomes research program. A bachelor's (or Pharm.D.) degree in pharmacy, chemistry, or the biological sciences and adequate preparation in mathematics is a prerequisite to admission to the other concentration areas. Three letters of recommendation and adequate scores on the Graduate Record Examination are also required for admission. For international students, adequate scores on the TOEFL exam are required.

Teaching is part of the graduate learning process and some teaching may be required of graduate students. A thesis/dissertation based upon research is required. Graduate study programs are individually planned after consideration of the student's preparation and professional objectives. A number of minor fields are acceptable. Many specialized facilities are available for the graduate student in pharmaceutical sciences.

507. Pharmacokinetics (4) I Graduate-level requirements include an in-depth analysis of a pharmacokinetic problem.

508a-508b. Pharmacokinetics Discussion (1-1) I II Graduate-level requirements include an in-depth analysis of a pharmacokinetic problem.


512. Quantitative Structure-Activity Relationships (3) I II Approaches to the quantification of pharmacological actions of drugs on the basis of chemical structure.


515. Toxicokinetics (3) II Graduate-level requirements include different examination and/or writing of paper.

527. Antineoplastic Drugs (2) II Graduate-level requirements include an extra paper or equivalent course project.

536. Medicinal Chemistry and Pharmacology I (4) II (Identical with PCOL 536, which is home).

537a-537b. Medicinal Chemistry II-III (3-3) I-II Graduate-level requirements include extensive use of the current literature and emphasis on drug design principles. P, PCOL 536. (Identical with PCOL 537a-537b).

542. Professional Management Practice (3) I Graduate students will write either an additional paper or proposal.

545. Medical Use and US Health Care Systems (3) I II Graduate students will write either an additional paper or proposal.

547. Perspectives in Geriatrics Lab (1) II P, CR, PHPR 448 (Identical with NSC 547, GERO 547).

548. Perspectives in Geriatrics (2) II Graduate-level requirements include one in-depth research paper on a single topic relevant to geriatric care. (Identical with PHL 548, GERO 548).

561. Pharmaceutical Research and Drug Literature Evaluation (3) II Graduate students will write either an additional paper or proposal.

583. Perspectives on Cancer Care (3) S

584. International Health Care and Pharmaceutical Systems (1-3) I II

585. Advanced Clinical Pharmacokinetics (3) II

589. Clinical Pharmacological Mental Disorder (2) I II Graduate-level requirements include a research paper on a single topic of psychopharmacology. (Identical with PHL 589).

593. Internship (1-6) [Rpt/]

596. Seminar
- a. Medical and Natural Products Chemistry (1) [Rpt/ 5] I II
- b. Pharmaceutical Chemistry Research (1) [Rpt/ 5] I II
- c. Pharmaceuticals Research (1-2) [Rpt/ 12 units] I II
d. Pharmaceutics (1) [Rpt/ 4] I II
e. Pharmacy Administration (1) [Rpt/ 5 units] II
f. Pharmacy Administration Research (1) [Rpt/ 5 units] II

599. Independent Study (1-5) [Rpt/]

601. Advanced Physical Pharmacy (3) I Applications of physical pharmacy to pharmacy. P, physical pharmacy or physical chemistry. Open to majors only.


606. Industrial Manufacturing Pharmacy (3) I II Pharmaceutics as applied to various aspects of industrial pharmacy.


611. Pharmaceutical Education Research (3) I Cultural, social, behavioral, and organizational foundations of pharmacy, including the development of the present state of practice. (Identical with PHL 611).

612. Pharmaceutical Outcomes Research (3) I II Survey of the theory, measurement, and applications of patient- reported outcomes, specifically health-related quality of life and consumer assessments of health care. (Identical with PHL 612).

621. Applied Health Technology Assessment (3) I II Application of the methodologies and tools used in the assessment of health technologies. Included are the application of decision analytic tools and techniques as well as methodologies such as cost-effectiveness, cost-benefit and cost-utility analysis. P, PHSC 513. (Identical with PHL 621).

630a-630b. Advanced Organic Medicinals (4-3) I-II Rational drug design, receptor site theories, mechanism of drug action, and metabolic pathways of medicinal agents; chemical and enzymatic synthesis of important pharmaceuticals. P, PHSC 437b, PCOL 471b.

632a-632b. Natural Medicinal Products (3-3) I-II Origin and isolation of steroid and alkaloid drugs and other natural products of interest. P, PHSC 437b, PCOL 471b.

634. Biomedical Applications of Mass Spectrometry (3) I Principles of mass spectrometry including instrumental design, interpretation of spectra, and applications to biomedical and related problems. P, CHEM 241b.

694. Practicum
- a. Clinical Clerkship (1-15) I II
- b. Administrative Clerkship (1-15) I II

695. Colloquium
- a. Research in Gerontology (1) I II (Identical with GERO 695A, which is home).

699. Independent Study (1-5) [Rpt/]

815. Pharmacy Subspecialty
- 1. Research (5) [Rpt/ 1] P, available only after completion of all required and didactic coursework in the first three professional years. (Identical with PHPR 815), which is home.

900. Research (1-5) [Rpt/]

910. Thesis (1-8) [Rpt/]

920. Dissertation (1-9) [Rpt/]

930. Supplementary Registration (1-9) [Rpt/]
Pharmacology (PHCL)
College of Medicine, Room 5103
Phone: (520) 626-7218
FAX: (520) 626-2204
WWW: http://www.ahsc.arizona.edu/pharmacy/index.htm

(Department, College of Medicine)

Professors: I. Glenn Sipes, Head (Anesthesiology, Pharmacology and Toxicology), David S. Alberts (Medicine), H. Vasken Aposhian (Molecular and Cellular Biology), Klaus Brendel (Emeritus), Rubin Bressler (Medicine, Emeritus), Thomas P. Davis, Robert T. Dorf (Medicine, Cancer Center, Pharmacology & Toxicology), A. Jay Gandolfi (Anesthesiology, Pharmacology and Toxicology), Marilyn J. Halonen (Microbiology, Respiratory Sciences, Internal Medicine), Ryan J. Huxtable, David G. Johnson (Medicine), Eugene Morkin (Medicine, Physiology), John D. Palmer (Emeritus), Frank Porreca (Anesthesiology), Garth Powis (Pathology), Charles W. Putnam (Surgery). William R. Roese (Medicine), Robert R. Sloviter (Neurology), Henry I. Yamamura (Biochemistry, Arizona Research Laboratories, Psychiatry)

Associate Professors: John W. Bloom (Medicine, Respiratory Sciences), Dean E. Carter (Pharmacology and Toxicology), Timothy Fagan (Medicine), Edward D. Frenc, Josephine Y. Lai, Douglas F. Larson (Surgery), Ronald M. Lynch (Physiology), Andrea J. Yoo (Physiology)

Assistant Professors: Qin Chen (Pharmacology & Toxicology), Bernard W. Futcher (Cancer Center)

Research Associate Professors: Philip D. Kanof, Mark L. Witten (Pediatrics)

Research Lecturers: Leslie V. Boyer

Hassen (Pediatrics), John C. Gilkey

For 400-, 500-, and 600-level course descriptions see Pharmacology and Toxicology (PCOL) - College of Pharmacy. For research opportunities, and admission requirements, see Graduate Interdisciplinary Program in Pharmacology and Toxicology.

800. Research (1-6) [Rpt.] I II

801. The Pharmacological Basis of Therapeutics (6) [Rpt.] I Actions of chemical agents upon living material at all levels of organization, with emphasis on mechanisms of action of prototype drugs; foundation for a rational approach to human therapeutics and toxicology. P, PSIO 580 or PSIO 601; and course equivalent to BI0C462a. Available as both PHCL 801 and PCOL 501.

815. Subspecialty

a. Clinical Pharmacology (3-6) [Rpt./] I II

825. Human Neuroscience (6) I I P, consent required to enroll. (Identical with MED 825, which is home).

891. Preceptorship

a. Pharmacology (3-12) [Rpt./12 units] I II

I. Perfusion Science (1-3) [Rpt./I Students register for 3 units Fall and Spring semesters and one unit Summer Session I and II. (Identical with SURG 8911).

899. Independent Study (3-12) [Rpt./I I II

Pharmacology and Toxicology (PCOL)
Pharmacy Building, Room 236
Phone: (520) 626-2823
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(Department, College of Pharmacy)

Application Questions: Sandi Sledge, (520) 626-7218, sledge@u.arizona.edu

Professors: I. Glenn Sipes, Head (Pharmacology, Anesthesiology), James Blanchard (Pharmaceutical Sciences), G. Timothy Bowden (Radiation Oncology, Molecular and Cellular Biology), Dean E. Carter, Lincoln Chin (Emeritus), Paul F. Consroe, Robert T. Dorf (Pharmacology, Medicine, Cancer Center), A. Jay Gandolfi (Anesthesiology, Pharmacology, Pharmacology), Wayburn S. Jeter (Emeritus), Daniel C. Liebler, Arnold M. Martin (Pharmaceutical Sciences), Albert L. Picchioni (Emeritus), John W. Regan, William A. Remers (Pharmaceutical Sciences), Findlay E. Russell (Emeritus, Pharmacology, Pharmacological Sciences, Arid Lands), Theodore G. Tong (Pharmacy Practice and Science)

Associate Professors: Charlene A. McQueen

Assistant Professors: William T. Bellamy (Pathology), Qin Chen (Pharmacology), Clifton D. Crutchfield (Family and Community Medicine, Health Education), John B. Sullivan (Surgery), Richard R. Vaillancourt, Mark D. Van Ert (Family and Community Medicine, Health Education)

For research opportunities, and admission requirements, see Graduate Interdisciplinary Program in Pharmacology and Toxicology.

501. The Pharmacological Basis of Therapeutics (6) I Action of chemical agents upon living material at all levels of organization with emphasis on mechanisms of action of prototype drugs. Foundation for a rational approach to human therapeutics and toxicology. P, PSIO 580 or PSIO 601; course equivalent to BI0C462a. Available as both PCOL 501 and PHCL 801.

508. * Insect Toxicology (3) II P, 3 units of organic chemistry or biochemistry. (Identical with ENTO 508, which is home).

509. Statistics for Research (4) I II (Identical with MATH 509, which is home).

510. Physical Exposures (3) II 2R, 3L. (Identical with PHL 510, which is home).

515. Basic Human Pathology (4) II 3R, 3L, P, consent of instructor. (Identical with PATH 515, which is home).

520. Clinical Pharmacology (2) II Effects of drugs on the natural history of disease; drug interactions; drug testing designs; drug abuse literature evaluation; aspects of clinical toxicology. P, PCOL 501.

523. * Mechanisms of Disease (5) I II (Identical with VSC 523, which is home).

536. * Mechanism of Chemotherapy and Pharmacology 1 (4) II General principles of medicinal chemistry and pharmacology, and comprehensive survey of anti-infective and antineoplastic drugs. P, PSIO 480, PCOL 307, BI0C 460, CHEM 241b, CHEM 243b or PSIO 480. Graduate-level requirements include a term paper. (Identical with PHSC 536).

537a-537b. Medicinal Chemistry II-III (3-3) I II P, BI0C 536. (Identical with PHSC 537a-537b, which is home).

545. * Drugs of Abuse (3) I Pharmacology and toxicology of abused drugs with emphasis on mechanisms of drug action, theories of addiction, involvement of AIDS and the immune system and treatment approaches. Graduate-level requirements include a term paper on some aspect of drug abuse.


551. Molecular Biology of Pharmacological Agents (3) I Molecular mechanism of drugs and toxins at the cellular and subcellular levels, including effects on control mechanisms, cell-cell interactions, organelles, and nucleic acid and protein synthesis. P, BI0C 462a, BI0C 462b or BI0C 411; BI0C 511. (Identical with CBIO 551).

553. Toxicology and Chemical Exposure (2-4) I P, CHEM 486. (Identical with PHL 553, which is home).


566. * Physiology Laboratory (3) II (Identical with ECOL 566, which is home).

571a-571b. * Pharmacology II and III (4) I Continuation of the comprehensive survey of the pharmacology of drugs, including agents acting on the autonomic, cardiovascular, hematopoietic, and inflammatory systems. P,
PCOL 436. Graduate-level requirements include an in-depth research paper on a current topic.

572. * Nursing Pharmacology (3) I Pharmacodynamics, pharmacology, and adverse effects of commonly used drugs, with emphasis on clinical applications. Not available for elective credit in the College of Pharmacy or graduate credit in pharmacology-toxicology graduate programs. P. Open only to nursing majors or with consent of course coordinator. Graduate-level requirements include a term paper on nursing pharmacology.

574. Clinical Toxicology (2) II Graduate students will complete sixteen hours experience in the Poison Information Center.

576. Environmental Toxicology (3) II Toxicity of agricultural and industrial chemicals, with emphasis on air and water pollutants; decision-making in environmental issues and risk assessment. P. PCOL 602a, 6 units of biology and organic chemistry. (Identical with ENTO 576).

577. * Pain Management: IDIS Team Approach (3) I II (Identical with NURS 577, which is home).

580. Systems Physiology (5) II P, PSIO 503 or equivalent, MATH 113, PHYS 103, CHEM 243b. (Identical with PSIO 580, which is home).

582. Immunotoxicology and Immunopharmacology (3) I Broad overview of the immune system, with emphasis on how chemicals affect the immune system (immunomodulation) and the role of the immune system in chemical-induced tissue injury/allergic responses. P, MIC 419 or equivalent; PCOL 602a, PCOL 602b. (Identical with MBIM 582).

584. Fundamentals of Industrial and Environmental Health (3) I (Identical with PHL 584, which is home).

585. Industrial Ventilation (3) II 3R, 1L. (Identical with PHL 585, which is home).

586a-586b. Introduction to Pharmacology and Toxicology Research (1-1) I II Introduction to basic research techniques in pharmacology and toxicology through supervised laboratory rotations; student-initiated and faculty-structured lab. Exercises in modern pharmacological and toxicological techniques.

593. Internship (1-3) I II

596. Seminar a. Advanced Graduate Research (1-3) [Rpt./ 9 units] I
b. Current Concepts in Industrial Hygiene (1) [Rpt./ 3] II
c. Advanced Toxicology (1-2) [Rpt./ 8 units] II

597. Workshop a. Computer-Assisted Instruction (1) I II

599. Independent Study (2-4) [Rpt./]

601. Analytical Instrumentation and Techniques (2-4) I Lecture and laboratory in the qualitative and quantitative determination of toxic substances in the environment and body fluids. Modern instrumental techniques are employed whenever appropriate. Lecture may be taken separately by non-majors. Toxicology majors take lecture/laboratory (4 units). P, CHEM 325, CHEM 326. Elective for pharmacology majors and others should consult with instructor before enrolling. 602a-602b. Biotoxicology (3-1) I 602a: Lecture. Mechanisms of organ directed toxicities in animals. Chemical carcinogenesis, teratogenesis and mutagenesis. P, organic chemistry, two semesters of biology and one semester of biochemistry. 602b: Laboratory. Proper use of animals in toxicology and pharmacology research; focuses on organ specific toxicities. (Identical with PHL 602a-602b, CBIO 602a-602b).

610. Topics in Advanced Toxicology (1-3) I II Current developments in toxicology including: chemical carcinogenesis, mutagenesis and teratogenesis; behavioral toxicology; inhalation toxicology; toxicokinetics; metabolism and environmental toxicology or other selected topics. P, PCOL 602a.

620. Principles of Pharmacology (3) I Basic principles of the actions of drugs and of intercellular communication; drug-receptor theory; principles of laboratory investigation in pharmacology and toxicology; historical and philosophical foundations of pharmacology and toxicology.

625. Human Neuroscience (6) P, consent of instructor. (Identical with MED 625, which is home).

653. Neuropharmacology (3) II Role of various neurochemicals in the peripheral and central nervous systems and the effects of drugs on the nervous system, including their actions at receptors and their influence on synthesis, storage, and release of neurotransmitters.


671. Perfusion Technology Laboratory (1) I An introduction to basic extracorporeal systems. P, Open to majors only. (Identical with SURG 671).

672. Principles of Perfusion Techniques II (2) I Introduction to basic extracorporeal techniques through discussion of blood propelling devices, heat transfer, gas transfer, bio-materials and perfusion pharmacology. P, Open to majors only. (Identical with SURG 672).

691. Preceptorship I. Perfusion Science (1-3) [Rpt./ 25 units] Students register for 3 units for Fall and Spring semesters and 1 unit for Summer Session I and II. F, admission into circulatory sciences option within pharmacology.

695. Colloquium a. Research Conference (1-3) [Rpt./ 33 units] I II b. Cellular/Molecular Pharmacology (1-3) [Rpt./ 4 units] II

696. Seminar a. Student Research (1) [Rpt./ 9] I II

699. Independent Study (1-5) [Rpt./ I II

815. Subspecialty I. Research (3) [Rpt./ 1] P, available only after completion of all required and didactic coursework in the first three professional years. (Identical with PHPR 815I, which is home).

900. Research (1-5) [Rpt./ Individual or independent work, directed reading or special problems under the supervision of a member of the faculty with whom specific arrangements have been made. Must be taken for graduate credit by Pharmacology and Toxicology graduate students.

910. Thesis (1-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Pharmacology and Toxicology (PCOL)
College of Medicine, Room 5103 Phone: (520) 626-7218 FAX: (520) 626-2204 WWW: http://www.pharm.arizona.edu

Graduate Interdisciplinary Program in Pharmacology and Toxicology

Application Questions: Sandi Sledge, (520) 626-7218, sledge@u.arizona.edu

Professors: I. Glenn Sipes, Head (Anesthesiology, Pharmacology and Toxicology), David S. Alberts (Medicine), H. Vasken Aposhan (Molecular and Cellular Biology), G. Timothy Bowden (Radiation Oncology, Molecular and Cellular Biology), Klaus Brendel (Pharmacology, Emeritus), Rubin Bressler (Medicine, Emeritus), Dean E. Carter (Pharmacology and Toxicology), Paul F. Conroe (Pharmacology and Toxicology), Thomas P. Davis (Pharmacology), Robert T. Dorr (Pharmacology, Medicine, Cancer Center), Timothy C. Fagan (Pharmacology, Medicine), A. Jay Gandolfi (Anesthesiology, Pharmacology), J. Halonen (Microbiology, Pharmacology, Respiratory Sciences, Internal Medicine), Ryan J. Huxtable (Pharmacology), David G. Johnson (Medicine), Daniel C. Liebler (Pharmacology and Toxicology), Michael Mayersohn (Pharmaceutical Sciences, Pharmacy Practice and Science), Paul F. McDonagh (Surgery), Eugene Morkin (Medicine, Physiology, Pharmacology), John D. Palmer (Emeritus), Frank
Perfusion Science (M.S.)

Perfusion science is the applied science concerned with the investigation of extracorporeal and cardiac methods of supporting life. This discipline will prepare students for professional practice in perfusion with a wide range of experiences including vascular surgery, heart and lung transplantation, and extracorporeal circulation. The discipline will prepare students for professional practice in perfusion with a wide range of experiences including vascular surgery, heart and lung transplantation, and extracorporeal circulation.

Industrial Hygiene (M.S.)

Industrial hygiene is the science with all aspects of the action of drugs and other chemicals on living systems. Its primary aim is the discovery of chemical mechanisms by which cellular and molecular functions are regulated, for the purpose of understanding how existing drugs act, and to develop new drugs for prevention or treatment of illness and disease. The broad scope of interests of pharmacology ranges from the study of intermolecular reactions of chemical constituents of cells with drugs, to the effects of drugs on entire populations within society. Pharmacologists generally pursue careers in basic research and teaching in academia or basic and applied research in industry or research institutes.

Research Areas

Carcinogenesis/Cancer Chemotherapy
The mechanisms of carcinogenesis and its treatment

Cardiovascular Pharmacology
The action of drugs on cardiovascular tissue

Clinical Pharmacology/Toxicology
Efficacy and adverse effects of drugs and chemicals

Endocrine Pharmacology
Drugs acting as hormones or affecting normal hormones

Environmental and Biochemical Toxicology
Chemicals affecting biological systems

Immunopharmacology/Toxicology
Effect of drugs and chemicals on the immune system

Molecular/Biochemical Pharmacology
The molecular basis of drug action with recombinant DNA and biochemical approaches

Molecular Toxicology
The molecular basis of chemical toxicity

Natural Products Chemistry
Identify biologically active compounds obtained from animals and plants

Neuropharmacology/Toxicology
Effect of drugs and chemicals that modify nervous system functions

Pharmacokinetics
Movement of drugs through biological systems

For course descriptions see Pharmacology and Toxicology (PCOL)-College of Pharmacy

Philosophy (PHIL)

Social Sciences Building, Room 213
Phone: (520) 621-3120
FAX: (520) 621-9559
WWW: http://w3.arizona.edu/~phil

Application Questions:
Richard Healey, (520) 621-5216,
rhealey@u.arizona.edu

Advising Questions:
Richard Healey, (520) 621-5216,
rhealey@u.arizona.edu

Degrees Offered: M.A.¹, Ph.D.

¹Initial admission is to the doctoral program only

Associate Professors: Thomas Christiano, Shaughan Lavine, David Owen, Margaret Reimer, Joseph T. Tolliver
Assistant Professors: Jenann Ismael, Houston Smit

The University of Arizona's philosophy graduate program is consistently ranked among the ten best in the United States. In recent years, Arizona's Ph.D.'s have been hired at major U.S. and international universities. The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in philosophy. In addition to the traditional areas of philosophy, concentrations that bridge philosophy with other disciplines such as law and cognitive science are available.

Students admitted to the philosophy Ph.D. program are normally expected to have completed an undergraduate major in philosophy or its equivalent, i.e. 30 units of course work in philosophy. The Philosophy Department does not admit graduate students who wish to proceed only to the master's degree. In addition to application materials required by the Graduate College, applicants should submit to the Department a copy of their completed application, copies of transcripts (these need not be official), three letters of recommendation from philosophy instructors, GRE general aptitude scores, and a sample of their written philosophy work.

Master of Arts: A student must demonstrate proficiency in logic and must pass at least one course in each of the following four areas: history of philosophy, metaphysics and epistemology, moral philosophy, and logic language and science. No thesis is required.

Doctor of Philosophy: A student must take at least two courses in each of the following distribution areas: (1) logic, philosophy of language, and philosophy of science; (2) history of philosophy; (3) epistemology and metaphysics; and (4) moral, social, and legal philosophy. At least half of a student's courses must be at the seminar level. Students must pass a comprehensive examination. In addition, a prospectus examination and a doctoral dissertation are required. Further details about requirements and procedures can be obtained from the Department. Teaching assistantships are available for qualified students.

501a. * Symbolic Logic (3) I Intermediate prepositional logic and quantification theory, natural deduction, axioms systems, elementary metatheorems, introduction notions of modal logic, selected topics in philosophy of logic. Graduate-level requirements include an in-depth research project on a central theme or topic of the course. (Identical with MATH 501a, C SC 501a).
501b. * Symbolic Logic (3) II Advanced prepositional logic and quantification theory; metatheorems on consistency, independence, and completeness; set theory, number theory, and modal theory; recursive function theory and Goedel's incompleteness theorem. Graduate-level requirements include an in-depth research project on a central theme or topic of the course. (Identical with MATH 501b, C SC 501b).
502. * Mathematical Logic (3) I (Identical with MATH 502, which is home).
503. * Foundations of Mathematics (3) II (Identical with MATH 503, which is home).
510a-510b. * History of Moral and Political Philosophy (3-3) I-II Reading and analysis of selected texts from the Greeks to the present. Course focuses on the history of social and political philosophy. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
512. * Readings in Greek Philosophy (3) [Rpt./ 6 units] I II Extensive readings in Greek in one of the following areas of Greek philosophy: the pre-Socratics, Plato's ethic and epistemology, Aristotle's Nicomachean Ethics. Graduate-level requirements include extensive reading and an in-depth paper. P, 3 units of 400-level Greek. (Identical with GRK 512).
514. * Philosophical Logic (3) I II Introduction to modal logic; problems of interpretation and application; extensions to such areas as tense logic, epistemic logic, deontic logic. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
516. * Philosophy of Mathematics (3) I II Problems at the foundations of geometry and set theory. Logicism, formalism, and intuitionism. Nominalism vs. realism. Epistemology of mathematics. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
519. * Induction and Probability (3) I II Basic philosophical problems concerning justification of induction, confirmation of scientific hypotheses, and meaning of probability concepts. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
521. * Philosophy of the Biological Sciences (3) I-II Laws and models in biology, structure of evolutionary theory, teleological explanations, reductionism, sociobiology. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with ECOL 521).
522. Linguistic Semantics and Lexicology (3) I II P, one course in linguistics. (Identical with LING 522, which is home).
523a. * Philosophy of the Physical Sciences (3) I Philosophical problems of space, time, and motion. Topics may include the nature of geometrical knowledge, the philosophical impact of relativity theory, absolute versus relative conceptions of space and time. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.
523b. * Philosophy of the Physical Sciences (3) II Theories and models. Measurement, experimentation, testing hypothesis. Philosophical problems concerning explanation, causation, and law of nature. Philosophical problems raised by quantum mechanics and/or other physical theories. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.
530a-530b. * Ethical Theory (3-3) I-II 530a: Meta-ethics or the meaning of moral terms, relativism, subjectivism, ethics and science, social contract theory. 530b: Normative ethics including Utilitarianism, egoism, rights, natural law, justice, deontological duties, blameworthiness and excuses. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.
532. * Psychology of Language (3) II (Identical with LING 532, which is home).
533. * Aesthetics (3) I II Classical and contemporary theories of art; the aesthetic experience, form and content, meaning, problems in interpretation and criticism of works of art. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
534. * Social and Political Philosophy (3) I II Fundamental concepts of politics; leading social and political theories such as anarchism, social contract, Marxism. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
536. * Games and Decisions (3) I Classical theory of subjective probability, utility, and rational choice, with applications to games theory and social welfare theory. P, MATH 119. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.
538a. * Philosophy of Law (3) I Nature and validity of law; law and morality, judicial reasoning, law and liberty. Graduate-level requirements include an in-depth research project on a central theme or topic of the course. (Identical with POL 538a).
538b. * Philosophy of Law (3) II Problems about justice, compensation and contracts and/or responsibility and punishment. Graduate-level requirements include an in-depth research project on a central theme or topic of the course. (Identical with POL 538b).
540. * Metaphysics (3) I II Topics include free will and determinism; causation; personal identity; necessity and essence; truth, realism and ontology. Graduate-level requirements include an in-depth research project on a central theme or topic of the course.

541. * Theory of Knowledge (3) I II Critical examination of some of the major problems concerning evidence, justification, knowledge, memory, perception and induction. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.

542. * Knowledge and Cognition (3) I Issues in philosophy and psychology of knowledge, with emphasis on cognitive mechanisms. Perception, memory, concepts, mental representation, problem-solving, reasoning and rationality. P, two philosophy courses. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.

543. * Knowledge and Society (3) I Interdisciplinary borrowings affecting the acquisition and diffusion of knowledge. Emphasis on philosophical perspectives, with interdisciplinary borrowings. P, one course in philosophy. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with IRLS 543).

545. * Neural Network Model (3) I II (Identical with PSYC 545, which is home).

550. * Philosophy of Mind (3) I II Topics include the nature of mental states; the relation between mind and brain; and analysis of perception, emotion, memory and action. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with PSYC 550).

551. * Philosophy and Psychology (3) I II Investigation of philosophical issues arising from current work in psychology including perception, reasoning, memory, motivation and action. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with PSYC 551).

555. * Philosophy and Artificial Intelligence (3) I II Interdisciplinary problems lying at the interface of philosophy and artificial intelligence. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with PSYC 555).

563. * Philosophy of Language (3) I II Survey of basic issues in the philosophy of language such as: speech acts, reference, meaning, logical form. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with LING 563).

564. Formal Semantics (3) I I I (Identical with LING 564, which is home).

565. * Pragmatics (3) I II Study of language use, its relationship to language structure and context; topics such as speech acts, presupposition, implication, performatives, conversations. Graduate-level requirements include a greater number of assignments and a higher level of performance. (Identical with LING 565).

567. * Early Analytic Philosophy (3) I II The 50 year rise of analytic philosophy from Frege through early Russell to Wittgenstein's Tractatus. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.

570. * Greek Philosophy (3) [Rpt./ 1] I II Topics in Greek philosophy. May be selected from the pre-Socratics, Socrates, Plato, Aristotle and post-Aristotelian philosophy. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course. (Identical with CLAS 570).

571a. * Rationalism and Empiricism (3) I Rationalists of the 17th and 18th centuries: Descartes, Spinoza, Leibniz, and Kant. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.

571b. * Rationalism and Empiricism (3) II Empiricists of the 17th and 18th centuries: Locke, Berkeley, Hume. Graduate-level requirements include an in-depth research paper on a central theme or topic of the course.

900. Research (1-4) [Rpt./]

910. Thesis (1-4) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

**Physics (PHYS)**

1118 E. Fourth St., Room 260
Phone: (520) 621-2290
FAX: (520) 621-4721
WWW: http://www.physics.arizona.edu

Application Questions:
Lisa Shapouri, (520) 621-2290,
lisas@physics.arizona.edu

Advising Questions:
Michael A. Shupe, (520) 621-2290,
shupe@uazhep.physics.arizona.edu

Degrees Offered: M.S., Ph.D.


Associate Professors: Raymond E. Goldstein, Kenneth A. Johns, Jay E. Treat (Emeritus), Ewan M. Wright (Optical Sciences)

Assistant Professor: Elliott Cheu, Srinivas Manne, Charles A. Stafford, Koen Visscher

Joint Appointments: Peter Franken (Optical Science), Thomas Kennedy (Mathematics), Willis E. Lamb, Jr. (Optical Science), Eugene Levy (Lunar and Planetary Sciences), Robert Maier (Mathematics), Pierre Meyeste (Optical
Science), Philip Pinto (Astronomy), Trevor Weekes (Smithsonian Astrophysical Observatory), Alwyn C. Scott (Mathematics)

Lecturers: Marco Fatuzzo, Adriana Pesci

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in physics.

Prerequisites for admission to full graduate standing are 30 units of undergraduate work in physics. These will normally include the following beyond introductory physics: appropriate laboratory work; one semester each of mechanics, thermodynamics, and optics; two semesters of electricity and magnetism; and two semesters of modern physics including quantum mechanics. All applicants must submit scores on the aptitude and advanced tests of the Graduate Record Examination.

An advisor is assigned to each graduate student to help plan a program for the advanced degree. Students without deficiencies are required to take a qualifying examination during the first week of classes. This diagnostic examination covers undergraduate physics only and the results will be used to help in determining an appropriate course of studies. Experience in teaching is an essential part of graduate training in physics. Graduate students are required to teach an amount to be determined on an individual basis by the graduate advisor and the department as a whole. Graduate students are required to take PHYS 695 until the comprehensive examination is passed.

Master of Science: At least 15 of the required 30 units of graduate work must be in physics and must include 579a, 511 and 515a or the equivalent. Also, each student must satisfy one of the following options: (1) write a thesis (for which up to 6 units may be allowed) and pass an oral examination on the thesis; or (2) take 21 of the 30 required graduate units in physics and pass a comprehensive final oral examination.

Doctor of Philosophy: Each student must complete at least 36 units of graduate work in physics exclusive of the dissertation and the supporting (minor) work. Courses will be chosen in consultation with the graduate advisor. Each student must complete four of the following courses: 513, 525, 535, 551, 562 or 563, 570c or 579a, 581, 582 or 589, and 685. In addition, at least two of the four courses must be from the subset of courses 535, 551, 562 or 563 and 581. The preliminary examination will cover classical mechanics, electromagnetic theory, relativity, statistical mechanics, experimental physics, quantum mechanics, modern physics, and questions on current developments. The courses 511, 515a-515b, 528, and 570a-570b indicate the areas covered in the examination and the level of understanding expected of the student. The comprehensive examination must be taken, at the latest, during the fifth semester (excluding summer sessions) of residence. It is expected that the dissertation, based upon original research, will be published in a refereed journal. The minor work may be satisfied within the Department of Physics but some courses taken in other departments may be used as well. An additional 9 units of work, chosen in consultation with the graduate advisor, are required for the minor in physics. Information on methods of demonstrating proficiency may be obtained from the Department of Physics.

Students intending to minor in physics (to supplement a major in another department) should consult the physics minor advisor early in their graduate work.

Experimental research is conducted in the following areas: elementary particle physics, cosmic rays and space physics, solid state physics, atomic and molecular physics, nuclear physics, carbon dating, surface science, quantum optics, biophysics, and general relativity. Theoretical research is conducted in solid state physics, atomic physics, nuclear physics, elementary particles, field theory, general relativity, cosmology, astrophysics and nonequilibrium statistical mechanics. Prospective students should write to the department for information about specific research programs, the faculty involved, the facilities available, and the research and teaching assistantships or fellowship support which can be offered. It is the policy of the department to award financial aid in the form of teaching assistantships solely on the basis of the student's academic record and financial need. Fellowships are also available to first-year graduate students.

502. * Medical Physics (3) I Basic physics of the human body: the principles of mechanics, thermodynamics, light and radiation, with emphasis on their role in biological systems and biomedical applications. P, PHYS 103 or PHYS 132; MATH 124 or equivalent. Graduate-level requirements include an original report demonstrating the ability to construct mathematical models related to one of the diagnostic or therapeutic modalities discussed in the course. (Identical with MCB 502).

503. Quantum Optics and Lasers (3) I P, PHYS 371. (Identical with OPTI 503, which is home).

505. * Digital Electronics Techniques (3) II This course is an introduction to electronic techniques used in experimental physics. Topics include op-amps, logic elements and the use of programmable logic. A large emphasis of this course is on computer-aided schematic capture and simulation. The course offers a two-hour lecture each week accompanied by a three hour lab. Graduate students complete a final project including programmable logic and at least one of the following components in its design: state machine, tri-state logic, memory or FIFOs, arithmetic units.

511. Analytical Mechanics (3) II Laws of motion as developed by Newton, d'Alembert, LaGrange and Hamilton; dynamics of particles and rigid bodies. P, PHYS 410.

513. Topics in Advanced Mechanics (3) I Modern topics in classical mechanics, including canonical perturbation theory, invariant mappings, nonintegrated dynamical mechanical behavior, and applications to semi-classical quantum theory. P, PHYS 511.


528. Statistical Mechanics (3) I Physical statistics; the connection between the thermodynamic properties of a macroscopic system and the statistics of the fundamental components; Maxwell-Boltzmann, Fermi-Dirac, Einstein-Bose statistics. P, PHYS 476.

529. Information and the Foundation of Physics (3) I P, OPTI 501 or PHYS 325 or equivalent. (Identical with OPTI 529, which is home).

530. * Introduction to Biophysics (2) I Concepts and experimental techniques of molecular biophysics; physical properties of biological macromolecules and cell organelles, optical interactions, macromolecular transitions, molecular mechanism or regulation. Graduate-level requirements include extra assignments. (Identical with MBIM 530).

531. Biophysical Theory (2) II Physical concepts and theories describing biomolecular structure and function, molecular evolution, limits to structure, symmetry, oligomer and virus structure, organelle structure and function. (Identical with MBIM 531).
533. * Physics Demonstration (1-3) II Introduction to teaching materials and laboratory demonstrations illustrating principles of classical and modern physics, with emphasis on inexpensive techniques and direct experience. P, CR, PHYS 570a, PHYS 570b.

535. Advanced Atomic Physics (3) II Details of atomic structure; interactions of atoms with electromagnetic fields, electrons and ions; techniques for calculating unperturbed and perturbed energy levels, transition probabilities and atomic interaction cross sections. P, PHYS 511, PHYS 515b, PHYS 570b.

545. * Experimental Physics (1) I Students select one to three sections from the five- week lectures listed as PHYS 545a through 545d. Credit can only be given once for each topic. P, consult department before enrolling. PHYS 545a is not prerequisite to PHYS 545bc or d. Graduate-level requirements include an in-depth report on a topic selected in consultation with the instructor.

a. Experimental Spectroscopy (1) Laboratory experiments with spectroscopic sources, spectrometers, instrument functions, detectors, light collection optics, spectral recording and analysis.

b. Experimental Acoustics (1) Laboratory experiments with sound sources, oscilloscopes, spectrum analyzers, sound level meters, filters, musical instruments, recording, room acoustics.

c. Experimental Microscopy (1) Laboratory experiments with microscopes and polarized scattered light to characterize small particles and surfaces, optical constants, lasers, remote sensing.

d. Experimental Geometric and Physical Optics (1-3) I II Experimental measures of geometrical and optical properties of basic optical elements: lenses, prisms, gratings, optical fibers, etc.

550. Introduction to Nuclear Physics (3) II Graduate-level requirements include additional special topics to be determined by the instructor.


556. Electrodynamics of Conduction Fluids and Plasmas (3) II P, PHYS 321, PHYS 331, PHYS 332. (Identical with PTYS 556, which is home).


563. Experimental Condensed Matter Physics (3) II Topics in experimental condensed matter physics; will include thin film theory, methods, characterization; high vacuum deposition technologies; evaporation sputtering, MBE, CVD, LPE, Ion Beam Deposition; epitaxial films; diffraction theory; x-ray, electron probes: RBS, XPS, Auger; magnetic films; super-conductivity.

570a-570b. Quantum Mechanics (3-3) I-II Principles of quantum mechanics; wave mechanics and matrix mechanics; applications to atomic structure and spectroscopy. P, PHYS 475; PHYS 476 recommended but not required.

570c. Intermediate Quantum Mechanics (3) II Formal quantum mechanics; scattering theory; relativistic wave equations; applications of DIRAC equation; angular momentum; symmetry; optical theorem; dispersion relations and path integral formulations. P.

571. General Relativity and Cosmology (3) I II (Identical with ASTR 571, which is home). P.

572. * Quantum Theory II (3) II Applications of quantum mechanics: fine structure of atomic spectra, addition of angular momentum, molecules, perturbation theory, transition rates, special topics in nuclear, elementary particle and condensed matter physics. Graduate-level requirements include additional homework problems.

573. * Atomic and Molecular Spectroscopy for Experimentalists I (3) I Experimental techniques to generate, analyze and detect photons from X-ray to infrared; interpretation of spectra from gases, liquids, solids and biological macromolecules; light scattering, polarization. Graduate-level requirements include homework problem assignments at an advanced level. (Identical with OPTI 573).

574. * Atomic and Molecular Spectroscopy for Experimentalists II (3) II Continuation of 573. Graduate-level requirements include homework problem assignments at an advanced level. (Identical with OPTI 574).

575. * Methods of Mathematical Physics I (3) I Mathematical techniques and their physical applications. Vector and tensor analysis; differential equations, complex variable theory, Green's functions. Graduate-level requirements include advanced examinations, as determined by the instructor.

576. * Methods of Mathematical Physics II (3) II Continuation of 475. Special functions, transform theory, integral equations, variational techniques. Graduate-level requirements include advanced examinations, as determined by the instructor.

579a-579b. Advanced Relativistic Quantum Mechanics (3-3) I-II Continousious groups; scattering theory; relativistic wave equations; quantum electrodynamics, Feynman diagrams, dispersion theory, renormalization; strong and weak interactions. P, PHYS 515b, PHYS 570b.

581. Elementary Particle Physics (3) I Production, interaction, and decay of mesons, baryons and leptons; high energy scattering of elementary particles; particle classification and symmetries; theoretical interpretation. P, PHYS 472.

582. High Energy Astrophysics (3) II (Identical with ASTR 582, which is home). P.

586. Techniques in Particle Physics (3) I II Classification of elementary particles and their interactions with matter, relativistic kinematics, detectors, data acquisition techniques, statistical techniques, analysis of experiments, cosmic radiation and accelerators.

587. Nuclear Astrophysics (3) I (Identical with ASTR 587, which is home). P.

588. Topics in Theoretical Astrophysics (3) [Rpt./ 1] I Current topics in theoretical astrophysics in depth, with emphasis on the methodology and techniques of the theorist and the cross-disciplinary nature of astrophysics theory. Example subjects are nuclear astrophysics, hydrodynamics, transient phenomena, planetary interiors and atmospheres, neutron stars, jets and the evolution of star clusters. (Identical with ASTR 589, PTYS 589).

591. Preceptorship (1-3) [Rpt./ I I

596. Seminar

b. Methods in Computational Astrophysics (3) II (Identical with ASTR 596b, which is home).
c. Issues in Science and Technology Policy (3) II (Identical with OPTI 590e).
f. Topics in Cosmology (3) I II Cosmography, dynamical models of general relativity (Einstein, Yilmaz, Quantum Field Theory), Evolution of Cosmic Big Bang.
h. Philosophy of Physical Science (3) [Rpt./ 2] I II (Identical with PHIL 596h, which is home).
999. Independent Study (1-6) [Rpt./]
685. Graduate Physics Laboratory (3) [Rpt./]
II Introduction to modern research methods and experiments. Problems in low-temperature physics; solid-state, atomic, and nuclear spectroscopy; computer-based data acquisition and analysis; solar-energy physics; and others.
695. Colloquium
a. Current Problems in Physics (1) [Rpt./] 1 II
b. Workshop
a. Problems in Computational Science (3) [Rpt./] 1 II (Identical with MATH 697a, which is home).
b. Applied Mathematics Laboratory (3) II S P, applied math core or equivalent. (Identical with MATH 697b, which is home).
699. Independent Study (1-3)
900. Research (1-4) [Rpt./]
909. Master's Report (1-9) [Rpt./] 1 II
910. Thesis (1-4) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Physiological Sciences (PS)
Arizona Health Sciences Center,
Room 4204
Phone: (520) 626-2898
FAX: (520) 626-2382
WWW: http://grad.admin.arizona.edu/idps/ps/ps.html

Graduate Interdisciplinary Program in Physiological Sciences

Application Questions:
M.S.: Christine Coronado, (520) 621-2785, coronado@u.arizona.edu
Ph.D.: Holly Lopez, HollyL@u.arizona.edu

Degrees Offered: M.S.¹, Ph.D.

¹Initial admission is to the doctoral program only.

Professors: Paul F. McDonagh (Surgery), Chair, Ronald E. Allen (Nutritional Sciences), Ealdon J. Braun (Physiology), Reginald Chapman (Arizona Research Laboratories, Division of Neurobiology), William H. Dantzler (Physiology), Fayez Ghishan (Physiology), Robert W. Gore (Physiology), Joseph F. Gross (Emeritus), Raphael P. Gruener (Physiology), Patricia Hoyer (Physiology), Richard Levine (Arizona Research Laboratories, Division of Neurobiology), Stan Lindstedt (Biology, NAU), Timothy G. Lohman (Exercise and Sport Sciences), Robert S. McCuskey (Cell Biology and Anatomy), Eugene Morkin (Internal Medicine), L. Claire Parsons (Nursing), John W. Regan (Pharmacology/Toxicology), William R. Roeke (Internal Medicine), Timothy W. Secomb (Physiology), Douglas G. Stuart (Physiology), Charles M. Tipton (Emeritus), Marc E. Tischler (Biochemistry), Stuart K. Williams (Surgery), Mark E. Wise (Animal Sciences), Stephen H. Wright (Physiology)

Associate Professors: Barker B. Antin (Nutritional Sciences), Ann L. Baldwin (Physiology), Janis M. Burt (Physiology), Ralph F. Fregosi (Exercise and Sport Sciences), Robert J. Gillies (Biochemistry), Ronald L. Heimark, Erik J. Henriksen (Physiology), Howard Y. Lien (Internal Medicine), Ronald M. Lynch (Physiology), Raymond B. Runyan (Anatomy), Andrea J. Yool (Physiology)

Assistant Professors: Andrew Fuglevand (Physiology), James Hoving (Biomedical Engineering), Gail F. Kosland (Physiology), Alexander Simon (Physiology), Adele Turzillo (Physiology), Ping Xia (Obstetrics and Gynecology)

Research Professor: James Bloedel (Physiology)

Research Associate Professors: Thomas M. Hamm (Physiology), Richard C. Schaeffer (Physiology)

Research Assistant Professor: Carl Boswell (Surgery)

Lecturer: Lucinda Rankin (Physiology, Molecular and Cellular Biology)

The Graduate Interdisciplinary Program in Physiological Sciences offers the Master's Degree and the Doctor of Philosophy degree major in Physiological Sciences. Research training is an integral part of both programs. The research areas of the faculty in the program can be broken down into six broad categories: Applied Physiology, Cardiovascular Biology, Cell and Molecular Physiology, Endocrinology, Neurobiology, and Renal and Transport Physiology.

Master of Science: Applicants should have completed courses in the basic sciences, such as anatomy, biology, biochemistry, mathematics, physics, and chemistry. Consequently, the strength of a student's application will depend partly on his or her science background.

The Master's degree in Physiological Sciences requires completion of a minimum of one of the following courses in Physiology with a grade of B or better: PSIO 580 (Human Physiology), PSIO 503 (Cell and Molecular Physiology), PSIO 601+ PSIO 602+ PSIO 620 (Systems Physiology; discussion section: Neurobiology). Students will select additional courses in consultation with a faculty advisor, with a goal of developing a study plan that is individually tailored to the student's particular interests.

Each student is expected to complete the program in two years, barring exceptional circumstances. Each M.S. student will select a formal Masters committee consisting of the major advisor and two committee members from the faculty of the Physiological Sciences program by the beginning of the student's second semester in the program. With approval from the student's committee, the student will choose one of 3 options as the final requirement for the M.S.: a Master's Thesis, a "first author" publication ready for submission to a peer-reviewed journal, or an oral examination administered by the student's committee. Satisfactory completion of the requirement will be determined by the student's committee.

Doctor of Philosophy: Applicants for the Ph.D. program in Physiological Sciences should hold a bachelor's degree in one of the physical or biological sciences. A basic knowledge of biology, biochemistry, mathematics, physics, and computer use is required of all candidates for admission, although in some cases deficiencies may be made up during graduate training. The general test of the Graduate Record Examination and three letters of recommendation are required to assist in the evaluation of applicants.

In the first year, students in the program take a core sequence of courses including Cellular and Molecular Physiology (PSIO 503) and Systems Physiology (PSIO 601); Readings in Systems Physiology (PSIO 602); and Introduction to Neurosystems Physiology (PSIO 620). Individual programs of study are determined with the student's mentor and the program committee. Considerable flexibility is possible so that the needs of each student can be best served. A wide variety of courses is available, including courses offered by Animal Sciences, Biochemistry, Ecology and Evolutionary Biology, Nutritional Sciences, Physiology, and Veterinary Science/Microbiology. Details of these courses may be found in listings in this Catalog.

502. Principles of Neuroanatomy (4) II P, 8 units of biological laboratory science; CBA 401: PSYC 302, PSIO 480 desirable. Consent of instructor. (Identical with PSYC 502, which is home).
503. Cellular and Molecular Physiology (3) I

Through the examination of fundamental cellular processes, the integrated function of diverse cell types is discussed. Topics include: mechanisms involved in protein expression, intracellular protein targeting, and regulation of protein function; membrane transport phenomena; cell signaling mechanisms; excitability, ion channels, synaptic function; muscle andocular function. P, CHEM 103b, CHEM 104b, CHEM 241b, CHEM 243b, PHYS 103, MATH 125, MATH 129, BIOG 460.

512. Biological Electron Microscopy (4) I II

P, one college level course in each of physics, chemistry, and biology. (Identical with MCB 512, which is home).

520. * Exercise and Environmental Physiology (3) I II

Regulation and adjustment of physiological systems during acute exercise and adaptations with chronic exercise in various populations and environments; emphasizes physiological mechanisms. Graduate-level requirements include a research-review paper on an approved topic. P, CHEM 103a, CHEM 103b, CHEM 104a, CHEM 104b, PSIO 201, PSIO 202; MATH 110, MATH 111.

521. * Physiological Sciences Laboratory (2) I II Laboratory techniques in systems physiology. Emphasis on data acquisition, analysis and interpretation. P, CHEM 103a, CHEM 103b, CHEM 104a, CHEM 104b, CHEM 241a, CHEM 241b, CHEM 243a, CHEM 243b, PSIO 201, PSIO 202, MATH 124 or MATH 125, PHYS 102, PHYS 103, P, or CR, PSIO 480. Graduate-level requirements include additional laboratory reports.

545. * Assessment and Regulation of Human Body Composition (3) I II Laboratory and field assessment of body fat and lean tissues; morphology of fat, muscle, and bone during growth and aging exercise, and dietary regulation of composition in health and chronic disease; obesity, osteoporosis, sarcopenia. P, PSIO 201 and PSIO 202. Graduate-level requirements include an additional research project and case report.

549. Survival Skills for Students (2) I II

(Identical with SP H 549, which is home).

562. * Neurophysiology: Sensorimotor Perspective (3) I Focuses on the mammalian sensorimotor system as a model system to understand principles of neural communication, sensory functions, information processing, and production of behavioral responses. P, PSIO 201, PSIO 202, MATH 111, PHYS 102, PHYS 103. Graduate-level requirements include a research paper.

566. * Physiology Laboratory (3) I II

(Identical with ECOL 566, which is home).

568. * Comparative Physiology (3) I II

(Identical with ECOL 568, which is home).

573. Statistical Analysis and Research Design in Physiological Sciences (3) I

Design and statistical analysis procedures in the field of physiological sciences, with emphasis on appropriateness of research designs, both experimental and descriptive, and interpretation of statistical analysis procedures. Includes application of statistical power and sample size estimates, reliability, covariance, and multiple regression techniques.

575. Special Topics In Biological Imaging (2) I II (Identical with CBA 575, which is home).

580. Systems Physiology (5) II Principles of systems physiology. Designed for graduate students throughout the university. P, PSIO 503 or equivalent, MATH 113, PHYS 103, CHEM 243b. (Identical with PCOL 580).

582. Topics in Neural Development (2) I P, consult program office before enrolling. (Identical with NRSC 582, which is home).

585. Neural Mechanisms of Behavior (2) I II (Identical with NRSC 585, which is home).

595. * Prerequisites of Cellular and Molecular Neurobiology (4) I P, consult program office before enrolling. (Identical with NRSC 588, which is home).

596. Seminar I.

i. Molecular Cardiovascular Biology (3) [Rpt./ 2] I (Identical with SURG 596, which is home).

599. Independent Study (1-6) I II

601. Systems Physiology (6) II Comprehensive coverage of systemic physiology with emphasis in the underlying principles of function. Consent required to enroll; consult instructor before registering. P, consult department before enrolling.


610. Research Methods in Physiology (1-3) [Rpt./ 10 units] I II Laboratory course providing students with an understanding of the types of research available in the department. (Maximum length is 8 weeks). P, consult department before enrolling.

615. Introduction to Systems Neurophysiology (2) II An interdisciplinary overview of selected aspects of systems neurophysiology specifically designed for graduate students in physiological sciences who do not specialize in neuroscience. The course focuses upon the generalized mammalian nervous system, with occasional reference to lower vertebrate and invertebrate systems. The course focuses upon key features of segmental (spinal, periphery sensory afferent, neurotransactor) and suprasegmental (brain) mechanisms that control and/or modulate sensorimotor, cardiorespiratory, and endocrine systems. Open to non-majors. P, PSIO 503 or PSIO 588 with consent of instructor.

625. Human Neuroscience (6) P, consent of instructor. (Identical with MED 625, which is home).

695. Colloquium I.

a. Motor Control (2) [Rpt./ 3] II (Identical with NEUR 695a, NRSC 695a, SPH 695a, PSYC 695a).

696. Seminar I.

a. Physiology Series (1) [Rpt./ 3] I II P, Open to majors only.

b. Preparation and Presentation (1) [Rpt./ 1] I II P, consult department before enrolling.

c. Physiology Student Forum (1) [Rpt./ 2] I II

697. Workshop I.

a. Physiology-Tutorial (3) [Rpt./ 4] I II P, PSIO 503 or PSIO 580 or equivalent. Consult department before enrolling.

699. Independent Study (1-5) [Rpt./]

800. Research (3-6) I Involvement in a special research project of special interest to the student. P, Instructor consent.

801. Human Physiology (7) [Rpt./] Comprehensive approach to understanding the system of human physiology.
Planetary Sciences (PTYS)
Kuiper Space Sciences Building, Room 325
Phone: (520) 621-6963
FAX: (520) 621-4933
WWW: http://www.LPL.Arizona.edu

Application Questions:
Joan M. Weinberg, (520) 621-2828,
Acad_info@LPL.arizona.edu

Degrees Offered: M.S., Ph.D.

Concentrations: observational, experimental, and theoretical studies of planetary atmospheres, surfaces, interiors, the sun and interplanetary medium


Associate Professors: Carolyn Porco, Timothy D. Swindle
Participating Scientists from the Lunar and Planetary Laboratory:
Senior Research Scientists: Lyle A. Broadfoot, Alex Dessler, Jay B. Holberg, Lon L. Hood, Larry A. Lebofsky, Bill R. Sandel

Associate Research Scientists: Alfred McEwen, Robert McMillan, Peter Smith
Assistant Research Scientist: Stephen Bougher

The department offers multidisciplinary programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in planetary sciences. Areas of specialization include, but are not restricted to, the experimental, observational, and theoretical study of planetary atmospheres; the interiors of planets and planetary satellites; asteroid and cometary astronomy and physics; meteoritics; problems of plasma physics associated with cosmic rays; the solar wind and its interaction with solar system bodies; celestial dynamics; and investigations of the formation of the solar system and other planetary systems.

Applicants should have completed an undergraduate major in a physical science such as astronomy, atmospheric sciences, chemistry, geology, mathematics, or physics. However, admission is based on the overall demonstrated capability and preparation of the applicant. For full consideration, applicants must submit applications, including scores on the aptitude and advanced (chemistry, geology, or physics) tests of the Graduate Record Examination, as well as the names of at least three references. Personal or telephone interviews are desirable in aiding the deliberations of the admissions committee.

Master of Science: A minimum of 30 hours of graduate credit is required for the Master's degree, including a minimum of 15 credit hours selected from the Planetary Sciences core curriculum. Selected courses are to include at least one course in each of the core areas - physics, chemistry, and geosciences. The remaining 15 hours are to be selected by agreement between the student and his or her advisor. The student must maintain a B average in all core courses.

A committee of three faculty members (the thesis advisor, and two others) is responsible, in lieu of the entire faculty, for advising the student of the degree requirements and reviewing the student's progress. This committee should be activated as soon as it is known that the student has the M.S. as a degree objective. The Graduate Student Affairs Committee, in consultation with the student and the thesis advisor, will nominate members for the committee, to be approved by the Department Head and the Dean of the Graduate College. In the event that a student has not chosen a thesis advisor at the time the committee is selected, a temporary member will be chosen. The temporary committee member will be replaced by the student's thesis advisor if the advisor is not already a member of the committee. It is the duty of the M.S. Committee to read and evaluate the M.S. thesis and to administer the Final Examination.

The Master's candidate is required to write a thesis suitable for publication. Final approval of the thesis rests with the M.S. Committee. It is expected that the thesis will be submitted to the members of the M.S. Committee at least two weeks prior to the date when the committee members' signatures are required.

A copy of the thesis to be deposited in the University Library has to be approved by the Graduate College and all regulations concerning typing, binding, etc. (as described in the "Manual for Theses and Dissertations"). The M.S. degree conferred will then be "with thesis." Registration for units of 910 (Thesis) is required and serves as an application for thesis. The standard number of thesis units is two to four.

Two copies of the thesis must be deposited with the LPL/PTYS library, where they will be cataloged and shelved. The defense of the thesis and general questions constitutes the Final Examination. The student should note that he or she must adhere to the deadline for the completion of the Final Examination. The relevant dates are listed in the current Graduate Catalog. There is no language requirement for the M.S. degree.

Doctor of Philosophy: All students must complete the 21-unit core program consisting of PTYS 505a-505b, 507, 510, 512, 517, and 554 (though exceptionally well prepared students may have parts of this requirement waived). An additional minimum of 15 units must be completed in a specialized area of planetary sciences. A specified reading competence in a
modern foreign language is required. Students are expected to complete all requirements for the degree within three or four years following successful completion of the comprehensive examination, which should be taken within three years after enrolling in the program.

Minor areas of study: The department requires its students to take a minor consisting of at least 12 units in a scientific area relevant to planetary science. The purpose of the minor is to deepen a student's knowledge of a subject that will support his or her research in planetary sciences. There are two ways of fulfilling this requirement:

Minor outside the Planetary Sciences department: The student may elect to minor in another department or approved program of the University. The choice of the department and the courses within that department must be made in consultation with the student's advisor, the minor department, and the Graduate Admissions and Advising Committee. The student is responsible for determining and fulfilling the current requirements of the minor department.

Minor in Planetary Sciences: The student may elect to minor in planetary sciences with a program of courses approved by the planetary sciences department. The minor will consist of at least 12 units of 500-level courses in which a grade-point average of 3.0 or higher is achieved. The courses must be approved by a minor committee established by the student in consultation with the department's Graduate Admissions and Advising Committee, which will also designate a chair. The written comprehensive examination will consist of the final examinations or their equivalent in the individual courses.

The Department of Planetary Sciences' degree programs are conducted in collaboration with the research programs of the Lunar and Planetary Laboratory (LPL). Together, the department and laboratory form an institute uncommonly broad and complete in its approach to planetary science education and research. The department and laboratory participate in many NASA space science missions. Among the missions in which the faculty have participated are the Voyager Mission, the Galileo Mission to Jupiter, the Cassini/Huygens Mission to Saturn, the Mars Pathfinder, Near Earth Asteroid Rendezvous, Discovery Missions, NASA Space Shuttle Missions, and the Ulysses Heliospheric Probe. In addition, LPL scientists make use of Earth orbiting observatories, including the Hubble Space Telescope, the Infrared Space Observatory, and the Ultraviolet Explorer. The laboratory's Space Imagery Center contains one of the most extensive collections of planetary images in the world, beginning with those obtained from the earliest space projects and continuing to most current missions. LPL's Planetary Imaging Research Laboratory is a modern image processing facility for the analysis of planetary and astronomical data. Also available for student research are cosmochemistry and geochemistry laboratories, including a scanning electron microscope and microprobe facility, an experimental petrology laboratory, a radiochemistry separation and neutron activation laboratory, and a noble gas mass spectrometry laboratory. The numerous telescopes of The University of Arizona Observatories are available for research projects, including instruments on Kitt Peak and in the Santa Catalina Mountains, as well as the Multiple Mirror Telescope on Mt. Hopkins all within easy reach of the University campus. Laboratory staff and students also make use of major observatories around the world, including the NASA Infrared Telescope Facility on Mauna Kea, Hawaii. The University is continuing to develop a new observatory site on Mt. Graham, northeast of Tucson. The department participates in interdepartmental programs in theoretical astrophysics and in applied mathematics.

The University's computer center, including a Convex supercomputer, is available to support educational and research activities. The Lunar and Planetary Laboratory maintains a variety of networked computers and workstations in support of the research and educational programs.

503. * Physics of the Solar System (3) II Survey of planetary physics, planetary motions, planetary interiors, geophysics, planetary atmospheres, asteroids, comets, origin of the solar system. P, PHYS 142 or PHYS 251. Graduate-level requirements include an in-depth research paper on a selected topic and an oral class presentation. (Identical with GEOS 503. ASTR 503).

505a-505b. Principles of Planetary Physics (3-3) I II Introductory physics of planetary and interplanetary fluids, plasmas, and solid bodies. Thermodynamics, kinetic theory, fluid dynamics, transport theory, rotational and tidal response theory and orbital mechanics, applied to solar system objects. P, classical and quantum mechanics at the level of PHYS 151 and PHYS 242.

507. * Chemistry of the Solar System (3) I Abundance, origin, distribution, and chemical behavior of the chemical elements in the Solar System. Emphasis on applications of chemical equilibrium, photochemistry, and mineral phase equilibrium theory. P, PHYS 132, CHEM 104b, MATH 125b or their equivalents. Graduate-level requirements include an original research paper or critical review.


511. * Geology of the Solar System (4) [Rpt./ 8 units] I II Geologic processes and landforms on satellites and the terrestrial planets, their modification under various planetary environments, and methods of analysis. 3R, 3L. P, GEOS 101 or equivalent, and MATH 125b or equivalent. Graduate-level requirements include an advanced research paper covering some topic in planetary geology, with an extensive literature search and evaluation.

512. Planetary Global Tectonics (3) I II Application of the physics of solid-state deformation to global tectonics of the terrestrial planets and icy moons of the solar system. Modes of topographic support, isostasy and implications for gravity/ topography ratios on one-plate planets.
Theory of floating elastic plates as an approximation to the lithosphere. Use of seismic data to determine the interior structure and composition and modes of heat conduction in planets.

517. Atmospheres and Remote Sensing (3) I II Structure, composition, and evolution of atmospheres; atomic and molecular spectroscopy; radiative transfer and spectral line formatting.

518. * Modern Astronomical Instrumentation and Techniques (3) I (Identical with ASTR 518, which is home).

519. * Physics of the Earth (3) II (Identical with GEOS 519, which is home).

520. Meteorites (3) II Classification; chemical, mineralogical and isotopic composition; cosmic abundances; ages; interaction with solar and cosmic radiation; relation to comets and asteroids. P, PTYS 510. (Identical with GEOS 520).

530. * The Chemical Evolution of Earth (3) I (Identical with GEOS 530, which is home).

541a-541b. * Dynamic Meteorology (3-3) I-II (Identical with ATMO 541a-541b, which is home).

544. Physics of High Atmospheres (3) II Physical properties of upper atmospheres, including gaseous composition, temperature and density, ozonosphere, and ionospheres, with emphasis on chemical transformations and eddy transport. (Identical with ATMO 544).

545. Stellar Atmosphere (3) I (Identical with ASTR 545, which is home).

549. * Image Processing for Scientific Discovery (3) II Image processing as a tool for exploration, discovery and analysis in a wide range of subjects. Suitable for both science and non-science majors, as well as pre-service and in-service mathematics and technology teachers. Graduate-level students are required to present advanced-level documentation.


554. Evolution of Planetary Surfaces (3) II The geologic processes and evolution of terrestrial planet and satellite surfaces including the Galilean, Saturnian and Uranian satellites. Course includes one or two field trips to Meteor Crater or other locales. (Identical with GEOS 554).

555. Remote Sensing of Planetary Surfaces (3) II Exploration of planetary surfaces, including that of the Earth, with remote sensing. Emphasis on compositional determination using visible and infrared methods. Basic principles, image and spectroscopic analysis techniques, and case studies in planetary remote sensing. (Identical with ASTR 555, GEOS 555).


565. The Outer Solar System (3) I Fundamental aspects of outer system studies presented at the beginning graduate level: solar system formation and solar nebula chemistry; outer planet atmospheres; outer planet interiors, satellite surface processes; ring phenomenology and physics; and Triton, Pluto/Charon, and Kuiper belt.

567. Inverse Problems in Geophysics (3) I II P, experience with linear algebra and computer programming recommended. (Identical with GEOS 567, which is home).

571. Terrestrial Planets (3) I Geophysical and geochemical techniques used to deduce composition and evolution of terrestrial planets. Topics include the Earth, Moon, Mars, Venus, and meteorites. P, PTYS 510, PTYS 554. (Identical with GEOS 571).

582. High Energy Astrophysics (3) II (Identical with ASTR 582, which is home).

583. Physical Geochemistry (3) I II P, MATH 125; MATH 129 or MATH 124. (Identical with GEOS 583, which is home).

587. Nuclear Astrophysics (3) I (Identical with ASTR 587, which is home).

589. Topics in Theoretical Astrophysics (3) [Rpt./] I (Identical with PHYS 589, which is home).

591. Preceptorship (1-5) [Rpt./]

594. Internship.
   a. Planetary Geology Field Studies (1) [Rpt./] I II

596. Seminar
   a. The Origin of Life in the Solar System (3) I II

599. Independent Study (1-5) [Rpt./]

691. Preceptorship (1-5) [Rpt./]

699. Independent Study (1-5) [Rpt./]

791. Preceptorship (1-5)

900. Research (1-8) [Rpt./]

909. Master's Report (3-6) [Rpt./]

910. Thesis (2-4) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Planning (PLN)
School of Planning
Architecture Building, Room 214
PO Box 210075
Phone: (520) 621-9597, (520) 621-3661
FAX: (520) 621-9820
www:http://architecture.arizona.edu

Application Questions:
Linda Erasmus, erasmus@u.arizona.edu,
(520) 621-9597

Advising Questions:
Barbara Becker, bbecker@u.arizona.edu,
(520) 621-3661

Degrees Offered: M.S.

Professors: Lawrence D. Mann, Sandra Rosenbloom, Fred Matter (Architecture), Gary Pivo, Art Silvers (Management and Policy)

Associate Professors: Barbara Becker, Head, Michael D. Bradley (Hydrology and Water Resources), Adrian Esparza (Geography and Regional Development), Stuart E. Marsh (Arid Lands Resource Sciences), Gary Peterson, Corky Poster (Architecture), Brigitte Waldorf (Geography/Regional Development), Robert Wortman (Language, Reading & Culture)

Assistant Professor: Stephen R. Yool (Geography)

Adjunct Lecturers: Frank Cassidy (Law), Grace Evens, Michael Grassinger, Maria Lemos (Latin American Studies), Gary Peterson

Research Planner: Martin Yoklic

The School of Planning directs a graduate professional program leading to the Master of Science degree with a major in planning.

The major consists of 52 units: 27 units of core course work, 21 units in a chosen area of concentration and a 4-unit internship. Core courses include 500, 501, 514, 544, 584, 605, 611, 660, 684, 696b and 693 (Internship). Areas of concentration include: sustainable community design, environmental resource planning, land use and community development, and international/borderlands planning.

The program requires completion of a projects course (PLN 611). A comprehensive written examination, Master's Report, or Master's Thesis must be completed as part of the 52 units of course work. Internship experience is required as well as an introduction to Geographic Information Systems (GIS). The program is specifically designed to expose students to the interdisciplinary nature of most planning problems. The course work provides a mixture of theoretical and practical perspectives on diverse planning issues.

Interested persons should contact the School of Planning for further information.
500. Ecosystemology for Urban Planning (3) I (Identical with HWR 500, which is home).

501a. * Introduction to Planning (3) I First of a two-course sequence introducing students to the planning profession, graduate planning program, and fundamentals of transportation planning, international planning, urban design, and housing and community development. Graduate-level requirements include one additional project and to lead in-class exercises. (Identical with GEOG 501a).

501b. * Introduction to Planning (3) II The second of a two-course sequence, this course is designed for first year graduate students. The primary objective of the course is to introduce students to the planning profession. Some of the topics covered include: history of planning, land use planning, growth management, and the ethics of planning. Graduate-level requirements include writing an additional paper. (Identical with GEOG 501b).

504. Public and Policy Economics (3) II (Identical with PA 504, which is home).

510. Planning in the Americas: Past, Present and Future (3) I A perspective on planning that is especially appropriate for students from, or who expect to practice in, other countries in the Americas. Pre-western (Native American) planning of human settlements and their relation to contemporary and future planning. P: open to majors only. (Identical with GEOG 510).

514. Analytic Methods in Local Planning and Management (3) II P: MKTG 552; GEOG 557 or consent of instructor. (Identical with PA 514, which is home).

516. * Geographic Information Systems for Geography and Regional Development (3) II (Identical with GEOG 516, which is home).

523. Health and Public Policy (3) II (Identical with PA 523, which is home).

535. Zoning, Ethics and Equity (3) I II Extensive look at zoning and regulation of uses of land and buildings, and these relationships to public health, safety, morals, and welfare. Field Trips.

544. * Site Planning (3) I Studies relating to design determinants for development of outdoor space. Lectures and exercises dealing with individual design criticism, including topography, hydrology, climate, and vegetation. Final project summarizing and applying all criteria to a realistic development project is required. Graduate-level requirements include an in-depth research paper focusing on one particular aspect of developing new techniques in the field. (Identical with ARCH 544).

550. Metropolitan and Regional Planning (3) I Survey and evaluation of concepts and examples, including metropolitan, economic development, state and national, and environmental plans in the U.S. and abroad. (Identical with GEOG 550).

553. * Locational Analysis (3) I (Identical with GEOG 553, which is home).

555. Introduction to Transportation (3) II Graduate survey and policy analysis course, focusing on the policy environment surrounding several major transportation issues. Field Trips.

557. * Statistical Techniques in Geography, Regional Development and Planning (3) I (Identical with GEOG 557, which is home).

559. * Land Use and Growth Controls (3) II Lecture/seminar class designed for graduate students in Planning. Looks at basic and advanced land use, the tools utilized for land use planning, and the methodology of land use planning. Current planning and legal issues dealing with regulation of growth, the sequence of growth, and the limiting of growth are analyzed. Issues of equity in controlling land use are also explored. Graduate-level requirements include the completion of a series of research projects. (Identical with GEOG 559).

561. Resource Management (3) I (Identical with GEOG 561, which is home).

563. Perception of Environment (3) I II (Identical with GEOG 563, which is home).

567. Geographical Analysis of Population (3) II (Identical with GEOG 567, which is home).

568. * Urban Transportation Planning (3) II CDT (Identical with C E 568, which is home).

571. * Problems in Regional Development (3) I II (Identical with GEOG 571, which is home).

573. * Geology and the Urban Environment (3) II (Identical with GEOG 573, which is home).

576. * The Land Development Process (3) [Rpt./ 1] A case-oriented approach to site selection, rezoning, financing, architectural design, economic feasibility, and other facets of the land development process. Field Trips. P, consult department before repeating this course. Graduate-level requirements include the completion of a series of research projects. (Identical with GEOG 576).

583. * Geographic Applications of Remote Sensing (3) II (Identical with GEOG 583, which is home).

584. * Planning the Built Environment (3) I (Identical with ARCH 584, which is home).

594. Seminar u. Interdisciplinary Environment-Behavior-Design (3) [Rpt./ 6 units] II P, consult college before enrolling. (Identical with PSYC 596u, which is home).

597. Workshop a. Issues in Architecture (3-8) [Rpt./ 16 units] I II P, open to majors only. (Identical with ARCH 597a, which is home).

b. Basic Computer Skills (1) II This one unit course is one of a series of modules designed to help students learn basic planning techniques necessary for success in academic and professional careers.

d. Graphic Skills (1) I This course is an introductory examination of graphic tools, techniques and technologies used by planners and other design professionals. Professional urban and regional planners prepare and use graphics to communicate with their peers, other professionals and the public. This course builds a basic understanding and elemental proficiency in graphics addressing issues from day to day communications with other professionals, to effective communication with larger groups and constituencies.

e. Public Presentation (1) II This module provides students with presentation techniques and help them identify areas of difficulty in their own presentation style.

f. Communicating with Numbers (1) I This module helps students think carefully about numbers and numerical analyses and to effectively use quantitative assessments in professional planning reports, presentations and public hearings; become experienced in the essentials of the leading computer software; and improve proficiency in developing graphics from spreadsheets and other computer programs.

i. * Interdisciplinary Studio for Community Design (3-6) I (Identical with ARCH 597i, which is home).

o. Writing for Planners (1) I A critical examination of the problems in written communications by professional planners. Emphasis is on developing enduring personal remedial strategies.

p. Desktop Publishing (1) II This module provides students with the ability to utilize desktop publishing software to enhance planning reports and documents.

q. Conflict Resolution (1) II This module trains students in the basics of negotiation and mediation as they relate to the planning field. Contemporary areas of potential conflict will be explored in the context of the role of planning in mediation and negotiation.

r. Grant Writing (1) II This module provides students with grant writing skills.

t. Housing and Households (3) II First of two-course sequence focusing on U.S. housing and community development. Topics covered include housing market projections, housing submarket analysis, housing finance and mortgage lending, household analysis, residential choice and residential mobility. Appropriate for students specializing in urban planning, architecture, urban geography and urban sociology. P, graduate status. (Identical with GEOG 597t).

599. Independent Study (1-6) [Rpt.]

605. Planning Theories and Perspectives (3) I A critical examination of normative and methodological assumptions of alternative
planning models, with emphasis on developing a perspective on contemporary issues. (Identical with GEOG 605).

610. Comprehensive and Strategic Planning (3) II Seminar in the theory and practice of strategic and comprehensive planning in urban and regional development. The tradition of strategic planning in corporations, public sector agencies, and not-for-profit organizations, the tradition of major comprehensive plans, the contemporary theories of both and the theory of strategic comprehensive planning.

611. Projects in Regional Planning (4) [Rpt./4] II Lectures, laboratory, and field projects covering various aspects of professional practice. P, PLN 605, 24 units toward a graduate degree in planning. (Identical with GEOG 611).

657. Spatial Analysis (3) II P, GEOG 557. (Identical with GEOG 657, which is home).

660. Land-Use Planning (3) II Review of the principal legal devices available to implement planning decisions on community design (official map, subdivision control), the use of land (nuisance, covenants and zoning) and housing needs (including urban renewal). Special attention is paid to the significance and legal effects of a comprehensive plan, and to the social and economic effects of planning decisions. (Identical with LAWS 660).

665. Quick Response Transportation Planning Methods (3) I (Identical with C E 665, which is home).

668. Urban Public Transportation Systems (3) I (Identical with C E 668, which is home).

684. History of Planning (1) I The history of planning in the United States with emphasis on the twentieth century and the direction of planning into the next century. Planning and other countries and cultures are also discussed where relevant. P, PLN 584.

693. Internship (3) [Rpt./6 units]

696. Seminar
b. Financing Public Services (3) I (Identical with ARCH 696b).
d. Border Issues in Planning (3) II Field Trips.
e. Issues Along Borders (3) II Seminar designed to examine issues, particularly environmental and social, in the context of public policy making in the United States, Mexico, and Latin American countries. The course focuses on issues involving borders, particularly the U.S.-Mexico border, and draws on literature about public policymaking in both the U.S. and Latin America. Specific cases are analyzed. P, graduate status. (Identical with LA S 696e).

u. Urban Social Issues (3) II Course focuses on the social dimension of North American cities, especially at community and neighborhood scales. Topics covered include poverty and deprivation, residential segregation, environmental justice and the role that urban planners play in shaping access to public space through land use controls and urban design. (Identical with GEOG 696u).

699. Independent Study (2-5) [Rpt./]

900. Research (1-3) [Rpt./]

909. Master’s Report (1-3) [Rpt./]

910. Thesis (1-3) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Plant Pathology (PL P)
Forbes Building, Room 204 Phone: (520) 621-1828 FAX: (520) 621-9290 WWW: http://ag.arizona.edu/PLP/plp/home.html

Application Questions: Dan Baerg, dbaerg@ag.arizona.edu Advising Questions: Hans Van Etten, vanetten@ag.arizona.edu Degrees Offered: M.S., Ph.D.

Professors: Merritt R. Nelson, Head, Stanley M. Alcorn (Emeritus), Robert L. Gilbertson (Emeritus), Martha C. Hawes, Richard B. Hine (Emeritus), Christina Kennedy, Michael A. McClure, Edward L. Nigh, Jr. (Emeritus), Michael E. Stanghellini (Emeritus), Hans D. Van Etten

Associate Professors: Iraj J. Misaghi, Marc Orchbach, Leland S. Pierson, III, Zhongguo Xiong

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in plant pathology. Subject area specialties within the department include mycology, nematology, virology, microbiology, and epidemiology. Research programs within these specialties emphasize basic and applied research in the areas of plant-microbe interactions, and include pathogenic, symbiotic, and beneficial interactions. These research programs include studies at the molecular, cellular, organismal, and ecosystem level, and a number of programs emphasize rhizosphere interactions.

Applicants to the department should have a bachelor’s degree and a solid background in biology, biochemistry, botany, molecular biology, or microbiology and must submit scores on the tests of the Graduate Record Examination to the department. Additional information and requirements for the graduate program can be obtained directly by contacting the department. At least 22 units in course work must be completed for the master’s degree. A decision to require or waive the requirement for a master’s thesis will be made after consideration of the student’s preparation, proposed graduate program, and professional objectives.

For information concerning the Doctor of Philosophy degree refer to Chapter VI: Requirements for Doctoral Degrees, in this Catalog.

502. * Agriculture and the Environment: Focus on Pesticides (3) II (Identical with AGTM 502, which is home).

512. Biological Electron Microscopy (4) I II P, one college level course in each of physics, chemistry, and biology. (Identical with MCB 512, which is home).

516. Plant Nematology (2) II The nature, ecology, classification, and control of nematode diseases in plants. P, PL P 521 or consent of instructor.

528. * Microbial Genetics (3) II Prokaryotic gene structure and function; methods of gene transfer and mapping, DNA structure, replication, transcription, and translation. Hands-on computer analysis of DNA sequences and gene cloning strategies. Principles of regulation of gene expression. Biology of plasmids and bacteriophages. P, SWES 325 or ECOL 320 or PL S 312. Graduate-level requirements include: analyzing three additional current research papers; analyzing unknown DNA sequence of an entire operon; extensive term paper. (Identical with GENE 528).

550. Principles of Plant Microbiology (4) I This course is for graduate students with a special interest in the interactions of plants with associated microflora. The primary focus is plant pathogens, but the course also includes concepts underlying the development of symbiotic and commensal relationships with plants. The course also emphasizes the mechanisms of how plants and microorganisms communicate to establish relationships from the molecular level through to the population level. The subjects considered include the physiology, biochemistry, genetics and molecular biology of plant pathogenesis and symbiosis, population dynamics, principles of plant epidemiology, and theories and practices in plant disease control and the use of microbes for plant health. Classical and contemporary research results are used to illustrate the major concepts and experimental approaches. Emerging theories are discussed with data from current literature. P, 305 or consent of instructor.

551. * Biology and Characterization of Plant Pathogenic Agents (4) II Examines the biological properties of the various groups of plant pathogens and the contemporary methods used to characterize these agents and the diseases they cause. P, PL P 530, one laboratory course or consent of instructor. Graduate-level requirements include additional assignments.
575. Advanced Mycology (3) I II Biology of fungi, including morphology, physiology, classification, genetics, ecological significance, and economic importance; emphasis on plant pathogens and environmentally essential fungi. P, PL P 427R or consent of instructor.

593. Internship (1-6) [Rpt.] I II

595. Seminar
   a. Contemporary TPCS Plant Path (1-3) [Rpt./ 12 units] I II
   b. Research Discussions (1-3) [Rpt./ 9 units] I II

599. Independent Study (1-5) [Rpt./]


621. Molecular Plant-Microbe Interactions (3) I Molecular properties that control development of host, parasite, and symbiotic relationships. Contemporary molecular hypotheses are related to genetic and biochemical data available on disease resistance and pathogenesis. P, BIOC 460. (Identical with MCB 621, BIOC 621).

693. Internship (1-6) [Rpt./] I II

694. Practicum
   a. Clinical Plant Pathology (1-3) [Rpt./ 9 units] I II
   b. Swiss Tech Plant Pathology (1-3) [Rpt./ 9 units] I II

695. Colloquium
   a. Plant Biology (1) [Rpt./ 4 units] I (Identical with MCB 695a, PL S 695a).
   b. Plant Pathology (1) II (Identical with MCB 695b, PL S 695b).

699. Independent Study (1-5) I II

900. Research (2-8) [Rpt./]

909. Master's Report (1-8) [Rpt./] I II

910. Thesis (2-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

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**Plant Sciences (PLS)**

Forbes Building, Room 303

Phone: (520) 621-1219

FAX: (520) 621-7186

WWW: http://ag.arizona.edu/PLS/gradprog.html

Application Questions:

Shirley Weber, (520) 621-1219, sweber@ag.arizona.edu

Advising Questions:

Gary A. Thompson, (520) 621-9735, garyt@u.arizona.edu

Degress Offered: M.S., Ph.D.

Concentrations: Plant biology, agronomy, and horticulture.


Assistant Professor: Kenneth Marcum

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in plant sciences. Specific areas of research emphasis include basic and applied aspects of plant science with emphasis upon plant growth and development, physiology, cell and molecular biology, crop production, genetics, and plant breeding. The department encourages students to integrate the more classical aspects of these areas with recent innovations in order to develop both breadth and depth in the field of plant sciences during their graduate studies. The ready availability of modern laboratories, field space, and greenhouses within the department insures that students have access to the very best facilities.

During their tenure, all graduate students will take a core of advanced courses including plant physiology, genetics, and development, and are expected to participate in departmental teaching and seminar programs. The needs and goals of individual students will determine subsequent course work from the various departments on campus. For their own research programs, students should select an area of specific interest to the faculty which will eventually lead to the preparation of a thesis or dissertation.

Applicants are expected to have completed a bachelor's degree and possess a good background in biology, chemistry, and mathematics. Under exceptional circumstances, candidates with specific deficiencies will be accepted into the program and required to remedy deficiencies early in their graduate studies. Applicants must submit scores from the Graduate Record Examination (GRE) for both the General Test and one advanced test in an appropriately related area. They should also arrange to have three letters of recommendation from individuals in a position to assess their potential as a graduate student sent to the department. Requests for information on additional requirements or further questions concerning the application process should be addressed to the Graduate Student Coordinator, Department of Plant Sciences. Individuals wishing to start in the fall semester are strongly encouraged to apply prior to January 1, particularly if they desire financial assistance.


515. Principles of Plant Breeding (3) I Application of the principles of genetics, botany and statistics to the improvement of plants. P, PL S 312 or ECOL 320. Graduate-level requirements include participation in computer-aided exercises in simulated recurrent selection.

539. Plant Cell Biology (3) I In-depth analysis of the empirical evidence, experimental methods, and theoretical background that underlies our understanding of modern plant cell biology. P, MCB 410 or equivalent. Graduate-level requirements include a substantive term paper. (Identical with MCB 539).

541. Economic Botany of Arid Lands (3) I II Examines past, present, and potential future industries based on plant resources in arid lands. Survey of useful products from arid lands, their biosynthesis and physiological function, taxonomic and geographic sources, and their role in local and global economies. P, PL S 360. (Identical with ARL 541).

550. Developmental Plant Anatomy (4) I II Structure, function, and development of vascular plants. 3R, 3L. P, PL S 100 or PL S 130 or MCB 181. Graduate-level requirements include preparation of an in-depth research project.

563. Plant-Water Relations (3) II Analytic approach to the study of water movement into and through plants; development of internal water deficits and their significance to physiological processes. P, PL S 360 or ECOL 260. Graduate-level requirements include preparation of an in-depth research project. (Identical with WS M 563).
565. Vegetable Physiology (3) II Examination of the growth, development and maturation of vegetable crops with special emphasis on postharvest processes. Designed for upper level undergraduates and graduate students with some prior knowledge of plant biochemistry and physiology. P, PL S 560; PL S 360 or BIOC 460. Graduate-level requirements include an additional term paper.

572. Systematic Botany (4) II (Identical with ECOL 572, which is home).

575. Physiology of Crop Production (3) I Plant processes, modifications, and environmental interactions in relation to growth of crop plants, with emphasis on recent advances and research techniques. P, PL S 360. Graduate-level requirements include preparation of in-depth research project.

580. Medicinal Plants (3) I Historical and cultural aspects of plants and medicine, therapeutic uses of plants, psychoactive and food plants, contribution of medicinal plants to modern medicine, future of medicinal plants. P, CHEM 101a-101b. Graduate-level requirements include review of at least two leading papers in the field. (Identical with ARL 580).

593. Internship (1-6) [Rpt./] I II

595. Colloquium
b. Current Topics in Plant Science - Advanced (1-3) [Rpt./ 15 units] I II P. graduate standing or instructor consent.
d. Plant-Insect Interactions (1) [Rpt./] I II (Identical with ENTO 596d).

599. Independent Study (1-5) [Rpt./]

620. Plant Biochemistry (3) I Current topics in bioengineering; photosynthesis; carbohydrate; nitrogen and lipid metabolism. This course deals with biochemical processes specific to plants and allows students to gain an understanding and appreciation of how chemical components are synthesized and utilized by the plant during growth and development. P, BIOC 462a, BIOC 462b, PL S 560.

627. Advanced Genetics (3) II Fundamental concepts of genetic analyses with an emphasis on application to current topics in plant genetics. Theoretical background and experimental approaches will be emphasized. Topics will include, but are not limited to, chromosome structure and function, gene regulation, transposable elements and genomics. P, PL S 312 or ECOL 320. (Identical with GENE 627).

660. Current Advances in Plant Physiology (4) I Investigation of the physiological, biochemical and molecular mechanisms that allow a plant to perceive and respond to environmental and chemical signals during normal growth and development and when it is experiencing a stress. P, PL S 360, CHEM 462a, CHEM 462b. (Identical with ECOL 560, MCB 560).


693. Internship (1-6) I II

695. Colloquium
a. Plant Biology (1) [Rpt./ 4 units] I (Identical with PL P 695a, which is home).
b. Plant Pathology (1) II (Identical with PL P 695b, which is home).

696. Seminar
a. Plant Sciences (1) [Rpt./ 4] I II

699. Independent Study (1-5) [Rpt./]

900. Research (1-8) [Rpt./]

909. Master's Report (1-8) I II

910. Thesis (1-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

Political Science (POL)

Social Sciences Building, Room 315
Phone: (520) 621-7600
FAX: (520) 621-5051
WWW: http://w3.arizona.edu/polisci/index.html

Application Questions:
Vickie Healey, (520) 621-7601, gradps@arizona.edu

Advising Questions:
Barbara Norrander, (520) 621-7600, gradps@arizona.edu

Degrees Offered: M.A., Ph.D.


Associate Professors: Phillip C. Chapman (Emeritus), Brian Crisp, John E. Crow (Emeritus), David Gibbs, Donald R. Hall (Emeritus), Paulette Kurzer, Deborah R. Mathieu, Cary J. Nederman, Daniel J. O'Neill (Emeritus), V. Spike Peterson, John P. Willerton

Assistant Professors: Suzanne Dovi, Gary Goertz, Bradford S. Jones, Laura Langer, David E. Spiro

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in political science. Concentrations are available in political theory, American politics, public policy, international relations, and comparative politics. The Master of Arts degree is designed as a basis for students who plan to continue into a Ph.D. program. In addition, the department also designs programs for students interested in government careers, community college teaching, or specialization in selected areas such as policy and environment or for self-improvement. Programs are planned, in consultation with an advisory committee, around the student's principal area of interest, emphasizing one or more of the areas of concentration listed above.

Applicants must submit scores on the Graduate Record Examination, three letters of recommendation, and the personal data called for on the department's information form. Applicants also are invited to submit any other evidence, including published materials, which they believe to be relevant to admission.

Master of Arts: Each student must specialize in one of the five fields of concentration listed above and complete at least 30 units of course work at the 500 and 600 levels. A supervised research paper is required and, depending upon the student's principal interest, reading knowledge of a foreign language may be required. The final master's examination will be based on the research paper.

Doctor of Philosophy: In addition to an area of concentration, each student must prepare in one or two additional fields prior to the comprehensive examination. Either one foreign language at high proficiency or advanced training in methodology are required. Finally, each student must complete one supervised original research paper prior to taking the comprehensive examination. The department may waive the requirement for a qualifying examination for a student who has received the master's degree at The University of Arizona.

506. Bureaucracy, Politics, and Policy (3) I Description and analysis of the executive branch of government: how federal agencies capture policy-making; why bureaucracy develops; the rules of bureaucratic culture; who controls the administrative branch. P, POL 102. Graduate-level requirements include an additional research paper. (Identical with PA 506).

507. Congress and American Politics (3) I II Examination of election politics, personalities, and career patterns of congressional members, the organization and structure of Congress, and the role of Congress in policy leadership and representation of the public. P, POL 102. Graduate-level requirements
include a much higher level of performance on term paper or research paper, and/or an additional paper of 8-10 pages.

510. * Struggle for the Presidency (3) I (Identical with COMM 510, which is home).

512. * Local Government and Administration (3) I II Examination and analysis of local decision-making structures and their policy outputs. P, POL 102, POL 230. Graduate-level requirements include a reading assignment of at least two additional textbooks and writing an essay on each.

525. * Liberalism and Its Critics (3) I II Recent theories of liberalism, the major criticisms of liberal ideas, such as communitarianism and feminism. Graduate-level requirements include additional essays in greater depth.

527. * The Marxist Legacy (3) I II FA critical survey of the main currents of Marxism from Marx to the present. Graduate-level requirements include a research term paper of 15-25 pages with a bibliography, as well as a beginning research bibliography.

528. * Problems in Contemporary Political Theory (3) II Intensive examination of selected problems and concepts in political theory. P, POL 160 or PHIL 110. Graduate-level requirements include an additional research paper and readings.

529. * The U.S.-Mexican Borderlands in Comparative Perspective (3) II Describes and analyzes the Mexican-United States Borderlands emphasizing several elements of the Borderlands culture, society, economy, and policy, as well as the evolution of borderlands in comparative perspective. P, POL 102. Graduate-level students are required to do an additional research paper and reading. (Identical with LA S 529, MAS 529).

531. * Political Culture and the Dynamics of Change in American Society (3) I Examination of the manner in which attitudes about politics and political problems are acquired from exposure to music and television, and the manner in which such attitudes lead to political action. Graduate-level requirements include additional research and paper.

532. * Pressure Groups (3) I II Formation, structure, and place of pressure groups in the democratic society; the function of interest groups in the political process; problems of leadership, internal organization, and membership loyalties. P, POL 102. Graduate-level requirements include a much higher level of performance on term paper or research paper. Additional readings and essays on those readings may also be required.

533. * Feminist Political Theory (3) I Examines the tradition of Western political theory through a gender-sensitive lens and surveys the development of feminist political theory. P, POL 160, W S 100. Graduate-level requirements include an additional research paper and readings. (Identical with W S 533).

535. * Public Opinion and Voting Behavior (3) I II Attitude and opinion formation and socialization; public opinion in the political process; the relationship between attitudes, opinion, and voting behavior in American politics. Graduate-level requirements include additional research, readings, and paper(s).

536. * Violent Crime and Political Order (3) II Description and analysis of how and why people wield, and respond to, authority. Based on presumption that people's reactions to the public order are influenced by the private order-or disorder-of their minds and the way they learned to respond to the private authorities of their childhood. P, POL 102, introductory level in psychology, sociology, or anthropology. Graduate-level requirements include an extensive research paper.

537. * Democracies, Emerging and Evolving (3) I Causal analysis of conditions of stability and breakdown of democratic regimes with particular emphasis on the developing democracies of the third world. P, POL 102. Graduate-level requirements include extensive reading and a research paper. (Identical with LA S 537).

538a-538b. * Philosophy of Law (3-3) I-II (Identical with PHIL 538a-538b, which is home).

541. Arab-Israeli Conflict (3) I II Graduate-level requirements include an additional research paper.

542. * Transformation of Agrarian Societies in the Middle East (3) II (Identical with NES 542, which is home).

543. * Soviet and Post-Soviet Politics (3) I Surveys the Leninist system and the transition to post-Soviet institutions and norms. Focus on decision-making and models of autocracy and pluralism. Particular attention to Russia, but overview of other post-Soviet successor states. P, POL 120. Graduate-level requirements include additional readings, research, and paper(s). (Identical with R S 543).

544. * East European Politics (3) I II Divergent models of Communist development, from East Germany to Yugoslavia; political, economic, social, and cultural reform. P, POL 140. Graduate-level requirements include additional readings, research, and paper(s).

545. * Comparative Political Revolution (3) I Examination of the causes and consequences of 20th-century revolutions and the revolutionary process, with emphasis on contemporary events. P, POL 140. Graduate-level requirements include extensive reading and a research paper.

546. Comparative Political Elites (3) I II Graduate-level requirements include class presentations and additional readings.

547. * Latin-American Political Development (3) I II Presentation of strategies for development in Latin America; examination of case studies from Cuba, Brazil, Chile, Guatemala, and other countries. P, POL 140. Graduate-level requirements include additional course readings. (Identical with LA S 547).

548. * Government and Politics of Mexico (3) I Description and analysis of Mexico's political economy, its political system, and its foreign policy, with emphasis on Mexican-U.S. relations. P, POL 140. Graduate-level requirements include a book review and related discussion with the instructor. (Identical with LA S 548).

549. * The Politics of Cultural Conflict (3) II Comparative examination of the approaches of different types of political systems to domestic conflict of a racial, religious, linguistic, and/or ethnic nature. P, POL 140. Graduate-level requirements include additional readings, research, and paper(s).

550. Religion and Politics (3) I II Graduate-level requirements include additional readings, research, and paper(s).

551. * Soviet and Post-Soviet Foreign Policy (3) I Graduate-level requirements include extensive reading plus a research paper.

552. * Politics in the European Union (3) I II Offers a comprehensive survey of the history, institutions, and functioning of the European Union. P, POL 140. Graduate-level requirements include extra readings and a seminar-length paper.

554. * Theories of International Relations (3) I Introduction to theories of international relations on the levels of man, the nation-state, and the international system, with a logical and empirical evaluation of approaches and theories. P, POL 102, POL 120. Graduate-level requirements include additional assignment/paper.

555. * American Foreign Policy (3) I I I Analysis of the Cold War; Congressional-Executive clashes over foreign policy control; approaches to policy analysis. Graduate-level requirements include additional assignment/paper.

556. * International Law (3) I The international state system; legal-political problems, including territory, environment, seas. P, POL 120. Graduate-level requirements include research readings and paper(s).

557. * Inter-American Politics (3) I Survey and analysis of the leading political and economic issues at controversy between the United States and Latin America. P, POL 140 or POL 102. Graduate-level requirements include a book review and related discussion with the instructor. (Identical with LA S 557).

560. * Modern Chinese Foreign Relations (3) I Survey of the developments and trends in Chinese foreign relations in the modern period, focusing mainly on the relationship between the theoretical and actual objectives of China's foreign policies from 1949 to the present. P, POL 120. Graduate-level requirements include an additional research paper. (Identical with CHN 560).

561. * Feminist and IR Theories (3) I II Issues in epistemology; survey and integration of feminist and IR theories; application of feminist theories to IR. P, W S 100 and POL 120 or POL 250. Graduate students will do a
Methods of Political Inquiry (3) II
Systematic examination of problems of scope and methods of inquiry in the discipline of political science; intended to acquaint students with the discipline and to prepare them for scholarly research in the field.

581. * Environmental Policy (3) II Role of government in management of energy, natural resources and environment; process and policy alternatives; special attention to the Southwest. P, POL 102. Graduate-level requirements include additional readings and a substantial research paper of at least 25 pages in length. (Identical with PA 581, HWR 581, RNR 581).

582. Research and Methodology (4) II Quantitative techniques and computer applications in political science.

583. * Urban Public Policy (3) I II Analysis and discussion of social, economic, and political problems and proposed solutions in changing urban environments. P, POL 102. Graduate-level requirements include additional readings, research, and paper(s).

584. Development of Federal Indian Policy (3) I II European colonial precedents through the treaty-making period; federal policy from treaty-making to the present. (Identical with LAWS 584, AIS 584).

585. Political Risk and Intelligence Analysis (3) II Examination of political risk and intelligence analysis with emphasis on forecasting political developments in nations. (Identical with LA S 585).

587a-587b. * Race and Public Policy (3) I II Examination of the race issue in the context of American politics. 587a: focuses primarily on the African American experience in America from 1619, when the first slaves were sold to the British, to approximately 1910 when segregation had replaced slavery. P, POL 102. 587b: Focuses on race-related events and policies during the urban/industrial transformation, the Depression and New Deal, World War to the Brown Decision of 1954, the Civil Rights years to the present. P, POL 587a Graduate-level requirements include additional paper, usually bibliographic in nature. (Identical with AIS 587a-587b).

589. * Public Choice (3) I II (Identical with ECON 589, which is home).

590. Teaching Political Science (3) I II Methods and problems involved with college teaching in general, and specifically in Political Science. Students are required to take this course as early as possible in their curriculum. Students must teach in the classroom under the supervision of a faculty member. P, graduate status.

592. Internship (1-6) [Rpt./] I II I Legislative Internship (1-9) [Rpt./] II

595. Colloquium
a. American Politics (3) [Rpt./ 2] I II c. Political Theory (3) [Rpt./ 2] I II
d. Comparative Politics (3) [Rpt./ 2] I II e. International Relations (3) I II
g. Public Policy (3) I II (Identical with PA 595g).
there are two areas of concentration in analysis of policies and laws. In addition, health criminal justice interactions, (mental health and health policy, mental motivation, social cognition, intergroup relations); social psychology (the self, ethology and evolutionary psychology social and emotional development); animal behavior, evolution, development, language development, and developmental psychology (cognitive neuropsychology, cognitive development, memory, psycholinguistics, cognitive psychology); cognitive psychology (perception, cognitive and computational neuroscience, cognitive neuroscience, and cognitive psychology (perception, memory, psycholinguistics, cognitive neuropsychology, cognitive development, consciousness studies, environmental cognition, and knowledge representation); developmental psychology (cognitive development, language development, and social and emotional development); ethology and evolutionary psychology (animal behavior, evolution, development); social psychology (the self, motivation, social cognition, intergroup relations); and psychology, policy and law (mental health and health policy, mental health criminal justice interactions, analysis of policies and laws). In addition, there are two areas of concentration in which students may minor: environmental psychology, and measurement and field research.

Applicants should contact the department early to obtain application materials since the deadline for receipt of completed materials is December 31. Applicants must submit scores on the aptitude and advanced (psychology) tests of the Graduate Record Examination. Psychology, policy and law concentration applicants interested in concurrently pursuing the J.D. degree must apply separately to the College of Law.

50a. Current Issues in Psychological Theory and Research (3) I Intensive examination of a range of content areas addressed in contemporary psychological theory and research. P, open to graduate students only.

50b. Current Issues in Psychological Theory and Research (3) II Intensive examination of a range of content areas addressed in contemporary psychological theory and research. P, open to graduate students only.

50a. Principles of Psychophysiology (3) I II Overview, principles, theory, and applications of physiological assessment; an introduction to theory and research in major areas of human psychophysiology with a particular emphasis on psychophysiological correlates and physiological substrates of cognition, affect, and psychopathology. May be taken alone or concurrently with 401b. P, PSYC 290, PSYC 297a, PSYC 302, PSYC 490. Graduate-level requirements include a more comprehensive literature review.

50b. Psychophysiology Laboratory (1) I II Provides a pragmatic "hands-on" experience in psychophysiological recording and analysis. Involves learning all facets of psychophysiological signal acquisition and analysis. P, PSYC 290, PSYC 297a, PSYC 302, PSYC 490. Consent of instructor. (Identical with PSIO 502, SP H 502, CBA 502).


50e. Human Brain-Behavior Relationships (3) I Human brain functions in relation to intelligence, speech, memory, judgment and reasoning, and visual-spatial abilities; methods of examination of human brain functioning in relation to individual differences in both normal and brain-damaged persons. P, PSYC 290, PSYC 302, PSYC 502. Open to majors only.

50f. * Laboratory in Mammalian Systems Neurophysiology (3) I II Neurophysiology laboratory including stereotaxic surgery, microelectrode recording of neural signals, electrical and chemical stimulation, and principles of analog and digital signal processing. P, PSYC 290, PSYC 297a, PSYC 302; CR, PSYC 403a. Graduate-level requirements include an in-depth research paper on a single aspect of a current problem in neurophysiological psychology. (Identical with NRSC 503b).


50a. * Principles of Mammalian Systems Neurophysiology (3) I Topics in the neurophysiology of sensation, perception, cognition, and action in mammals illustrating the application of modern research methods to the understanding of higher brain function. (Identical with NRSC 503a).

50b. * Laboratory in Mammalian Systems Neurophysiology (3) I II Neurophysiology laboratory including stereotaxic surgery, microelectrode recording of neural signals, electrical and chemical stimulation, and principles of analog and digital signal processing. P, PSYC 290, PSYC 297a, PSYC 302; CR, PSYC 403a. Graduate-level requirements include an in-depth research paper on a single aspect of a current problem in neurophysiological psychology. (Identical with NRSC 503b).

50c. Principles of Mammalian Systems Neurophysiology (3) I II Cellularelements and recognized subsystems of the mammalian nervous system, with emphasis on general principles of neuroanatomical organization and their functional significance. P, 8 units of biological laboratory science; CBA 401: PSYC 302, PSIC 480 desirable. Consent of instructor. (Identical with PSIO 502, SP H 502, CBA 502).

50d. * Principles of Mammalian Systems Neurophysiology (3) I Topics in the neurophysiology of sensation, perception, cognition, and action in mammals illustrating the application of modern research methods to the understanding of higher brain function. Enrollment is restricted to those concurrently enrolled in the lab. P, PSYC 297a, NRSC 598; CR, PSYC 403b. Graduate-level requirements include an additional term paper pertinent to current topics in neurophysiology of sensation, perception, cognition, and action in mammals illustrating the application of modern research methods to the understanding of higher brain function. (Identical with NRSC 503a).

50e. * Laboratory in Mammalian Systems Neurophysiology (3) I II Neurophysiology laboratory including stereotaxic surgery, microelectrode recording of neural signals, electrical and chemical stimulation, and principles of analog and digital signal processing. P, PSYC 290, PSYC 297a, PSYC 302; CR, PSYC 403a. Graduate-level requirements include an in-depth research paper on a single aspect of a current problem in neurophysiological psychology. (Identical with NRSC 503b).

50f. * Laboratory in Mammalian Systems Neurophysiology (3) I II Neurophysiology laboratory including stereotaxic surgery, microelectrode recording of neural signals, electrical and chemical stimulation, and principles of analog and digital signal processing. P, PSYC 290, PSYC 297a, PSYC 302; CR, PSYC 403a. Graduate-level requirements include an in-depth research paper on a single aspect of a current problem in neurophysiological psychology. (Identical with NRSC 503b).
509. History of Psychological Theories and Research (3) II Development of psychology as a science; schools, systems, theories, major advances, famous investigators. P, open to majors only.


512. * Animal Learning (3) II II Animal learning with emphasis on interspecies comparisons. P, PSYC 290, PSYC 297a. Graduate-level requirements include an in-depth research paper on an aspect of animal learning.

513. * Drugs, Brain and Behavior (3) I II Physiological, neurotoxic and behavioral effects of drugs on individual neurotransmitter systems in the brain. Special emphasis will be given to the historical use and political significance of the major drugs of abuse. P, PSYC 101 or INDV 101, PSYC 230, PSYC 290, PSYC 302. Graduate-level requirements include an additional term paper pertinent to the course topic.

515. * The Design of the Mind: Genes, Adaptation, and Behavior (3) I Part I: Basic mechanisms of behavioral evolution, genetics, and natural selection, as well as other factors impinging on the evolutionary process. Part II: Historical approaches that converge upon the broadly defined research program of behavioral evolution, theoretical perspectives, and empirical contributions made by each of these approaches, and current controversies in the field, framed as a single integrated area of study in which multiple approaches and perspectives can contribute to a comprehensive understanding. P, PSYC 297a, PSYC 230, PSYC 290, PSYC 240 or PSYC 340, or consent of instructor. Graduate-level requirements include in-class oral presentations. (Identical with FS 515.)

517. * Invertebrate Psychology (3) II Animal behavior laboratory in behavioral manipulation, observation, and data recording with invertebrate animals. P, PSYC 101 or INDV 101, PSYC 230, PSYC 290, PSYC 297a. Graduate-level requirements include an additional paper or presentation to the class.

524. Gerontology: A Multidisciplinary Perspective (3) I II Graduate-level requirements include an in-depth research paper on a single aspect of gerontology. (Identical with GER 524, PHIL 524, NRSC 524.)

526. Advanced Human Memory (3) II Graduate-level requirements include an in-depth research paper on human memory and cognition.

528. Cognitive Neuroscience (3) [Rpt./ 2] I Recent advances in analysis of the neural bases of cognitive functions, such as learning, memory, and thinking.

529. * Advanced Perception (3) [Rpt./ 1] II Perception of space, theories of object recognition, evolutionary constraints, learning, attention, visual cognition, and theories of perception. P, PSYC 230, PSYC 290, PSYC 297a, PSYC 329. Graduate-level requirements include an additional paper on a particular issue.

530. Neural Basis of Language (3) I The neural basis of language comprehension and production, with reference to its relationship to other perceptual, cognitive and motor skills. P, graduate status. (Identical with NRSC 530.)

532. * Psychology of Language (3) II (Identical with LING 532, which is home).

533. Visual Cognition (3) [Rpt./ 1] II Recent advances in the area of perception and attention, with emphasis on visual process. Rotating topics.

538. * Computational Linguistics (3) I (Identical with LING 538, which is home).

539. * Animal-Human Communication (3) II (Identical with ECOL 539, which is home).

540. * Advanced Cognitive Development (3) [Rpt./ 1] II Examination of major theories and research findings in cognitive development, with emphasis on infant cognition and conceptual development through childhood. Topics include concept representation and development, naive theories of the world and knowledge restructuring. Topics will vary. Graduate-level requirements include an in-depth research paper on an aspect of cognitive development.

541. * Language Acquisitions (3) II (Identical with SP H 541, which is home).

542. * Psycholinguistics (3) [Rpt./ 1] I II Recent advances in the area of psycholinguistics, with an emphasis on sentence processing and the contribution of linguistic theory to an understanding of psychological mechanisms. (Identical with LING 542, SLAT 542.)

543. * Advanced Language Development (3) I II Current theory and data on first language acquisition with special focus on research that relates linguistic theory and learnability theory to empirical studies of children's linguistic abilities. P, senior status or consent of instructor. Graduate-level requirements include a written paper on a subject pertinent to topic area. (Identical with LING 543.)

545. * Neural Network Model (3) II Hands-on introduction to artificial neural networks. The basic principles and tools required to develop neural models, and/or to effectively apply technology. P, PSYC 297a, and PSYC 325 or PSYC 346 or PSYC 402, college-level algebra skills, statistics, computer familiarity either with Unix PCC, or Mac. Graduate-level requirements include a more substantial modeling project. (Identical with PHIL 545.)
social situations. Graduate-level requirements include a research paper pertinent to the topic of social cognition.

562. * Mental Health Law and Policy (3) [Rpt./ 3] I II Theory, research and practice in law and mental health interactions and in the delivery of mental health services. Graduate-level requirements include a paper on a pertinent topic. (Identical with LAWS 562).

563. * Forensic Assessment: Intervention and Treatment (3) I II Theory, research and practice in the assessment and treatment of, and intervention with, persons involved with the legal process who have clinical problems. P, PSYC 297a, consent of instructor. Graduate-level requirements include a different grading system for class participation and exams.

564. Methods for Psychosocial Research (3) I II Logic of inquiry and issues of philosophy of science as they apply to psychosocial research. Problems encountered by researchers in personality, family studies, social and clinical psychology, and creative approaches to their data analysis and methodological design resolutions.

567. Experimental Phonetics: Physiology (3) I P, SP H 260. (Identical with SP H 567, which is home).

568. * Speech Perception (3) II (Identical with SP H 568, which is home).

570. * Foundations of Artificial Intelligence (3) I (Identical with C SC 570, which is home).

573. * Stress, Coping, and Health/Performance (3) I II Examines within a biopsychosocial framework the concept of stress as it relates to performance and the etiology of stress-related health disorders. Also examines and applies stress management interventions to enhance performance and promote health. Graduate-level requirements include an extra term paper, and a project in connection with another student.

574. Field Methods in Environmental Psychology (3) II (Identical with LAR 574, ARCH 574).

576. * Environmental Cognition (3) [Rpt./ 1] I II Recent advances in the area of environmental cognition, with an emphasis on cognitive aspects of environmental psychology. Graduate-level requirements include an in-depth research paper on a single aspect of environmental cognition.

577a-577b. * Psychology, Law and Social Policy (3-3) I II Critical review of theory, methods and research in the psychology, law and social policy interface. Graduate-level requirements include a research paper.

578. * Sleep and Sleep Disorders (3) I II Topics include sleep-wake rhythms, sleep deprivation, dreams, and the diagnosis and treatment of sleep disorders. Graduate-level requirements include a critical review of the research literature of a relevant topic.

579. Issues in Rural Health (3) II (Identical with NURS 579, which is home).

580. Clinical Neuropsychology (3) [Rpt./ 1] I II Cognitive and affective sequelae of human central nervous system disease/damage, with emphasis on clinical evaluation, management and rehabilitation.

581. * Psychopathology (3) II In-depth study of current theoretical and research formulations in psychological disorders; various approaches to behavior change. Graduate-level requirements include an in-depth research paper on psychopathology.

582. Advanced Psychopathology (3) [Rpt./ 1] I II Advanced survey of current theory and research in symptoms, causes and treatment of the major psychological disorders.

583. * Biological Basis of Psychopathology (3) II Etiology and treatment of major psychological disorders with emphasis on behavioral genetics, imaging, psychopharmacology and animal models of schizophrenia, affective disorders and anxiety disorders. Graduate-level requirements include presentations and an in-depth research paper on an aspect of biological bases of psychopathology.

584. * Advanced Health Psychology (3) [Rpt./ 1] I II Current research and theory concerning psychological contributions to health maintenance, illness prevention and treatment, and the organization of health services. P, PSYC 297a. Graduate-level requirements include an additional paper pertaining to the course topic.

585. * Contemporary Issues in Psychology (3) [Rpt./ 1] I II Variable content (consult schedule): major topical problems in psychological research, theory, and applications. Graduate-level requirements include an in-depth research paper on an aspect of contemporary psychological research.

586. * Ethical Issues in Psychology (3) I II A consideration of issues in the derivation of ethical criteria, selection of the appropriate subset of criteria to guide ethical decision-making, and utilization of the criteria when making a decision in psychological research or practice. Graduate-level requirements include a paper on a single aspect of the course topic.

589. * History of Psychology (3) I Growth of psychology as a science; major schools and theories; contributions of famous investigators and major advances; psychology as an art and a science today. P, PSYC 297a, 6 units upper-division psychology. Graduate-level requirements include an in-depth research paper on an aspect of history of psychology.

593. Internship (1-6) I II

594. Practicum (1-3) [Rpt./]

596. Seminar

a. * Social Psychology (3) [Rpt./ 3] I II In-depth coverage of selected topics in social psychology. Graduate-level requirements include an in-depth study of selected topics in social psychology.

c. Developmental Psychology (3) [Rpt./ 1] I II

e. Biopsychology (3) [Rpt./ 1] I II

600. Lab (1) [Rpt./]

602. Colloquium

f. Linguistics and Applications (3) [Rpt./ 3] I II (Identical with LING 696f, which is home).

699. Independent Study (1-3) [Rpt./]
Public Administration and Policy (PA)
McClelland Hall, Room 405
Phone: (520) 621-7965, (520) 621-3634
FAX: (520) 621-4171
WWW: http://www.bpa.arizona.edu/
FAX: (520) 621-4171
Phone: (520) 621-7965, (520) 621-3634
McClelland Hall, Room 405

Application Questions:
M.P.A.: Neil Vance,
nvance@bpa.arizona.edu
Ph.D.: Keith Provan,
kprovan@bpa.arizona.edu

Degrees Offered: M.P.A., Ph.D. (major in management)
Joint Programs: M.P.A./J.D., M.P.A./M.I.M. (Master of International Management)

Concentrations: Criminal justice, health care, human services, natural resources, and public and nonprofit finance

Professors: H. Brinton Milward, Associate Dean, Lee Roy Beach, Terry Connolly (Management and Policy), Stephen Cornell, Michael R. Gottfredson, Barbara Gutek, Helen Ingram (Emerita), Theodore Koff, Keith Provan, John Schwarz (Political Science) Arthur Silvers, Ronald Vogel, Mark Zupan (Economics)

Associate Professors: Chris Demchak, Shawn Everett Kantor, Michael Polakowski, Edella Schlager
Assistant Professors: Leslie Eidenberg, Greg Pogarsky. Rhonda Trautman

The School of Public Administration and Policy offers the Master of Public Administration, which is designed to prepare men and women for positions of leadership in public sector and nonprofit organizations, as well as private organizations dealing with the public sector.

Graduates may expect to pursue management or policy-making concerns in a wide variety of settings within organizations at local, state, national, and international levels. The department also participates in the Doctor of Philosophy degree with a major in management.

For admission and degree requirements, see Master of Public Administration in chapter IV: Requirements for Master's Degrees.

501. Public Organization Theory (3) I II Course focuses on understanding and analyzing interactions, effectiveness and complexities of organization structures.


503. Politics and the Policy Process (3) I Various theories of how public policy is formulated.

504. Public and Policy Economics (3) II Applications of economics to the analysis of public policy and planning problems. (Identical with PLN 504)

505. Methods for Policy Analysis and Program Evaluation (3) II Techniques for analyzing the effects of public policies and programs. P, MKTG 552 or consent of instructor.

506. * Bureaucracy, Politics, and Policy (3) I (Identical with POL 506, which is home).

507. Negotiation and Conflict Resolution for Public Managers (3) II Emphasis will be on the role of public managers and the ways in which conflict resolution tools, processes and skills can assist them in carrying out their work as employees, as administrators, and as public servants.


513. Government and the Nonprofit Sector (3) I In the past twenty years, governments have drastically altered the way they deliver public services. While government spending on services has grown, nonprofit organizations under contract to government increasingly deliver public services in health, welfare and many other areas. This course will map the dimensions of this new relationship; discuss the consequences of third party management of public services; and develop skills in contracting, monitoring and measuring performance.

514. Analytic Methods in Local Planning and Management (3) II Methods and models for program planning and policy analysis; forecasting, service demand, facility location in capital investment programming, task sequencing, program analysis and evaluation. P, MKTG 552; GEOG 557 or consent of instructor. (Identical with GEO 514, PLN 514).

516. * Health, Ethics and Public Policy (3) II Dealing with ethical and public dimension of health care. Policy issues include who pays for health care, who can have access to health care and the implications of for-profit health care provision will be discussed. Graduate-level requirements include individual presentations. (Identical with SOC 516).

517. Public Policy Analysis (3) I Introduction to theory and practice of public policy analysis.

521. Social Policy (3) I Design, implementation and outcomes of social policy initiatives in the U.S. and abroad. Themes include historical overview of antipoverty policy in the U.S., competing explanations for conditions of inequality, and examination of policy solutions. (Identical with SOC 521).

522. Organizational Analysis of Health Systems (3) I Introduces the student to the scope and nature of public and private health systems in the U.S.; examines roles of government and private enterprise in the development and operation of health institutions.

523. Health and Public Policy (3) II Examines public policy issues in health, including recent developments in health policy and planning at the national, state and local levels, and their impact on administrative behavior. (Identical with PLN 523).

524. * Management of Long Term Care Facilities and Programs (3) II Problems and principles of management of facilities and community based programs providing health and social services to the chronically impaired. Graduate-level students will be required to produce more papers for the class at administrative level.

525. Comparative Management in Health Administration (3) I Assists students in applying general management principles to particular types of health agencies. Models of organizational behavior are used to develop a paradigm for comparative analysis. P, PA 522.

526. Health Economics (3) I Applies microeconomic theory, industrial organization and public finance to efficiency and equity problems in the acute and chronic health-care sectors. Explores solutions to these problems. P, PA 522; ECON 500 or consent of instructor. (Identical with ECON 526).

527. * Aging and Public Policy (3) II Policy framework for administrators of programs, planners, providers, policy makers, and public servants, related to the needs of the aging in modern society. (Identical with GERO 527).

528. Topics in Public and Nonprofit Financial Management (3) II Advanced issues in public-sector financial management. P, PA 508; FIN 511. (Identical with FIN 528).

530. Aging and Social Sciences (3) I (Identical with GERO 530, which is home).


541. Deviance and Social Control (3) I II P, SOC 341 or SOC 342; SOC 201. (Identical with SOC 541, which is home).

543. White Collar and Organizational Crime (3) I The nature and distribution of white collar and organizational crime. Sociological and economic explanations for crime in
organizational settings. Societal response and control mechanisms. (Identical with MAP 543, SOC 543).

546. Crime and Public Policy (3) [Rpt./ 6 units] I II Role of government in the prevention and control of crime. Graduate-level requirements include additional reading and paper along with facilitation of a class. (Identical with SOC 546).

557. * Law of the Elderly (3) II (Identical with GERO 557, which is home).

573. * Government and Economic Well-being (3) I II (Identical with POL 573, which is home).

580b. Theory of Management and Organizations: Organizations in Their Environments (3) II P, MAP 305 or MAP 502. MAP 580a is not prerequisite to MAP 580b. (Identical with MAP 580b, which is home).

581. * Environmental Policy (3) II (Identical with POL 581, which is home).

593. Internship (1-6) [Rpt./] I II

595. Colloquium g. Public Policy (3) I II (Identical with POL 595G, which is home).

596. Seminar i. Management and Policy for Ecological Sustainability (3) [Rpt./] I II (Identical with POL 596i, which is home).

599. Independent Study (1-6) [Rpt./]

699. Seminar f. Ph.D. Seminar in Public Management (3)

1. Course focuses on a review and discussion of major works and streams of thought that have guided the evolution of the study of public administration and management. Introductory seminar for all new doctoral students entering the department's Ph.D. program. (Identical with MAP 696f, POL 696f).

699. Independent Study (1-3) I II

900. Research (1-9) I II

910. Thesis (1-6) I II

920. Dissertation (1-9) I II

930. Supplementary Registration (1-9) I II

Public Health (PHL)

Arizona Health Sciences Center, Room 1115
Phone: (520) 626-3200
FAX: (520) 626-3206
WWW: http://www.ahsc.arizona.edu/publichealth/100.htm

Application Questions:
Alison Pearson, (520) 626-3208,
mphadmit@u.arizona.edu

Advising Questions:
(520) 626-3200

Degrees Offered: M.P.H.

Professors: Carlos C. Campbell (Director), James E. Dalen (Internal Medicine), Bill Johnson (Health Administration and Policy, ASU), Bradford Kirkman-Liff (Health Administration and Policy, ASU), Mary Koss, Jennie Kronenfeld (Health Administration and Policy, ASU), Michael Lebowitz, James Marshall, Lawrence Mayer (Economics, ASU), Keith Provan, Catherine Shisslak, Eugene Schneller (Health Administration and Policy, ASU), Ronald Vogel (Public Administration and Policy and Economics), Anthony Vuturo

Associate Professors: Scott Leischow (Family and Community Medicine), Kathleen May, Patricia Moore (Nursing, ASU), Richard Papenfuss, Laurie Price (Health, Physical Education, Exercise Science and Nutrition, NAU), John Sciaccia (Health, Physical Education, Exercise Science and Nutrition, NAU), Duane Sherrill, Douglas Taren (Family and Community Medicine).

Assistant Professor: Julie Baldwin (Health, Physical Education, Exercise Science and Nutrition, NAU), Jeffrey Burgess, Anna Giuliano, Robin Harris, Bryan Williams

The Arizona Graduate Program in Public Health (AzGPPH) is an inter-university and interdisciplinary program. The AzGPPH evolves from and is built on the strengths of various medical and health related programs at The University of Arizona, Arizona State University, and Northern Arizona University. In addition, health programs and agencies throughout the state contribute to the AzGPPH. The AzGPPH blends the expertise and experiences of the medical care and health related programs of the university and community health agencies in Arizona to provide a community oriented program of sufficient breadth and depth and high quality.

The mission of the Arizona Graduate Program in Public Health is to prepare professionals for leadership roles in health promotion and disease prevention in Arizona, the southwestern United States and the global community. Particular emphasis is placed on rural and urban medically under served populations, including Hispanics, Native Americans and other ethnic minority groups.

The Master of Public Health is a professional degree designed to prepare public health practitioners who can apply a breadth of understanding as well as expertise in one specific area of public health. The M.P.H. degree is often the terminal degree for the front-line public health worker.

The AzGPPH Master of Public Health degree is established as an inter university, interagency program. At The University of Arizona there are five concentration areas for the M.P.H. degree: Community Health Practice, Environmental and Occupational Health, Epidemiology and Biostatistics, Family and Child Health, and Health Education and Behavioral Sciences. Arizona State University offers two concentration areas: Community Health Practice and Health Administration and Policy. The Health Education and Behavioral Sciences concentration area is available at Northern Arizona University.

The M.P.H. degree requires a minimum of 33 to 49 credits, including a minimum of 3 credits of internship. Individual requirements vary by concentration area. Potential students are advised to contact the AzGPPH office to obtain specific information for a specific concentration area.

All students will take 5 core courses, internship, required concentration courses, and elective courses. The core courses are as follows:

1. Social and Behavioral Basis of Public Health (PHL 577) (3)
2. Basic Principles of Epidemiology (PHL 573a) (3)
3. Biostatistics in Public Health (PHL 576) (3)
4. Health Administration and Policy (at ASU, HSA 560) (3)
5. Environmental and Occupational Health (PHL 575) (3)

500. Research (3-12) I II

510. Physical Exposures (3) II R, 3L (Identical with PCOL 510).

511. Health Care Systems (3) I (Identical with PHSC 511, which is home).

513. Health Technology Assessment (3) II P, PHSC 511. Open to majors only. (Identical with PHSC 513, which is home).

524. Gerontology: A Multidisciplinary Perspective (3) I II (Identical with PSYC 524, which is home).

525. * Topics in Latino Health (3) I (Identical with MAS 525, which is home).

527. Psychology of Sport and Exercise (3) I (Identical with PE 527, which is home).

530. Methods in Nursing Research (3) II (Identical with NURS 530, which is home).

532. Program Planning (3) Principles for planning, implementing, administering and evaluating health education programs utilizing the "PRECEDE Model" as a framework.

534. Program Evaluation (3) II This course provides a conceptual overview of theories, issues and recent practice in evaluation. Theoretical delineation and application will

Public Health /203
be illustrated using case studies and lab-based experiences. This course seeks to prepare entry-level practitioners to effectively design, implement, and assess an evaluation plan. P. PHL 576a.

535. Multicultural Health Beliefs (3) II
Designed to provide sensitivity by health promotion professionals to the varying multicultural health beliefs and needs of our society. Special emphasis on ethnic characteristics of minority populations in Arizona with recommendations for programming strategies.

540. Program Intervention (3) II Examination of health education promotion literature from ancient societies to present, including an analysis of current health literature from various professional, community, voluntary, public and international health organizations.

546. Biobehavioral Approaches to Cardiovascular Health & Illness (3) [Rpt./1] S (Identical with EPI 546, which is home).

548. Perspectives in Geriatrics (2) II (Identical with PHSC 548, which is home).

553. Toxicology and Chemical Exposure (2-4) I Principles of toxicology related to industry, dose response, mechanisms of toxicity, hazard evaluation principles, toxicology of major classes of industrial chemicals. P. CHEM 486. (Identical with PCOL 553).

558. International Health (3) I Students will become familiar with, discuss and understand major concepts, issues, and methodologies in the field of International Health. P. graduate status.


570. Issues and Trends in Public Health (3) Public health methods, organizations and services such as environmental/occupational health; disease control; health education and promotion; policy and legislation; and medical care.

571. International Comprehensive Health Care System (3) Comparison of health care systems in developing and industrialized countries in relation to other social systems; public/private component analyses; health care methods and finance.

573a. Basic Principles of Epidemiology (3) [Rpt./1] I II P, EPI major or minor, MPH major, or consent of instructor (Identical with EPI 573a, which is home).

573b. Epidemiologic Methods (3) I II P, EPI 573a, EPI 576a and EPI 576b. (Identical with EPI 573b, which is home).

573c. Advanced Epidemiology (3) I II P, EPI 573a, EPI 573b, EPI 576a, EPI 576b and advanced standing. (Identical with EPI 573c, which is home).

574. Health Administration and Policy (3) [Rpt./1] Management processes/roles of public health professionals; health service organization; policy issues and resource utilization/control; human resources management; public health trends.

575. Environmental and Occupational Health (3) [Rpt./1] Examination of living/working environments impacting human health; chemical and physical stressors affecting health; techniques for assessing and controlling risks in air, soil and water.

576a. Biostatistics in Public Health (3) I (Identical with EPI 576a, which is home).

576b. Biostatistics for Research (3) II P, EPI 576a or PHL 576a. (Identical with EPI 576b, which is home).

576c. Applied Biostatistical Analysis (3) [Rpt./1] S P, EPI 576a, EPI 576b, EPI 573a, EPI 573c or consent of instructor. (Identical with EPI 576c, which is home).

577. Social and Behavioral Basis of Public Health (3) [Rpt./1] I Social learning theory, diffusion of innovations, relationship of cultural values to behavioral change, social marketing, high risk behavior intervention strategies, and communication issues.

578. Public Health Nutrition (3) II Community and individual nutritional assessment; risk profiles; planning, implementing and evaluating programs; international, national and local resources/programs; Healthy People 2000 goals.

579. Issues in Rural Health (3) II (Identical with NURS 579, which is home).

580. Community Based Research Methodologies (3) II P, PHL 576a, F CM 596. (Identical with F CM 580, which is home).

581. Introduction to Community Health (3) I (Identical with F CM 581, which is home).

583. Advanced Industrial Hygiene and Safety (3) I II An in-depth coverage of the professional practice of occupational and environmental health. Containment behavior and assessment are emphasized. A comprehensive environmental health assessment on an industrial site is required. P. PHL 580.

584. Fundamentals of Industrial and Environmental Health (3) I Introduction to the principles of occupational and environmental health, with emphasis on the anticipation, recognition, evaluation, and control of health hazards. (Identical with C E 584, PCOL 584).

585. Industrial Ventilation (3) I II Design and evaluation of industrial ventilation systems. Emphasis is on level evaluation of industrial contaminants. Five laboratory exercises and course design project. 3R. 1L. (Identical with PCOL 585).

586. Maternal and Child Health (3) I Focuses on current health problems and diseases affecting both pregnant women and children worldwide. The impact of various common health problems at different stages of the life cycle and their functional outcomes in terms of morbidity, mortality, psychological well-being, reproduction and growth will be highlighted. Students will become acquainted with the epidemiology of maternal and childhood diseases in developed and developing countries. Programs and resources available to combat health and nutritional problems will be evaluated. The role of different international organizations will be discussed in the context of socioeconomic development and current political/economic policies and realities.

587. Poverty and Health (3) II (Identical with NURS 587, which is home).

589. Clinical Pharmacological Mental Disorder (2) I (Identical with PHSC 589, which is home).

593. Internship a. Public Health (3) I

596. Seminar a. International Health: Clinical and Community Care (3) S P, open to health majors only. (Identical with F CM 596a, which is home).

b. Public Health Seminar (1) [Rpt./2 units] I II

g. Occupational Disease (1-2) II P, open to medical or industrial hygiene students only, consult department before enrolling. (Identical with F CM 596g, which is home).
b. Prevention and Control of Disease (1) P, consult department before enrolling. (Identical with F CM 596h, which is home).
i. Seminar for Clinical Educators (4) II (Identical with F CM 596i, which is home).
j. Health Policy: Leadership and Current Issues (2-3) II (Identical with F CM 596j, which is home).
m. Practice of Community-Oriented Medicine in Rural Areas (2) II (Identical with F CM 596m, which is home).

q. Managed Health Care (3) II (Identical with F CM 596p, which is home).

r. Health Care Leadership and Medical Management (2-3) [Rpt./6 units] P, open to medical and graduate students only. (Identical with F CM 596q).

a. AIDS, Cancer, Nutrition Immunity (1) II (Identical with F CM 596a, which is home).
t. Tropical Disease Problems (2) I II (Identical with F CM 596t, which is home).

u. Diet and Disease Prevention (2) II (Identical with F CM 596w, which is home).

599. Independent Study (1-6) [Rpt./1 II

602a. Biotoxicology (3) I P, organic chemistry, two semesters of biology and one semester of biochemistry. (Identical with PCOL 602a, which is home).

602b. Biotoxicology Laboratory (1) I (Identical with PCOL 602b, which is home).

603. Public Health Science (3) I P, open to majors only. (Identical with NURS 603, which is home).

607. Cross-Cultural Nursing (3) S P, open to majors only. (Identical with NURS 607, which is home).

611. Pharmaceutical Education Research (3) I (Identical with PHSC 611, which is home).

612. Pharmaceutical Outcomes Research (3) II (Identical with PHSC 612, which is home).
Reliability Engineering  
(See Systems and Industrial Engineering)

Remote Sensing and Spatial Analysis (REM)  
1955 E. Sixth St., Suite 205  
Phone: (520) 621-8586  
FAX: (520) 621-3816  
Graduate Interdisciplinary Program in Remote Sensing and Spatial Analysis

Application Questions:  
ChiyO Yamashita-Gill, (520) 621-8567  
Degrees Offered: Ph.D. minor only

Professors: Charles F. Hutchinson (Arid Lands Studies), Chair, Victor R. Baker (Hydrology and Water Resources), Robert E. Dickinson (Atmospheric Sciences), Barry Ganapal (Aerospace and Mechanical Engineering), Benjamin M. Herman (Atmospheric Sciences), Alfredo Huete (Soil, Water and Environmental Science), Donald E. Myers (Mathematics), Merritt R. Nelson (Plant Pathology), John A. Reagan (Electrical and Computer Engineering), Richard W. Reeves (Geography and Regional Development), William J. Shuttleworth (Hydrology and Water Resources), Philip N. Slater (Optical Sciences), Soroosh Sorooshian (Hydrology and Water Resources), Spencer R. Titley (Geosciences)

Associate Professors: Charles E. Glass (Mining and Geological Engineering), D. Phillip Guertin (Renewable Natural Resources), Stuart E. Marsh (Arid Lands Studies and Geography and Regional Development), Robert A. Schowengerdt (Electrical and Computer Engineering, Arid Lands Resource Sciences)  
Assistant Professors: George L. Ball (Renewable Natural Resources), Kurtis J. Thome (Optical Sciences), Stephen Youl (Geography and Regional Development)  
Physical Scientist: Mary Susan Moran (Soil, Water and Environmental Science)  
GIS Coordinator: Craig A. Wissler (Renewable Natural Resources)

The data are processed by digital computer or optical techniques to extract information of value to earth scientists and resource and environment managers at the local, state, and federal levels.

The Program in Remote Sensing and Spatial Analysis offers no graduate major. Minor programs are available for doctoral students. Emphases are available in remote sensing sciences or spatial analysis.

Requirements  
Students will complete two required core courses (six units) in their selected option and six additional graduate units from the courses listed below with the prior approval of minor representatives on their committee. Any one of the core courses, either option, may also be used towards the six elective units, in either option.

Remote Sensing Sciences  
OPTI 550 Fundamentals of Remote Sensing  
ECE/OPTI 531 Image Processing Laboratory for Remote Sensing  
Plus six additional graduate units from the general Remote Sensing curriculum or from the Spatial Analysis core (one course maximum)

Spatial Analysis  
REM 590 Remote Sensing for the Study of Planet Earth, GRD 516 Geographic Information Systems for Geography and Regional Development, or RNR 517 Geographic Information Systems for Natural Resources  
Plus six additional graduate units from the general Remote Sensing curriculum or from the Remote Sensing Sciences core (one course maximum)

Students are required to discuss the program with members of the Program in Remote Sensing and Spatial Analysis before selecting the courses to be taken. The program selected must be approved in advance by the Committee.

590. * Remote Sensing for the Study of Planet Earth (3) II A multidisciplinary course delineating the physical basis of electromagnetic remote sensing, the concepts of information extraction, and applications pertinent to earth systems science. Graduate-level requirements include an additional term paper. (Identical with HWR 590, OPTI 590, GEOS 590, ATMO 590, MN E 590, ARL 590, SWES 590, RNR 590).

696. Seminar  
a. Remote Sensing (1) II

Range Management (RA M)  
(See Renewable Natural Resources)
Renewable Natural Resources, School of (RNR / RA M / WS M / WFSC)

Biological Sciences East, Room 325
Phone: (520) 621-7255
FAX: (520) 621-8801
WWW: http://www.srnr.arizona.edu

Application Questions:
Mary E. Soltero, (520) 621-7260,
mes@ag.arizona.edu

Advising Questions:
Mary E. Soltero, (520) 621-7760,
mes@ag.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: C. P. Patrick Reid, Director, Hanna J. Cornter, Terry C. Daniel (Psychology), Leonard F. Debano (Emeritus), Joseph E. DeSteiguer, Peter F. Ffollott, Martin M. Fogel (Emeritus), Lloyd W. Gay, Frank Gregg (Emeritus), William L. Halvorson, Richard H. Hawkins, Malcolm K. Hughes (Tree Ring Laboratory), Robert R. Humphrey (Emeritus), Warren Jones (Emeritus), David A. King (Emeritus), James O. Klemmedson (Emeritus), Philip N. Knorr (Emeritus), Paul R. Krausman, Donald V. Lightner (Veterinary Science), R. William Mannan, O. Eugene Maughan, Phil R. Ogden (Emeritus), William W. Shaw (Emeritus), John L. Thames (Emeritus), Robert F. Wagle (Emeritus), Ervin H. Zube (Emeritus), Malcolm J. Zwolinski (Associate Director)

Associate Professors: Stephen DeStefano, H. Randal Gimblett, Lisa J. Graumlich (Tree Ring Laboratory), D. Phillip Guertin, Gordon S. Lehman (Emeritus), Vincente L. Lopes, William J. Matter, Mitchel P. McClaran, Carole C. McIvor, Guy R. McPherson, E. Lamar Smith (Emeritus), Thomas W. Swetnam (Tree Ring Laboratory), Jerry Tash (Emeritus), Donovan C. Wilkin, Charles D. Ziebell (Emeritus)

Assistant Professors: Maria Fernandez-Gimenez, Cecil R. Schwabale, Robert J. Steidl, David G. Williams

Assistant Research Professor: George L. Ball

Extension Specialist: George B. Ruyle

Associate Extension Specialist: Lawrence Sullivan

Assistant Extension Specialist: Larry D. Howery

Academic Associate: Michael D. Johnson

The School of Renewable Natural Resources is concerned with the management and conservation of natural ecosystems with emphasis on the desert, rangeland, and forest ecosystems of arid and semi-arid environments. Graduate programs leading toward the degrees of Master of Science and Doctor of Philosophy prepare students for (1) research and teaching in the areas of natural resource science, management, and planning; and (2) positions in natural resource management that require specialization in one of the available majors. All students are urged to gain a broad understanding of social and political institutions as they affect fundamental relations of humans and their environment, particularly those involving plants, animals, soil and water resources, and climate.

Students pursuing the M.S. or Ph.D. degree may elect to major in one of four disciplinary emphasis areas: rangeland science and management; renewable natural resources studies; watershed hydrology and management; and wildlife and fisheries science. Applicants for the Master of Science or Doctor of Philosophy degree programs are required to submit three letters of recommendation and scores on the Graduate Record Examination. For information concerning requirements for the M.S. degree see Chapter IV: Requirements for Master's Degrees in this catalog. For information concerning the Ph.D. degree refer to Chapter VI: Requirements for Doctoral Degrees, in this Catalog. Students in all majors are encouraged to seek cross-disciplinary (across majors) experience and interaction.

Rangeland Science and Management: Concentrations are available in rangeland management, rangeland science, and dryland forestry. Applicants are expected to have completed an undergraduate major in rangeland management or similar natural resources field with strong training in biological, physical, and social sciences equivalent to that required for the bachelor's degree at The University of Arizona. Applicants lacking these prerequisites will be required to complete additional units in established watershed resources courses. Students working toward the M.S. degree shall complete at least 30 units including a thesis for which as many as 5 units may be earned.

Wildlife and Fisheries Science: This major includes specializations in wildlife ecology and fisheries science. For the M.S. degree, both programs require the completion of at least 30 units including a minimum of 20 units of course work and an acceptable thesis focusing on original research that addresses a wildlife and fisheries management topic.

Range Management (RA M)

536. Grazing Ecology and Management (3) I Application of animal diet and nutrition, grazing behavior, and vegetation-soil-herbivore interactions in management of grazing animals for improved livestock production, wildlife habitat, watershed protection, forest reproduction or other land use objectives. Includes design of water developments, fences and other structural range improvements. Graduate-level requirements include additional required readings and research paper on a selected topic.

546. * Range and Forest Management (4) II Principles and technical procedures associated with management of rangeland and forest plant communities. Manipulations will focus on controlling species composition to achieve management objectives, and include chemical, biological, and cultural treatments. P, RNR 316. Graduate-level requirements include a research paper on an aspect of rangeland improvement.

536. * Rangeland Inventory and Monitoring (3) I Techniques of mapping and measuring attributes of vegetation and soils for inventory and monitoring of range lands. Interpretation
of data with respect to range condition and trend, watershed protection, value for livestock and wildlife habitat. Graduate-level requirements include additional assigned readings and discussion periods.

570. Functional Ecology of Arid Land Plants (2) II Concepts and current approaches in physiological ecology of arid land plants, focusing on processes at whole plant and ecosystem levels. Hands-on experience with instrumentation and methods used to measure plant-water relations, gas exchange, isotopic variation, and ecosystem fluxes.

587. * Rangeland Management Plan (2) II Conduct a field inventory, develop management alternatives, and provide environmental and economic analyses of alternative management proposals in a written plan. 6L. All-day field trips. P, RA M 456. Graduate-level requirements include development of additional management alternatives and environmental and economic analyses.

939. Colloquium I II
- Rangeland Policy (3) [Rpt./ I II
- Diet of Free-Ranging Ruminants (2) I

999. Independent Study I II
- Rangeland Policy (1) [Rpt./ I I II
- Independent Study (1-5) [Rpt./ I I II

599. Seminar I II
- Rangeland Policy (1) [Rpt./ I II

699. Internship (1-8) [Rpt./ I II

506R. * Conservation Biology (3) II (Identical with ECOL 506R, which is home).
- Conservation Biology in the Field (1) II (Identical with ECOL 506L, which is home).

506L. * Conservation Biology in the Field (1) II (Identical with ECOL 506L, which is home).

512. Recreational Dimensions of Natural Resource Management (3) I Human perception, value and behavioral aspects of outdoor recreation; sociological dimensions of the recreational experience in wildland recreation settings and activities; development of sociological concepts and theories employed to understand recreation behavior; and computer-based models for recreation. (Identical with LAR 512).

516. * Geographic Information Systems for Geography and Regional Development (3) II (Identical with GEOG 516, which is home).

517. * Geographic Information Systems for Natural Resources (3) II Introduction to the application of GIS and related technologies to natural resource management. Conceptual issues in GIS database design and development, analysis, and display. 2R, 3L. P, basic knowledge of computer operations. Graduate-level requirements include a thorough bibliographic review and a scholarly paper on a current application of geographic information systems in the student's major field. (Identical with GEOG 517, SWES 517).

519. * Cartographic Modeling for Natural Resources (3) I Computer techniques for analyzing, modeling, and displaying geographic information. Development of spatially oriented problem design and the use of logic are applied to the use of GIS programs. Emphasis on applications in land resources management and planning. Graduate-level requirements include a research paper. (Identical with GEOG 519).

522. * Resource Mapping (3) II Use of computer technologies to map and inventory natural environments; integration of global positioning systems, remote sensing, and geographic information systems. 2R, 3L. Graduate-level requirements include a detailed report on the application of resource mapping to a specific problem in natural resource management. (Identical with GEOG 222).

527. Artificial Intelligence in Resource Management (3) I Use of artificial intelligence as it applies to natural resources, including knowledge representation, problem solving, expert systems, feature recognition, neural networks, and genetic algorithms. Examples are derived from current applications using various techniques to address management problems. P, computer programming skills.

536. Systems Ecology (3) I Study of processes that shape environmental and ecological structure, how these processes develop, and reaction to change. Focus is on the landscape scale and descriptive tools, including GIS and remote sensing. This course is temporary, and will be offered during the Fall of 1999 only. P, ECOL 182, CHEM 103a, CHEM 103b, PHYS 102; MATH 124 or MATH 125.

595. Colloquium
b. Public National Resource Management (2) II
596. Seminar
i. Management and Policy for Ecological Sustainability (3) [Rpt./ 1] II (Identical with POL 596l, which is home).
m. Conservation Biology (1) [Rpt./ 5] II (Identical with ECOL 596m, which is home).
597. Workshop
a. * Natural Resource Conservation Workshop (1) [Rpt./ 2] S
b. Desert Ecosystems (1) [Rpt./ 3] II
w. * Advanced Cadastral Survey (1-4) II P, prior training and work experience in cadastral surveying. (Identical with C E 597w).
599. Independent Study (1-5) [Rpt./]
613. Applied Biostatistics (3) II Introductory and advanced statistical methods and their applications in ecology. Focuses on how research design dictates choice of statistical models; explores principles and pitfalls of hypothesis testing.
693. Internship (2-8) [Rpt./] II
694. Practicum (1-8) I II
a. Teaching in Renewable Natural Resources Studies (1-3) [Rpt./ 4 units] I II
b. Teaching in Range Management (1-3) [Rpt./ 4 units] I II
c. Teaching in Watershed Management (1-3) [Rpt./ 4 units] I II
d. Teaching in Wildlife and Fisheries Science (1-3) [Rpt./ 4 units] I II
696. Seminar
a. Renewable Natural Resources (1-2) [Rpt./ 4 units] I II
b. Integrating Advanced Technology (3) I
a. * Natural Resource Conservation Workshop (1) [Rpt./ 2] S
605. Watershed Management (WS M) 506. * Applied Hydraulics (3) I (Identical with ABE 506, which is home).
508. * Wildland Fire Management (3) I Principles of fire behavior in forest, range and other vegetation types; interrelationships of fuels, weather, and topography; pyrolysis and combustion processes; effects of fire; fuels inventory; prevention, detection, and control techniques; fire danger rating and fire behavior modeling. Graduate-level requirements include a research paper on a specific fire issue or problem in the student's professional discipline area.
526. * Soil and Water Conservation Engineering (3) II S (Identical with ABE 526, which is home).
531. Dryland Forest Management (3) II Utilization and management of forest resources in dry environments; biophysical and socio-economic issues related to the development of forest commodities and amenities. P, 6 units of upper-division WS M.
532. Agroforestry (3) I Ecological and socioeconomic factors related to the planning and implementation of agroforestry systems. P, 6 units of upper-division WS M.
535. Water Management in Dryland Ecosystems (3) I Graduate-level requirements include a report and oral presentation on a topic related to hydrology or water management in dryland ecosystems. (Identical with ARL 535).
562. * Watershed Management (3) II
563. * Plant-Water Relations (3) II (Identical with PL S 563, which is home).
564. * Introduction to Dendrochronology (4) I (Identical with GEOS 564, which is home).
565. * Erosion and Environment (3) I Principles of erosion and sediment yield by water and wind; modeling and measurement of soil erosion; strategies for erosion and sediment control. Field Trips. P, WS M 460 or equivalent. Graduate-level requirements include a research paper and oral presentation.
567. * Advanced Watershed Hydrology (3) I Advanced topics in watershed hydrology; rainfall-runoff, infiltration, overland flow routing, sediment modeling, statistical analysis and research methods in hydrology. P, WS M 460. Graduate students will be required to do additional exercises. (Identical with ABE 567, HWR 567).
568. * Wildland Water Quality (3) II Introduction to water quality and its influences in natural environments. Interactions with land management and relationships to the larger issues of environmental quality. Graduate-level requirements include a class report and presentation on a negotiated topic of interest.
569. Spatial Analysis of Hydrology and Watershed Management (3) Geographic information systems (GIS) as a tool for hydrologists and environmental managers. Topics relate to the application of GIS including classification and suitability analysis, interpolation techniques, terrain analysis, model integration, and visualization. Examines sources of potential error and their ramifications. 2R, 3L. P, RNR 417 or RNR 517. (Identical with HWR 569).
571. Water Quality Control (3) II 2R, 3L. P, CHEM 103b. (Identical with C E 571, which is home).
577. Advanced Topics In the Economics of Environmental Regulation (3) II P, MATH 113, ECON 361. (Identical with AREC 577, which is home).
593. Internship (1-8) [Rpt./] II
595. Colloquium
c. * Dendrochronology (1-4) [Rpt./ 9 units] I II (Identical with GEOS 595c, which is home).
597. Workshop
c. * Dendrochronology (1-4) II (Identical with GEOS 597c, which is home).
599. Independent Study (1-5) [Rpt./]
605. Watershed Modeling (3) I Distributed modeling of hydrological and sedimentation processes at the watershed scale; emphasis on current concepts and applications.
693. Internship (1-8) [Rpt./] I II
696. Seminar
a. Watershed Management (1-2) [Rpt./ 4 units] I II
699. Independent Study (1-5) [Rpt./] I II
900. Research (1-8) [Rpt./]
909. Master's Report (1-3) [Rpt./]
910. Thesis (1-8) [Rpt./]
920. Dissertation (1-9) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

Wildlife and Fisheries Science (WFSC)
505. * Aquatic Entomology (4) II (Identical with ENTO 505, which is home).
541. * Limnology (4) I Study of lakes and streams; biological characteristics, as related to physical, chemical, geological, and historical processes operating on fresh waters. 2R, 6L. P, 6 units of biology and 3 units of chemistry. Graduate-level requirements include a report that synthesizes literature on a research issue of current concern, an in-class presentation and several discussion meetings. Field Trips. (Identical with ECOL 541).
549. Diseases of Wildlife (3) II (Identical with V SC 549, which is home).
555L. * Fishery Management Laboratory (1) II Field and laboratory methods pertaining to fishery investigations and management. P, or CR, WSFC 455R, WSFC 482. Graduate-level requirements include a detailed report and presentation on a current advance in field or laboratory methods of study.
555R. Fishery Management (3) II Methods and concepts pertaining to fishery investigations and management; application of principles for enhancement of fisheries and
aquatic habitats. Graduate-level requirements include a report on a current issue in management and a report on a research issue, plus several discussion meetings.

556. * Aquaculture (3) II Overview lectures and assigned readings on the theory and practice of aquaculture. Includes the culture of seaweeds, mollusks, crustaceans, and finfish. Field Trips. P, ECOL 181, ECOL 182, CHEM 103a, CHEM 103b, CHEM 104a, CHEM 104b. Graduate-level requirements include a topic report. (Identical with V SC 556).

574. * Aquatic Plants and the Environment (4) I II (Identical with SWES 574, which is home).

575. * Freshwater and Marine Algae (4) II (Identical with ECOL 575, which is home).

576. * Aquatic Vegetation (4) I II (Identical with ECOL 576, which is home).

578. Wildlife Population Dynamics (3) I Concepts and methods for estimating abundance and survival of fish and wildlife population, with emphasis on computer-assisted techniques, application to research design, and implications for management of populations. P, graduate standing.

581. Conservation, Biology, and Management of Large Mammals (3) I An in-depth examination of the ecology and management of big game in North America and an introduction to large mammals and megaherbivores in Asia, Europe, and Africa. Field Trips. P, WFSC 444 or WFSC 544.

582. * Ichthyology (4) I (Identical with ECOL 582, which is home).

583. * Herpetology (4) II (Identical with ECOL 583, which is home).

584. * Ornithology (4) II (Identical with ECOL 584, which is home).

585. * Mammalogy (4) I (Identical with ECOL 585, which is home).

588L. * Arizona Mammals Laboratory (1-2) S P, ECOL 588R. (Identical with ECOL 588L, which is home).

588R. * Arizona Mammals (3) S P, ECOL 588L. (Identical with ECOL 588R, which is home).

589. * Selected Studies of Birds (2) [Rpt./1] I (Identical with ECOL 589, which is home).

593. Internship (1-8) [Rpt./1] I II

595. Colloquium
a. Biopolitics (2) II Integrating views of partners and adversaries in decisions on management of ecosystems and endangered species. Consensus and decision making in managing wildlife. Objectivity or advocacy as the role of the professional wildlife biologist. c. Colloquium (2) II e. Advanced Topics of Population Ecology (1)

599. Independent Study (1-5) [Rpt./]

601. Population Regulation in Animals (2) II Exploration of theoretical and empirical basis of population regulation; critical review of literature on extrinsic and intrinsic forces; implications for management.

649. Fishery-Water Quality and Toxicology (3) I II Pertinent water quality parameters essential for fish life, and the effects of various substances and their interrelationships to fish and aquatic organisms. 2R, 3L. P, WFSC 441 or WFSC 445B; CHEM 241a. (Identical with V SC 649).

693. Internship (1-8) [Rpt./] I II

696. Seminar
a. Fish and Wildlife Ecology (1) [Rpt./1] II b. Restoration Ecology (2) I Examination of the emerging field of restoration ecology from a habitat and population perspective. Investigates concepts and applications of restoration ecology, with emphasis on southwestern ecosystems. This course is temporary, and will be offered during the Fall of 1999 only.

699. Independent Study (1-5) [Rpt./1] I II

900. Research (1-8) [Rpt./]

909. Master's Report (1-3) [Rpt./]

910. Thesis (1-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Retailing and Consumer Studies
(See Family and Consumer Resources)

Rhetoric, Composition and the Teaching of English
(See English)

Russian and Slavic Languages (RUSS)
Modern Languages, Room 340
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Degrees Offered: M.A.

Professors: George Gutsche, Head, Grace Fielder, John Garrard
Associate Professors: Alexander Dunkel,
Delbert Phillips, Teresa Polowy, Boriss Roberts (Emeritus)
Assistant Professor: John Leafgren
Senior Lecturer: Roza Simkhovich

The Department of Russian and Slavic Languages offers a diversified and balanced program of study that includes courses in literature, grammar, conversation, linguistics, and culture. All literature courses are conducted in Russian by native or near-native speakers. The emphasis is on the acquisition of practical skills as preparation for continued study, research, teaching, government service, and business careers. The program leads to a Master of Arts degree with a major in Russian.

Prerequisite for admission is the completion of at least 16 acceptable units of upper-division work in Russian.

The degree program requires the completion of at least 32 units, 27 of which must be in Russian, including 501a-501b, 507a-507b, 696c, 696d, 583, and one other linguistics course. Within this general framework and with the guidance of their advisor, students may choose to emphasize linguistics, literature and culture, language, pedagogy, or Slavic and East European studies. The decision regarding the requirement for a thesis will be made by the department after consideration of the student's preparation, graduate study program, and professional objectives. No more than 6 units may be earned for the preparation of a thesis. All students must pass a written/oral comprehensive examination. Prior to taking the final examination, each student must give satisfactory evidence of proficiency in the use of the Russian language or in the use of the English language if applicable.

The Arizona Russian Abroad programs provide an opportunity for Russian language study in St. Petersburg and Moscow. In addition, Arizona Russian Abroad provides an intensive business Russian program with internships in Russian and foreign firms that do business in Moscow. Information regarding these semester and summer programs may be obtained in the Russian and Slavic Languages Department, Modern Languages 340.

501a.-501b. Russian Stylistics (3-3) I Designed to improve the student's practical mastery and understanding of Russian at a higher and more sophisticated level. P, RUSS 301b.

502a.- 502b. Stylistics (5-5) I II Advanced grammar, root analysis, verb prefixes, and selected topics.

505a.-505b. Survey of Russian Literature (3-3) I II Graduate-level requirements include additional assignments.

506a.-506b. Survey of Russian Literature (2-2) I II Literary use of the Russian language across time and place.
b. Business Internship in Russia (3) II Internship in Moscow. 
b. Business Internship (1-6) I II

690. Seminar
a. Topics in Slavic Literature and Culture (3) [Rpt./ 2] I II
b. Russian Literature: 18th Century (3) [Rpt./ 3] I II
c. Russian Literature: 19th Century (3) [Rpt./ 3] I II
d. Russian Literature: 20th Century (3) I II
e. Topics in Slavic Linguistics (3) [Rpt./ 2] I II (identical with SLAT 696E).

699. Independent Study (1-5) [Rpt./]
900. Research (1-3) [Rpt./]
910. Thesis (1-6) [Rpt./]
930. Supplementary Registration (1-9) [Rpt./]

School Psychology  
(See Special Education and Rehabilitation)

Secondary Education  
(See Teacher and Teacher Education)

Second Language Acquisition and Teaching (SLAT)

427 N. Martin Ave.
Phone: (520) 621-7391
FAX: (520) 621-7391
WWW: http://www.coh.arizona.edu/SLAT/

Graduate Interdisciplinary Program in Second Language Acquisition and Teaching

Application Questions: Iris Rink, (520) 621-7391, AZSLAT@u.arizona.edu
Advising Questions: Mary Wildner-Bassett, (520) 621-1799, wildnerbh@u.arizona.edu
Degrees Offered: Ph.D.

Professors: Robert Ariew (French and Italian), Thomas G. Bever (Research (Cognitive Science, Linguistics, and Psychology), Richard Demers (Linguistics), Grace Fielder (Russian and Slavic Languages), Kenneth L. Forster (Psychology), Merrill F. Garrett (Psychology), Roseann D. Gonzalez (English), Kenneth S. Goodman (Emeritus, of Language, Reading and Culture), Yetta M. Goodman, Regent's Professor (Anthropology), D. Terence Langendoen (Linguistics), Adrienne J. Lehrer (Emerita), Luis C. Moll (Language, Reading and Culture), Susan U. Phillips (Anthropology), Frank Pialorsi (English), Hamdi A. Qafisheh (Near Eastern Studies), Richard Ruiz (Language, Reading and Culture), Muriel Saville-Troike (English), Renate A. Schulz (German Studies), Rudolph C. Troike (English)

Associate Professors: H. Douglas Adamson (English), Shirin Antia (Special Education and Rehabilitation), Andrew Bars (Linguistics), Paul Bloom (Psychology), Alexander Dunkel (Russian and Slavic Languages), Carol Evens (Teaching and Teacher Education), Lou Ann Gerken (Linguistics and Speech and Hearing Sciences), Donna M. Johnson (English), Kimberley A. Jones (East Asian Studies), Simin Karimi (Linguistics and Near Eastern Studies), Feng-hsi Liu (East Asian Studies), Teresa L. McCarty (Language, Reading and Culture), Cecile McKee (Linguistics), Samuel J. Supalla (Special Education and Rehabilitation), Cynthia White (Greek and Latin for the Classics Department), Mary Wildner-Bassett (German Studies), William J. Wilson (Near Eastern Studies), Ofelia Zepeda (Linguistics)

Assistant Professors: Carlee Arnett (German Studies), Dalila Ayoun (French) Lynn Carbon (Spanish), Todd V. Fletcher (Special Education and Rehabilitation), Rudolf Gaudio (Anthropology), John Gutierrez (Spanish and Portuguese), Eloise Jelinek (Adjunct, Linguistics), John R. Leafgren (Russian and Slavic Languages), Jun Liu (English), Norma Mendoza-Denton (Anthropology), Mario Montalbetti (Spanish), Antonio Olarra (Spanish and Portuguese), Tsuyoshi Ono (East Asian Studies), MaryAnn Willie (Linguistics), Mary L. Zampini (Spanish and Portuguese)

The Interdisciplinary Ph.D. Program in Second Language Acquisition and Teaching provides an instructional program to prepare researchers, teachers, curriculum specialists, and administrators at all levels of instruction who are concerned with aspects of second language acquisition, learning, and teaching. The cooperating departments include Anthropology; Classics; East Asian Studies; Educational Psychology; English; French and Italian; German Studies; Language, Reading and Culture; Linguistics; Near Eastern Studies; Psychology; Russian and Slavic Languages; and Spanish and Portuguese.
Students may choose from specializations in (1) second language analysis (grammar; contrastive linguistics/interlanguage studies), (2) second language use (discourse analysis, sociolinguistics, language policy/planning, rhetoric, pragmatics), (3) second language processes and learning (second/foreign language acquisition: theory and research), or (4) second language pedagogical theory and program administration (ESL/FL methods, curriculum development, testing and evaluation, reading and writing, educational technology).

Admission to the program is based on the following kinds of evidence: (1) excellent prior academic performance in a related field as indicated by a transcript; (2) three letters of recommendation from persons familiar with the student's performance; (3) an example of the student's scholarly writing on a topic related to the proposed area of study, or a critical review of a relevant book; and (4) GRE Aptitude test. In addition, the TOEFL examination is required of international students.

All students must demonstrate a thorough knowledge of one language other than English before advancement to candidacy, judged according to criteria and procedures established by the committee. Evidence of such second language proficiency, including (but not limited to) a tape recording of speech production in that language, will be required prior to admission of all students applying for a graduate teaching assistantship.

Students will be required to complete a minimum of 81 units beyond the B.A./B.S. degree including 33 units of required courses, 18 units in one of the 4 areas of specialization, 12 units in a minor area of specialization, and 18 units of dissertation. It is anticipated that most students entering this degree program will hold the master's degree or its equivalent. Prior graduate-level course work which is judged by the committee to be comparable to required courses in this program may be counted toward the 81 total units. Core course requirements include linguistics, psycholinguistics, sociolinguistics, and research methodology, as well as second language acquisition theory and teaching practice. A detailed listing of courses and alternatives is available from the program office.

Prospective Ph.D. candidates must pass a qualifying examination after entry into the program. Before formal admittance to candidacy all students must pass a comprehensive examination in both the major and minor field of study. A final examination is required following completion of the dissertation.

**Sociology (SOC)**

Social Science Building, Room 400
Phone: (520) 621-3531, (520) 621-5057
FAX: (520) 621-9875
WWW: http://ws3.arizona.edu/SOC/

Application Questions:
Bonnie Thompson
thompsonb@u.arizona.edu

Advising Questions:
Albert J. Bergesen, (520) 621-3303, albert@u.arizona.edu

Degrees Offered: M.A., Ph.D.


Associate Professors: James T. Borheke (Emeritus), Mark A. Chaves, Courtney B. Cleland (Emeritus), Elisabeth Clemens, Don Grant, Jerry L.L. Miller (Emeritus), Calvin Morrill, Kathleen S. Schwartzman, James W. Shockey

Assistant Professors: Richard B. Arum, Sun-Ki Chai, Ted Gerber, Marc Schneiberg, Sarah Soule

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degree. Requirements of sociology are represented in the department, with special concentrations in the areas of law, deviance and social control, culture, organizations, social psychology, stratification (including race, class, and gender), and political sociology (including political institutions, social movements and collective action, and world-systems analysis).

Master of Arts: The M.A. degree requires a total of 30 units of credit for 500-level courses in sociology, including six required courses: SOC 500a-500b, 570a-570b, 575 and 595a (a 1-credit colloquium). Students must write and successfully defend, in a final oral examination, a research paper that is suitable for publication in a professional sociology journal. No formal master's thesis is required. The master's program is designed for students who intend to continue work toward the Ph.D.

Doctor of Philosophy: The Ph.D. degree requires a total of 69 units of graduate credit, including credits taken during the master's program. These credit hours must include 18 hours of dissertation credit. At least 51 hours of credit must be in courses in sociology, the major subject. In addition to completion of the required courses for the M.A. degree, students must complete (1) two courses from each of two preliminary examination areas, and (2) one course in advanced methods or statistics. Students must also pass written comprehensive examinations in each of two areas and an oral examination over both areas. Finally, they must write and successfully defend a doctoral dissertation in a final oral examination. There is no language requirement and no requirement for a minor, although students have the option of minoring in another department.

Admission requirements: Admission to the graduate program is offered to a limited number of students demonstrating academic excellence and professional promise. To receive consideration for fall admission with financial aid, completed applications must be received by January 15. In addition to application materials required by the Graduate College, applicants must submit to the department a completed departmental application form, GRE general aptitude scores taken within the last three years, three letters of recommendation, a statement of purpose, and a sample of written work.


505. World-System Theory and Research (3) I II Theory and research on the modern world-system.

508. Sociology of Culture (3) II Theory and research on the nature of cultural systems, cultural production and consumption, and strategies of interpretive analysis. P, consult department before enrolling.

509. Objects and Methods of Cultural Analysis (3) I From content analysis to statistical analysis, means of gathering and analyzing data on cultural objects.

510. Political Sociology (3) II Basic approaches in political sociology, with emphasis on the relationship of economic and political processes.

511. Rational Choice Sociology (3) II Survey of the rapidly growing literature that applies the basic principles of rational choice theory to classic sociological problems such as the emergence of effective norms, the
causes of marriage and divorce, the attainment of group solidarity, the causes of collective action, and the effects of institutions on social order.

514. The State and Social Policy (3) I II Examination of the historical development of the state, processes of policy formation, and the political economy of modern welfare and regulatory regimes.

515. Social Movements and Collective Action (3) I II A sociological examination of the emergence and development of social movements/collective action at both the societal and individual levels. Major theoretical perspectives on social movements/collective action will be reviewed as will recent and classical empirical works in the area. P: admission to graduate program or consult department before enrolling.

516. * Health, Ethics and Public Policy (3) II (Identical with PA 516, which is home).

520. * Communication and the Legal Process (3) I (Identical with COMM 520, which is home).

521. Social Policy (3) I (Identical with PA 521, which is home).

524. Organization Ecology (3) I Survey of theory and research in organizational ecology, focusing on the organizational population as the level of analysis. Topics include population boundaries, selection vs. adaptation, evolutionary dynamics.

525. Organizational Theory (3) I II Basic review of classic and contemporary approaches to the study of complex organizations; formation, development, and internal processes. (Identical with MAP 525).

527. Social Networks (3) I II The logic and methods of social network analysis. Emphasis on theoretical underpinnings and applications to sociological research.

530. Theories and Research in Social Psychology (3) I II A comprehensive introduction to the major theoretical perspectives, methodologies, research areas, and issues in contemporary social psychology.

532. Structured Approaches to Role and Identity (3) I II An examination of the concepts of role, self, and identity in relation to social structures. Alternative approaches are presented, but the structured symbolic interactionist perspective is highlighted. P, SOC 530 or consult department before enrolling.

533. Social Relations, Groups, and Networks (3) I An analysis of social interaction in relations, groups, and networks, emphasizing the reciprocal influences of social structure and social process. Theories of exchange, power, status, and justice are considered. P, SOC 530 or consult department before enrolling.

535. Advanced Topics in Social Psychology (3) [Rpt./2] I II An in-depth study of one area of theory and research in social psychology. Topics vary.

540. Correctional Policy and Theory (3) I II (Identical with PA 540, which is home).

541. Deviance and Social Control (3) I II Theory and research on the origins of various forms of deviant behavior, and on the consequences of efforts to control them. P, SOC 341 or SOC 342; SOC 201. (Identical with PA 541).

542. Criminology (3) I II A comprehensive review of classic and contemporary approaches to crime, its nature, causes and consequences.

543. White Collar and Organizational Crime (3) I (Identical with PA 543, which is home).

545. Law and Society (3) [Rpt./1] I Comprehensive survey of major theoretical perspectives, methodologies, and empirical works on the origins, operations, development, and social consequences of legal and quasi-legal institutions.

546. Crime and Public Policy * (3) [Rpt./6 units] I II (Identical with PA 546, which is home).

551. Stratification and Class (3) I II Basic examination of concepts and research in the area of stratification, with emphasis on the classic statements and contemporary research.

552. Advanced Topics in Stratification (3) [Rpt./1] I II In-depth study of one contemporary area of research in stratification. Topics will vary.

553. Sociology of Education (3) I Survey of sociological theory and research on education. Focuses on courses and consequences of variation in school practices affecting individual student achievement, behavior, and labor market outcomes.

556. Gender Issues in Organizational Behavior (3) I II (Identical with MAP 556, which is home).

557. Gender and Labor (3) I Sources and consequences of gender differentiation and inequality, with attention to occupations, earnings, labor markets, household work, and the family. P, 3 graduate credits in women's studies, sociology, or economics. (Identical with COMM 557).

560. Race and Ethnicity (3) I II Analysis of recent research on the relations among racial and ethnic groups in society, with special attention to current empirical and theoretical issues.

569. Basic Quantitative Methods (3) I An introduction to basic quantitative methods for professional sociologists, including computer, mathematical, and statistical concepts.

570a-570b. Social Statistics (3-3) I Probability, distributions, estimation and hypothesis testing. 507b: II Ordinary least squares regression, generalized least squares regression, structural equation models (path analysis and non-recursive systems).

575. Advanced Social Research Methods (3) I II Nature and execution of social research; experimental and non-experimental designs, data collection, techniques of analysis and interpretation.

576. Field and Observational Methods (3) I II Comprehensive and critical examination of the collection, coding, analysis, and presentation of ethnographic/qualitative field data. Original field research required. P, admission to graduate program or 3 graduate credits in women's studies, sociology, or economics. (Identical with COMM 576).

577. Experimental Methods (3) I The logic, design and analysis of experiments in social science research. Topics include the relation of experimentation to theory, experimental design, and practical issues. P, SOC 575 or consult department before enrolling.

580. Population Studies (3) I Theory and research in the fields of fertility, mortality, and migration, with emphasis on their relationships to social structure. An original research project is required.

585. Constructing Social Theories (3) I II The nature and fundamental types of social theories. Formulating theories to guide research across a range of substantive areas. Criteria for choosing among alternative theories.

595. Colloquium
   a. Introduction to Graduate Study (1) I

596. Seminar
   a. Advanced Problems in Research (1-3) [Rpt./6 units] I II
   b. Graduate Teaching (3) I II
   c. Teaching Practicum (1) I II
   d. Sociology of Religion (3) I Course begins with classic alternative treatments of the relationship between religion and society and then proceeds to consider recent developments in the sociological study of religion. Among the general questions this course will address: what is the nature of religion as social phenomenon? Do religious beliefs have causal efficacy in the social world? What are the relationships between religious beliefs and social position? Whence the great variety in religion's social expression and organization? What is the relationship between religion and social conflict? Between religion and rationality? What is religious conversion and why do individuals convert? Are modern societies
secular? This course is temporary, and will be offered during the Fall of 1999 only.

e. Social Organizations (3) [Rpt./ I I [Note: This is a two-semester course beginning in the fall, that receives a "K" grade at the end of the first semester. P, completion of 1st year graduate program curriculum in sociology. (Identical with MAP 596c).

r. Research and Publication (3) [Rpt./ I I

s. Technology and Social Theory (3) II (Identical with MSE 596s, which is home).

599. Independent Study (3) [Rpt./]

693. Internship (1-4) [Rpt./]

696. Seminar

a. Science and Social Theory (3) II (Identical with ENGR 696a, which is home).

699. Independent Study (1-4) [Rpt./]

900. Research (2-8) [Rpt./]

910. Thesis (4) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Soil, Water and Environmental Science (SWES)

Shantz Building, Room 429
Phone: (520) 621-1646
FAX: (520) 621-1647
WWW: http://ag.arizona.edu/SWES/

Application Questions:
Judith Ellwanger, Graduate Secretary, (520) 621-1646, ellenwang@ag.arizona.edu

Advising Questions:
Mark L. Brusseau, (520) 621-1646, sw@ag.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: Peter J. Wierenga, Head (Soil Physics), Donald J. Baumgartner (Environmental Engineering), Hinrich L. Bohn (Soil Chemistry), Mark L. Brusseau (Subsurface Hydrology), Gordon R. Dutt (Emeritus), Wallace H. Fuller (Emeritus), Charles P. Gerba (Microbiology), Ed P. Glenn (Botanical Sciences), Alfredo R. Huete (Soils/Remote Sensing), Ian L. Pepper (Environmental Microbiology), Donald F. Post (Emeritus), Norval A. Sinclair (Emeritus), Jack L. Stroehlein (Emeritus), Thomas C. Tucker (Emeritus), Arthur W. Warrick (Soil Physics)

Associate Professors: Robert J. Frye (Ecology/Evolutionary Biology), David M. Hendricks (Soil Science), Allan D. Mathias (Environmental Physics), Raina Maier (Environmental Microbiology), James J. Riley (Hydrology), Thomas L. Thompson (Soil Chemistry/Fertility)

Assistant Professor: Joan E. Curry (Physical Chemistry)

Research Scientist: Charles Sanchez, Manager Yuma Agricultural Center

Associate Research Scientists: Janick F. Artiola (Environmental Chemistry), Kevin Fitzsimmons (Aquaculture)

Extension Specialists: Paul Brown (Meteorology/Soil Science), James Walworth (Plant Nutrition)

Joint/Adjunct Faculty: Susan Moran, USDA (Remote Sensing), Stephen Nelson, Environmental Research Laboratory (Marine Ecology), Jeffrey Silvertooth, Plant Sciences (Plant Nutrition), Jim Yeh, Hydrology (Hydrology/Water Resources), Martin Yoklic, Environmental Research Laboratory (Planning Systems)

The department offers opportunities for study toward the Master of Science and Doctor of Philosophy degrees with a major in Soil, Water, and Environmental Science. Three areas of emphasis are available: Environmental Science, Soil Science, and Soil-Plant-Water relations. Areas of concentration in Environmental Science include: environmental chemistry; environmental microbiology; contaminant transport; pollution management and remediation; water quality; and remote sensing of terrestrial ecosystems. Areas of concentration in Soil Science include; soil physics; soil chemistry; soil biology; soil genesis, morphology, and classification; soil and mineralogy. Areas of concentration in Soil-Plant-Water Relations include soil-water management, soil fertility, and plant nutrition. Theses and dissertations are required, and must be prepared in acceptable formats according to department and Graduate College guidelines. A minor is available with a minimum of 12 units of soil science courses, which includes three of the following courses: SWES 511, 525, 531, 570 or 602. Details of the graduate program can be found in the Department Graduate Student Handbook (http://ag.arizona.edu/SWES/97handb.htm).

Graduate study in the Department of Soil, Water and Environmental Science is open to students with undergraduate preparation in biological, chemical, physical, earth or engineering sciences. A limited number of graduate research assistantships are available to students with outstanding potential. A limited number of teaching/research assistantships are also available.

The Department of Soil, Water and Environmental Science brings together an interdisciplinary faculty of scientists, distinguished by their understanding of soil, water, and the environment, and their ability to carry out research and planning towards the solution of environmental and resource use problems.

501. Management of Arid Land and Salty Soil (3) II Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.

504. Irrigation Principles and Management (3) II P, open to non-majors only. (Identical with ABE 504, which is home).

505. Environmental, Soil and Water Chemistry Laboratory (3) II Principles and methods of the chemical analysis of soils, water and biological materials with emphasis on illustrating important soil and environmental concepts and processes. P, CHEM 322, CHEM 532, PHYS 102. Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.

511. Soil Chemistry (3) I CDT Composition and crystal chemistry of soil minerals; nature of soil organic matter; application of colloidal chemistry to the soil system; chemistry of the soil solution and acid- and salt-affected soils.

517. Geographic Information Systems for Natural Resources (3) II (Identical with RNR 517, which is home).

520. Environmental Physics (3) I Physical principles used in assessment, prevention or reduction of environmental problems. Main themes include energy sources; energy and mass transport; and pollution within soil, water and air. P, MATH 125b, PHYS 103. Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.


526. Environmental Microbiology Laboratory (3) I Basic techniques for isolation and characterization of environmental soil and water microflora including methods for enumeration and measurement of physiological activity. P, SWES 425. Graduate-level requirements include additional assignments. (Identical with MBIM 526).

531. Soil Morphology, Classification and Interpretation (3) I Theory and practice of describing characteristics of soils; principles of soil classification and classification systems; making soil interpretations for selected land uses. P, SWES 200, SWES 201. Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.
540. * Biodegradation of Pollutants in Soil and Groundwater (3) II Description of modern pollution problems and potential biological remediation techniques focusing on the chemistry, biochemistry and molecular biology of biodegradation of hazardous and toxic compounds. P, SWES 425. Graduate-level requirements include a short oral presentation about a recent journal article and a paper pertaining to recent advances in biodegradation studies. (Identical with MBIM 540).

541. Soil Genesis (3) II Physical and chemical processes and mineralogy of weathering and soil formation; quantitative pedology; the soil as part of the ecosystem. P, GEOS 101, CHEM 103h. (Identical with GEOS 541).

544. Applied Environmental Law (3) I A guided journey through real world environmental law; U.S. legal system, major environmental laws-criminal and civil; common marketplace problems and solutions; high profile cases; essential professional skills. Graduate-level requirements include extra term papers and case studies.


550. * Anticipating the Future: Focus on Environment (3) II Techniques and approaches to understanding broad issues about the future with focus on environmental topics. Uses computer conferencing with Internet and significant student discussion and opportunities for team approaches and reporting. Graduate-level requirements include a report in an area of special interest.

553. * Remote Sensing of the Environment (3) II Remote sensing techniques and applications for improved natural resource utilization of soils, water, grasslands, and forest. Fundamental energy-matter interactions that influence the spectral characteristics of vegetation, soil, and water. P, SWES 330 or PHYS 102h. Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.

561. * Soil and Water Conservation (3) I Consideration of major world soil and water conservation problems and solutions; principles of soil and water degradation by erosion, ground water overdraft, chemical transport in surface and ground water and their effects on world food production and environmental problems. P, SWES 200. Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.

564. Environmental Chemistry (3) I Physical and chemical processes influencing the behavior of contaminants in the subsurface environment. Includes equilibrium and kinetic theory of solubilization-dissolution, volatilization, sorption, hydrolysis, photolysis, surface catalysis and radioactive decay. P, CHEM 103b, CHEM 480a.

565. Contaminant Transport in Porous Media (3) II The transport of contaminants in the subsurface environment. Effects of dispersion, interphase mass transfer, transformation reactions, and porous-media heterogeneity on transport. Covers aqueous (dissolved) and multiphase (immiscible liquid, gas) systems. P, SWES 570 or HWR 518 or HWR 531.

566. Soil and Groundwater Restoration (3) I Graduate-level requirements include a research paper. P, HWR 531 or equivalent, SWES 564 or equivalent. (Identical with HWR 566).

570. * Soil Physics (3) II CDT Soil structure and physical constitution of soils; the physical properties of soil-water systems, movement and exchange of gases in the soil, and physical laws governing the movement and availability of soil water. P, SWES 200, PHYS 103; CR, MATH 125a. Graduate-level requirements include an in-depth research paper on a single aspect of a current topic.

573. Monitoring Biosphere Process (3) I Global-scale interactions of soils with their plant cover and climate. The spatial distributions and dynamics of soil-plant-water processes with emphasis on measurements from space. P, SWES 330 or SWES 453; SWES 200.

574. * Aquatic Plants and the Environment (4) II The role of riparian areas, estuaries, and constructed wetlands in the environment. Emphasis on plants as wildlife habitat for nutrient cycling and bioremediation. (Identical with ECOL 474, WFSC 474). Graduate-level requirements include an additional research project and class presentation. (Identical with ECOL 574, WFSC 574).

575. * Freshwater and Marine Algae (4) II (Identical with ECOL 575, which is home).

583. * Geographic Applications of Remote Sensing (3) II (Identical with GEOG 583, which is home).

590. Remote Sensing for the Study of Planet Earth (3) II (Identical with REM 590, which is home.)

593. Internship (1-3) [Rpt./] 1 II

599. Independent Study (1-4) [Rpt./] 1 II

602. Soil-Plant Relationships (3) I Principles of soil solution and colloid chemistry, soil-water relationships, soil microbiology, and plant physiology and metabolism. These principles are applied to processes of soil nutrient cycling, nutrient availability, and plant growth. P, SWES 200.

605. Soil-Water Dynamics (3) II Water flow in soils; closely related problems of solute, pollutant, and heat transfer; emphasis on current concepts and research. P, MATH 254. (Identical with ABE 605, HWR 605).

693. Internship (1-3) [Rpt./] 1 II

696. Seminar

699. Independent Study (1-6) [Rpt./] 1 II

900. Research (1-6) [Rpt./]

909. Master's Report (1-9) [Rpt./]

910. Thesis (1-8) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Spanish and Portuguese (SPAN)

Modern Languages Building, Room 545
Phone: (520) 621-3123
FAX: (520) 621-6104
WWW: http://www.coh.arizona.edu/spanish/spanish.html

Application Questions:
Graduate Secretary, (520) 621-3125

Degrees Offered: M.A., Ph.D.


Associate Professors: Gilbert E. Evans (Emeritus), Karl C. Gregg (Emeritus), John Gutierrez, H. Reynolds Stone (Emeritus), Amy R. Williamsen, Mary Zapinni

Assistant Professors: Lynn Carbon, Ana Maria Carvalho, Lydia Fossa, Mario Montalbetti, Antonio Olarrea, Pithamber Polsani

Lecturers: Maria Nivea Parsons, Ana Perches

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in Spanish. For students in other departments, the Department of Spanish and Portuguese offers a doctoral minor in Spanish.

Admission to all graduate programs requires the completion of a bachelor's degree with a major in the proposed field of study. Admission to the doctoral program in Spanish is dependent upon the completion of a Master of Arts degree with a major in Spanish at The University of Arizona or elsewhere.

All graduate teaching assistants in Spanish are required to complete a language teaching methodology course during their first semester of classroom teaching.
The Master of Arts with a major in Spanish requires a minimum of 30 units in one of two concentrations plus a 1-unit proseminar.

1. Hispanic literature concentration. The applicant must hold or anticipate completing by the time of admission a bachelor's degree from an accredited U.S. college or university or the equivalent degree from a university elsewhere. The applicant is expected to have a minimum of 15 semester hours of Hispanic literature courses at the advanced level and one advanced Spanish grammar and composition course or the equivalent of the undergraduate major in Hispanic literature at The University of Arizona; to have a minimum grade-point average of 3.3 on a 4-point scale overall; and to have a minimum grade-point average of 3.4 on a 4-point scale in Spanish.

Upon entering the program, the student establishes his/her degree study program in consultation with the Director of Graduate Studies. The student is required to complete a minimum of 30 graduate units with equal concentration in Spanish and Spanish-American literature, a 3-unit seminar in Hispanic literature, a 1-unit proseminar, and a general written examination in the field of Hispanic literature.

2. Hispanic linguistics concentration. The applicants must hold or anticipate completing by the time of admission a bachelor's degree from an accredited U.S. college or university or the equivalent degree from a university elsewhere. The applicant is expected to have a minimum of one advanced Spanish grammar course and one advanced Spanish conversation and composition course; to have a minimum of 9 semester hours in areas including Spanish phonetics and pronunciation; advanced Spanish syntax, and general linguistic theory or their equivalent; to have a minimum grade-point average of 3.3 on a 4-point scale overall; and to have a minimum of 3.4 on a 4-point scale in Spanish.

Upon entering the program, the student establishes his/her degree study program in consultation with the Director of Graduate Studies. The student is required to complete a 3-unit seminar in Hispanic linguistics; 1-unit proseminar; and a general written examination in the field of Hispanic linguistics.

Applicants to the Doctor of Philosophy with a major in Spanish must hold (or anticipate completing by the time of admission) an M.A. degree from an accredited U.S. college or university or the equivalent degree from a university elsewhere, have a minimum grade-point average of 3.4 on a 4-point scale in the M.A. in Spanish, and meet the general requirements of the Graduate College.

Upon entering the Ph.D. program, the student establishes his/her degree study program in consultation with the Director of Graduate Studies. The student must (1) complete a minimum of 36 graduate units; (2) complete a 1-unit proseminar and at least two 600-level seminars; (3) present a reading knowledge of one foreign language, other than English or Spanish, appropriate to the field of specialization; (4) pass a comprehensive examination, partly written and partly oral, in the primary field of study and in two secondary fields of study; and (5) complete 18 doctoral dissertation units, and write and defend a dissertation.

In consultation with the Director of Graduate Studies, the student selects one primary field of study from the following areas: (1) Medieval, Renaissance, and Golden Age Spanish literature; (2) eighteenth, nineteenth, and twentieth-century Spanish literature; (3) Spanish American literature from the Pre-Columbian period to independence; and (4) Spanish American literature from the Pre-Columbian period to independence; and (4) nineteenth and twentieth century Spanish American literature. In addition, the student selects two secondary areas of study outside the primary field from the following areas of study: (1) thirteenth through eighteenth-century Spanish literature; (2) nineteenth and twentieth-century Spanish literature; (3) Pre-Columbian through eighteenth-century Spanish American literature; (4) Pre-Columbian through eighteenth-century Spanish American literature; (4) Pre-Columbian through eighteenth-century Spanish American literature; (5) Mexican and Mexican American literature; (6) Hispanic linguistics; (7) Luso-Brazilian literature; and (8) literary theory.

At least 18 units must be taken in the primary field of study and 6 units in each of the two secondary areas of study. The remaining 6 units are electives. A student whose major field is Spanish American literature must choose one secondary field in Spanish peninsular literature, and vice versa.

Spanish (SPAN)

501. Introduction to Hispanic Studies (1) I II Broad view of fields of research, faculty and courses to familiarize students with some practical aspects of graduate studies, issues that pertain to specific fields of research and questions currently being debated across the profession.

510. Development of Spanish Medieval, Renaissance, and Golden Age Literature (3) I Spanish medieval, renaissance, and golden age literature (short fiction, poetry, novel and drama) from the twelfth through the seventeenth century.

511. Topics in Medieval Literature, Renaissance, and Golden Age Literature (3) [Rpt./ 3] I II Representative topics include the development of lyric verse; Mester de Ciceria, art of the Juggler; the Romancero; the development of prose; renaissance and baroque prose or verse; Cervantes; Golden Age drama; picaresque novel.

520. Development of 18th, 19th, and 20th-Century Spanish Literature (3) I Spanish eighteenth, nineteenth, and twentieth-century literature (short fiction, poetry, novel and drama).

521. Topics in Eighteenth, Nineteenth, and Twentieth-Century Spanish Literature (3) [Rpt./ 3] I II Representative topics include Spanish romanticism; nineteenth century realist and naturalist Spanish prose; the generation of '98; modern Spanish prose fiction; modern Spanish poetry; the contemporary novel of the post-Franco era; contemporary Spanish poetry; modern and contemporary Spanish theater.

530. Development of Spanish-American Literature: Pre-Columbian to Independence (3) I Spanish-American literature from the Pre-Columbian period to independence (prose, poetry and drama). (Identical with LA S 530).

531. Topics in Spanish-American Literature: Pre-Columbian Period to Independence (3) [Rpt./ 3] I II Representative topics include pre-Columbian Aztec, Mayan, and Maya Quiche literature; the chronicle; Renaissance and baroque poetry.


541. Topics in Spanish-American Nineteenth and Twentieth-Century Literature (3) [Rpt./ 3] I II Representative topics include: nineteenth-century Hispanic-American prose fiction; modernismo; modern Hispanic-American prose fiction; modern Hispanic-American poetry; contemporary Hispanic-American prose fiction; contemporary Hispanic-American poetry; modern and contemporary Hispanic-American theater; trends in the Hispanic-American short story.

551. Topics in Mexican and Mexican-American Literature (3) [Rpt./ 3] I II Representative topics include: novel of the Mexican revolution; trends in Mexican and Mexican-American films; trends in contemporary Mexican literature; Mexican American prose fiction since 1965; trends in Mexican-American theater; major movements and authors of Mexican-American literature.

561. Topics in Hispanic Literature (3) [Rpt./ 3] I II Representative topics include Hispanic women writers; U.S. Hispanic literature; trends in modern and contemporary Spanish film; trends in modern and contemporary Hispanic American film.

571. Topics in Literary Theory and Criticism (3) [Rpt./ 3] I II Topics include historical overview of major developments in literary theory and criticism with theoretical and critical analysis of Hispanic texts.

574. Linguistic Perspectives on Mexican-American Spanish and Bilingualism (3) I II Focuses on descriptive linguistic analyses of Chicano language phenomena examined in sociolinguistic/psycholinguistic contexts. Analyses include phonological and phonetic levels with primary emphasis on morphosyntactic and lexical realizations. Macro-sociolinguistic topics of languages in contact/conflict, language shift, language choice/preference, language attitudes and specific linguistic behaviors associated with Chicano bilingualism. P, SPAN 340. (Identical with LING 574, MAS 574).

579. Issues/Methods in Post-Second Foreign Language Teaching/ Learning (3) I II (Identical with GER 579, which is home).

580. Introduction to Hispanic Linguistics (3) [Rpt./ 3] I II May be taken up to four times and will rotate between the following four topics: 1) Introduction to Hispanic Sociolinguistics: Current sociolinguistic perspective on the Spanish Language, 2) Introduction to Spanish in the Americas: Diachronic and synchronic perspectives on the evolution and development of the Spanish-American Dialectology, 3) Introduction to Spanish Phonology: Theoretical perspectives on major issues of Spanish phonology, and 4) Introduction to Spanish Morpho-Syntax: Current theoretical perspective on major issues of Spanish Morpho-Syntax.

581. Topics in Second Language Theories and Applications (3) [Rpt./ 3] I II May be taken up to four times and will rotate between the following four topics: 1) Theories of Second Language Acquisition: Analysis of the current theories of second language acquisition including theories from linguistics, psychology and education, 2) Curriculum and Materials Development: Development of curricula and materials that reflect the impact of current research in the field of second language acquisition, 3) Theories and Techniques of Teaching Spanish: Study and analysis of theories of language instruction and learning with an emphasis on proficiency-oriented approaches that stress strategic development of skills and accuracy, and 4) Applied Linguistics: Application of current linguistic theories to language analysis for the purpose of teaching forms and functions teaching based on patterns of use as well as similarities and contrasts with English.

582. Topics in Hispanic Linguistic Theories and Applications (3) I II May be taken up to four times and will rotate between the following four topics: 1) Morphological Theory: Theoretical perspectives on the major morphosyntactic and morphophonological issues of Spanish Morphology, 2) Linguistic Perspectives on Mexican American Spanish and Analyses of (socio)linguistic phenomena encountered in the Spanish of the Southwest, 3) History of the Spanish Language: Diachronic and synchronic perspectives on the evolution and development of peninsular Spanish, and 4) Theoretical Issues in Spanish Phonology: Further nonlinear theoretical analyses of selected problems in Spanish Phonology.

587. Testing and Evaluation in Foreign/ Second Language Programs (3) I II (Identical with GER 587, which is home).

596. Seminar J. Second Language Acquisition Research (3) [Rpt./ 4] II P, ENGL 506. (Identical with ENGL 596j, which is home).

599. Independent Study (1-4) [Rpt./]

609. Independent Study (1-4) [Rpt./]

699. Independent Study (1-4) [Rpt./]

Portuguese (PORT)

501. * Luso-Brazilian Literature-1900 (3) I II Overview of literary periods and introductions to major literary figures of Portugal, Brazil and the Luso-African countries (Angola, Mozambique, Cape Verde, Guinea-Bissau, Mozambique and Porto Principe) from the beginning of their literature to 1900. P, PORT 325 or equivalent. Graduate-level requirements include a 20-page paper and an oral presentation.

530. * Brazilian Civilization (3) I II Broad survey of Brazilian culture. Thematic examination of some of the major cultural developments. Topics include: Brazilian music, Afro-Brazilian culture, the role of women in Brazilian society, Brazilian popular culture. P, PORT 325 or equivalent.

Graduate students required to write four research papers and give one lecture on a topic of his/her choice.

531. * Civilization in the Portuguese-Speaking World (3) I II Cross-cultural examinations of the Portuguese-speaking world (Brazil, Portugal, Angola, Cape Verde, Mozambique, Guinea-Bissau, Porto Principe). Topics include: colonization and decolonization, religion, music, dance, painting, architecture. P, PORT 325 or equivalent. Graduate-level requirements include a twenty page paper and an oral presentation on the paper. (Identical with LA S 531).

549. * Brazilian Literature in Film (3) I II Presentation of the masterpieces of Brazilian literature and the great films based upon them. P, PORT 325 or equivalent. Graduate-level requirements include an in-depth research paper. (Identical with LA S 549).

563. * Topics in Luso-Brazilian Literature (3) I II Major works, authors and tendencies in the literature of the Portuguese speaking countries (Brazil, Portugal, Angola, Cape Verde, Mozambique, Guinea-Bissau, Porto Principe). P, PORT 325. Graduate-level requirements include additional research and reports. (Identical with LA S 563).

597. Workshop r. * Advanced Intensive Portuguese and Brazilian Culture (6) I P, one year of Portuguese and consent of instructor.

599. Independent Study (1-4) [Rpt./ 1 II

699. Independent Study (1-4) [Rpt./ 1 II

Special Education and Rehabilitation (SERP)

Education Building, Room 412
Phone: (520) 621-7822
FAX: (520) 621-3821
WWW: http://www.ed.arizona.edu/departs/ser/serinfo.html

Application Questions: Luciana Alicio, sergrad@u.arizona.edu
Advising Questions: Luciana Alicio, sergrad@u.arizona.edu

Degrees Offered: M.A., Ed.S., Ed.D., Ph.D.
Concentrations: behavior disorders, bilingual learning disabilities, deaf and hard of hearing, gifted and talented, interstellar, learning disabilities, orientation and mobility, rehabilitation counseling, rehabilitation vision, school psychology, severe profound and visually impaired.

Professors: Lawrence M. Aleamoni, Head, Shirin D. Antia, Candace S. Bos, James C. Chaffant, Bob G. Johnson (Emeritus), C. June Maker, Jeanne McCarthy (Emerita), Shitala Mishra, Richard J. Morris, John E. Obrzut, Amos P. Sales, Inez Tucker (Emerita), John Umbrett
The department is committed to scholarship and leadership in the development of theory and practice related to the empowerment of individuals with disabilities and special abilities. The department's research, teaching, and service address current issues in special education, rehabilitation, and sign language studies. The department offers professional preparation of special education teachers and specialists; school psychologists; teachers of the gifted and talented; rehabilitation counselors; and administrators, researchers and teacher educators.

The department offers programs leading to the Master of Arts, Educational Specialist, Doctor of Education and Doctor of Philosophy degrees with a major in special education and rehabilitation. Educational Specialist and doctoral programs focus on leadership in research, administration, and teacher education in special education and rehabilitation.

Concentrations focus on rehabilitation counseling; school psychology; and teacher education in the areas of deaf/hard-of-hearing, emotional/behavioral disorders, gifted and talented, bilingual special education, learning disabilities, mental retardation, rehabilitation vision, severe/multiple disabilities and visually impaired.

An undergraduate grade-point average of at least 3.0 is required for admission to full standing in a graduate degree program. However, applicants with undergraduate grade-point averages of 2.75 to 2.99 may be admitted on a provisional basis, if approved by the department head and the Dean of the Graduate College. A master's degree is a prerequisite for admission to a specialist or doctoral program. Beyond these minimal requirements, applicants must also meet the specific admission requirements of the majors.

500. Foundations of Special Education and Rehabilitation (3) I II Provides beginning graduate students with a knowledge of issues surrounding the fields of special education and rehabilitation. Issues include legal; principles and concepts of assessment; principles of teaching and counseling. Students will examine and develop their personal philosophies regarding assessment of, services to and intervention with individuals with exceptionalities. P, SERP 400.

501a. * Assessment and Instruction or Students with Early Reading and Spelling Difficulties (3) I II Procedures, methods, strategies for informal diagnosis and instruction of students with learning problems in the areas of reading and spelling. Strategies appropriate for use in the elementary or the special classroom. Graduate-level requirements include an in-depth project.

502. * Behavior Principles and Disability (3) I II Use of behavior principles to positively support individuals with disabilities, especially those with moderate and severe disabilities. P, SERP 400. Graduate-level requirements include in-depth paper(s) on aspects of current issues in the field.

503. * The Special Services (3) Information to aid teachers in dealing with responsibilities and concerns in school settings with regard to P.L. 94-142, Education for All Handicapped Children Act, Section 504 of the Rehabilitation Act, Family Education Rights and Privacy Act, and other legal issues. Graduate-level requirements include an in-depth paper(s) on aspects of current issues in the field.

504. * Cultural and Linguistic Diversity in Exceptional Learners (3) I Provides a theoretical base and practical approach to the study of special needs of students with language and cultural differences; basic premises of bilingual special education; and the interface of the two fields. Graduate-level requirements include an in-depth paper(s) on aspects of current issues in the field.

505. * Introduction to Learning Disabilities (3) I II Theories and history of programs for individuals with learning disabilities: definition, characteristics, etiology. P, SERP 500. Graduate-level requirements include an in-depth paper(s) on aspects of current issues in the field.

507a.- 507b. Methods for Diagnosing Specific Learning Disabilities (3-3) I Educational and psychological assessment of academic areas and learning processes involving perception, integration, and expression, with emphasis on strategies for planning and implementing instructional programs at the elementary level. P, or CR, SERP 505, or consent of department; CR, SERP 593.

508. Teaching Elementary Students with Learning Disabilities (3) II Remediation of academic areas and cognitive processes involving perception, integration, and expression, with emphasis on strategies for planning and implementing instructional programs at the elementary level. P, or CR, SERP 505, or consent of department; CR, SERP 593.

510. * Introduction to Mental Retardation and Severe Disabilities (3) I History and philosophy of educational programs for persons with mental retardation and other developmental disabilities; etiology, classification, and characteristics, with consideration of educational, social, and psychological problems. P, or CR, SERP 500. Graduate-level requirements include in-depth paper(s) on aspects of current issues in the field.

512. Teaching Learning Disabled Adolescents (3) I Intervention alternatives for teaching the learning disabled adolescent at the secondary level. Emphasis on current intervention methods and practices.

513. Educating Students with Mental Retardation and Severe Disabilities (3) II Methods of developing age-appropriate, functional and inclusive programming, community-based instruction, and integrative source delivery for students who have moderate to profound retardation and other physical, sensory and behavior disorders.

515. * Physical and Multiple Disabilities (3) I II Physical and multiple impairments, etiology, intervention practices, adaptations, transferring and handling skills, and integration into typical environments. Graduate-level requirements include additional assignments. Field trips.

517. Behavior Modification and Theory in Schools (3) II Application of behavior principles and techniques to promote learning and social development of school-related behavior. P, ED P 510 or consent of instructor.

518. Augmentative Communication for Learners with Severe and Multiple Disabilities (3) [Rpt./ 3] II Techniques for assessment and intervention of communication skills other than speech for students with severe disabilities. Nonsymbolic communication skills development for all ages; social interaction skills; augmentative communication aids.

520. * Low Vision and Visual Functioning (3) II Anatomy and physiology of the eye; implications of visual disorders including visual field losses; introduction to optics; use of optical and non-optical aids in classroom settings. Graduate-level requirements include writing at least one paper and one additional item.

521. Introduction to Visual Impairments and Deaf-Blindness (3) I An overview of educational services for the student with visual impairments and multiple sensory impairments. Emphasis is placed on the psychosocial effects of visual impairments on the individual and means of compensating for those effects. Graduate-level requirements include writing a grant proposal to obtain monies to enhance service delivery.

522. * Orientation and Mobility for Teachers of Individuals with Visual Impairments (3) II Methods of teaching orientation and mobility skills to visually impaired and blind students. Emphasis on the school-aged child, with particular attention to concept development, orientation skills, pre-cane skills, personal safety, and independent ambulation, including an introduction to long-cane techniques. Graduate-level requirements include completion of an additional research paper and presentation.
523a-523b. * Braille I - I (3-3) I II Fundamentals of Braille reading and writing, methods of teaching Braille and preparation of materials. Graduate-level requirements include an in-depth paper(s) on aspects of current issues and class presentations.

524. * Methods of Teaching the Visually Impaired (3) II Curriculum development and adaptation in various educational programs; adaptation of classroom materials; and procedures for use with blind/partially sighted children and youth. Emphasizes teaching academic and non-academic skills and educating students with non-disabled peers. Graduate-level requirements include a short review of the literature using APA style about their chosen topic. P, SERP 521; CR, SERP 593.

525. * Strategies of Vocational Development and Supported Employment (3) II Systematic study of the strategies used to place and retain individuals with disabilities in paid, community employment. Topics to include job development, consumer assessment, job placement, job-site training, and follow-up. P, SERP 400. Graduate-level requirements include an in-depth paper(s) on aspects of current issues in the field.

526. Principles and Assessments of Orientation & Mobility (3) I In-depth study of the principles supporting orientation and mobility instruction; assessment principles and strategies specific to Orientation & Mobility. P, SERP 520 or equivalent; SERP 522a.

527. Advanced Orientation & Mobility Practice and Procedures (4) I Prepares orientation and mobility (O & M) specialists in methods, techniques and approaches using the long cane and other mobility devices essential in the development of travel skills of persons with visual impairments. P, SERP 520 or equivalent; SERP 522a.

530. * Education and Rehabilitation of Deaf and Hard of Hearing Individuals (3) I Current and historical perspectives; educational and rehabilitative services; etiology; impact on families, psychosocial, cognitive and intellectual development and functioning of deaf and hard of hearing individuals. Graduate-level requirements include an in-depth paper and a class presentation.

531a-531b. * American Sign Language (4-4) Designed to develop intermediate ASL conversational skills in a variety of settings, topics, and functions. P, SERP 370b or consent of department. Graduate-level requirements include a research paper and an oral presentation on an approved aspect of the linguistics of American Sign Language.

532. Oral/Aural Development and Assessment: Deaf and Hard of Hearing (3) II Development of speech and speech reception skills; assessment of speech intelligibility, articulation, speech reading and auditory functioning of deaf and hard of hearing children. P, SERP 430 or SERP 530; SP II 583.

533a-533b-533c. * Special Topics in Deaf Studies (3-3-3) I II III Classes will be offered on a rotating basis in 533a-533b-533c-533d sequence; however, courses need not be taken in sequence. 533a: Introduction to the structure of ASL. 533b: Languages and Cultures of the Deaf Communities. 533c: History of the Deaf Community. 533d: ASL Literature and Film. P, SERP 431b or consent of department. Graduate-level requirements include an in-depth research paper on a course-related topic and a class presentation.

534. Language Development for the Exceptional Child (3) I Pragmatic, semantic and syntactic aspects of pre-linguistic and linguistic development in exceptional children and youth; cognitive and social bases of language development.

535. Assessment of Bilingual Exceptional Learners (2) II Educational and psychological assessment of bilingual students with emphasis on informal and formal evaluation methods and procedures for purposes of identification and educational planning. P, SERP 307.

536. Teaching Bilingual Exceptional Learners (2) II Instructional and program development for exceptional students from culturally and linguistically diverse backgrounds. Emphasis on current intervention methods and practices. P, SERP 508.


538. Methods for Oral/Aural Communication Development: Deaf and Hard of Hearing (3) I Methods for teaching auditory and oral/aural communication skills to deaf and hard of hearing children and adolescents. P, SERP 532; CR, SERP 594b. 539a-539b-539c. * Special Topics in Sign Language Studies (3-3-3) I II Classes will be offered on a rotating basis in the following sequence; 539a, 539b, and 539c. Courses need not be taken in sequence. 539a: ASL Acquisition and Bilingualism. 539b: Signed language Policy, Planning and Intervention. 539c: Methods and Materials of ASL/ESL Instruction. P, SERP 331b or consent of department. Graduate-level requirements include an in-depth research paper on a course-related topic and a class presentation.

540. * Education of Gifted Children (3) I Issues in education of the gifted; discussion of definitions, characteristics, development, screening, identification, curriculum, teaching strategies, and program development. Graduate-level requirements include an in-depth paper(s) on a single aspect of current issues in the field.

541. Teaching the Gifted: Questioning Strategies (3) I Mastery of skills involved in developing abstract thinking abilities in gifted children by using the Hilda Taba Teaching Strategies. Emphasis on using these sequential questioning methods in all content areas and at all grade levels. P, SERP 540.

542. Teaching the Gifted: Productive Thinking (3) I Mastery of skills involved in developing productive thinking abilities in gifted children by using teaching-learning models developed by Parnes, Williams, Taylor, Guilford, Renzulli and Treflger at all grade levels and in all content areas. P, SERP 540.

543. Teaching the Gifted: Hierarchical Models (3) I Introduction to general principles involved in providing a curriculum for the gifted. Overview of ten teaching-learning models commonly used with the gifted. Mastery of skills involved in using the hierarchical models with gifted students. P, SERP 540.

544a-554b-554c. * Intensive ASL (3-6/3-6) SERP 544a-544b-554c need not be taken in sequence. 554a: Intensive ASL. 554b: Introduction to Interpreting. 554c: Classroom Instruction in ASL. P, SERP 531b or consent of department. Graduate-level requirements include an in-depth paper on aspects of current issues in the field.

547. Rehabilitation Teaching in Visual Impairment (3) I Overview of rehabilitation services for individuals with visual impairments, with emphasis on psychosocial variables and strategies for learning adaptive skills. The course addresses adult experiences, with an emphasis on adulthood.

548. Independent Living Skills for Adults with Visual Impairment (3) I This course provides rehabilitation teachers with the skills to teach daily living activities to adults who are blind or who have low vision. Topics include discrepancy analysis, environmental adaptation, and task instruction in food preparation, clothing care, housekeeping, home maintenance.

549. Introduction to School Psychology (3) I Roles of the school psychologist; implementing programs in the public schools; legal and ethical issues in school psychology.

550. * Introduction to Emotional or Behavioral Disorders (3) I Issues in the education of the emotionally or behaviorally disordered; discussion of history, current issues, definitions, characteristics, and theoretical perspectives. P, SERP 400. Graduate-level requirements include an in-depth paper(s) on a single aspect of current issues in the field.

551. Teaching Children with Emotional or Behavioral Disorders (3) I Assessment techniques, academic and behavioral intervention strategies, and classroom management with emotionally or behaviorally disordered children and youth.

555. * Rehabilitation and Aging (3) I I II Emphasis on aging from the viewpoint of the aging person and those working with the aged. Graduate-level requirements include an in-depth research paper and a class presentation on a topic related to course content.
579. Cultural Diversity in School Psychology (3) II Current theoretical, social, and practical issues in the use of norm-referenced tests with individuals from minority groups.

580. *Introduction to Early Childhood Special Education (3) I II Focuses on the disabling conditions impacting on infants, toddlers and their families, preschool children, programs available to serve them and their families, and critical issues in this rapidly evolving field. P, SERP 400.

Graduate-level requirements include an in-depth paper(s) on a single aspect of current issues in the field.

581. Methods of Teaching Preschool Children with Disabilities (3) II Deals with competencies required to teach all categories of disabilities found in preschool children except deaf/blind. P, SERP 460 or SERP 560; SERP 562, SERP 575; CR, SERP 593.

582. Methods of Assessment for Preschool Children with Disabilities (3) I Norm-referenced and criterion-referenced instruments for screening, diagnosis and assessment of infants, toddlers, and preschool children. Emphasis is be placed on teacher involvement in the assessment process. P, SERP 400 or SERP 500; SERP 575.

583. Client Assessment in Rehabilitation (3) II Exploration of the world of work; critical review of vocational choice theories; experiences in the use and interpretation of individual assessment techniques. P, or CR, SERP 565; CR, ED 458. Open to majors only.

585. *Principles of Rehabilitation (3) I Principles underlying rehabilitation programs and interdisciplinary relationships of agencies engaged in rehabilitation services. Graduate-level requirements include submission of a group research exercise/presentation, NCRE email networking, and submission of a scholarly paper.

586. *Transition Methods (3) II Provides an understanding of effective strategies for promoting the smooth transition of students with disabilities from school to work and adult living. Graduate-level requirements include additional assignments including a term paper.

587. Administration of Special Education Programs (3) I Review of current federal and state Special Education Laws and Regulations and related federal mandates, special education funding, compliance and legal issues, precedent setting court cases, and current issues in special education administration and program delivery. P, consult department before enrolling.

588. Supervision of Special Education (3) II Theory and practice concerning various aspects of supervising special education programs and services, service delivery models, staff and program development, philosophy, communication, systemic and personal change, and evaluation. P, SERP 570.

572. Policy and Program Evaluation Analysis in Special Education (3) I Practical aspects of policy analysis and program development/evaluation in schools and other social agencies that serve individuals with disabilities and/or giftedness.

575. *Observation and Participation in Special Education Programs (1-3) [Rpt./ 6 units] II Practical experiences with individuals having special needs with a focus on psychological, educational and service-related implications and practices. Field trips, class observations and seminars. P, SERP 400 or SERP 500.

578. *Prevention of Addictions (3) I Analysis of addictive behaviors (e.g., drug addictions, eating disorders, compulsive gambling) from a psychosocial and biological perspective, and the implications of this analysis for primary, secondary, and tertiary prevention of addictions. Graduate-level requirements include an in-depth research paper or other project.

580. Medical Aspects of Disability (3) [Rpt./ 1] I I I Exploration of the psychological, sociological and cultural aspects of disability; analysis of somatopsychology, psychosomatics, and social psychology.

582. Principles and Practices of Vocational Evaluation (3) I Understanding work skills and labor market conditions; process of vocational evaluation of rehabilitation clientele; collecting and synthesizing evaluation data and writing meaningful reports.

583. Counseling Theories and Human Development (3) [Rpt./ 1] I I I Professional rehabilitation counseling practices with varied ethnic, age disability, and dependency populations. P, Open to majors only.

584. *Problems of Drug Abuse (3) I I I Survey course for teachers, counselors, and agency workers concerned with drug abuse; exam creation of community, cultural, and educational approaches to drug use and abuse. Graduate-level requirements include an in-depth research paper and a class presentation on a topic related to course content.

585. Vocational Planning and Placement (3) II Problems of physical, mental, social, and emotional disability, as they relate to the formulation of a rehabilitation plan; exploration of the various sources of occupational and career choice information, case management and job placement and development. P, SERP 580; SERP 563, SERP 565 or SERP 580.

586. Psychological Assessment of the Deaf Person (3) II Selection, administration, and interpretation of various psychosocial evaluation instruments used with deaf persons. P, SERP 674a, ED P 673.

588. Professional Problems and Ethical Concerns in Rehabilitation Psychology (3) I I Introduction to the field of rehabilitation psychology including an examination of ethical and legal considerations in the practice of rehabilitative psychology, foundational material in professional psychology, and an overview of the rules and functions of rehabilitation psychology. P, Open to majors only.


590. Applied Research with Exceptional Learners (3) II Review of principles and practices underlying applied research with exceptional learners; practice in preparation of research proposals; conduct of research emphasized.

591. Preceptorship (1-3) [Rpt./ ]

593. Internship (1-12) [Rpt./ ] I I I Legislative Internship (1-9) [Rpt./ 1 II

594. Practicum (1-3) [Rpt./]

a. Communication Development for Deaf and Hard of Hearing Children (1-6) [Rpt./ 1 I II

b. Teaching the Gifted (1-6) [Rpt./ 9 units] I II P, Open to majors only.

c. Teaching the Gifted (1-6) [Rpt./ 9 units] I II P, concurrent enrollment in SERP 540, SERP 541, SERP 542, SERP 543 required.

595. Colloquium

b. Language Learning and Reading Disabilities (3) II (Identical with LRC 595b).

c. Mental Retardation and Severe Disabilities (3) II
d. Recent Advances in Special Education and Rehabilitation (3-6) I II
e. Bilingual Special Education (2) I

f. Emotional or Behavioral Disorders (3) I P, Open to majors only.
g. Orientation and Mobility (3) II S P, SERP 520, SERP 522a, SERP 522b, SERP 526.
k. Group Processes and Ethics (3) I I I

596 Seminar

a. Issues in Special Education and Rehabilitation (1-3) [Rpt./ 6 units]

597. Workshop

a. Creativity and Giftedness (1-3) [Rpt./ 9 units] I
d. Woodcock-Johnson - Revised (1) S GRD P, Open to majors only.

e. Consultation and Collaboration for Special Needs Students (2) II
g. Best Practices for Educating Students with Severe Disabilities (2) S

k. * Group Processes

l. Attention Deficit Disorders (1) S

599. Independent Study (1-3) [Rpt./ ]
638. Behavioral Consultation in Education Settings (3) I II Principles and techniques of conducting behavioral consultation in educational settings to promote learning and development of children and youth. P, SERP 517.

673. Theoretical Foundations of Intelligence (3) I II Various theories and models of human intelligence and their implications for intellectual assessment.

674a-674b. Field Experience in Intellectual Assessment in Education (3-3) I Supervised field experience in the administration, scoring and interpretation of various intellectual assessment devices: Wechsler Adult Intelligence Scale. P, or CR, SERP 673. Credit allowed for either SERP 674a, or SERP 674b. Open to majors and minors only.

677. Individual Assessment Techniques in the Schools (3) II Techniques for assessing personality and social behavior; practice in implementing programs derived from assessment techniques. P, SERP 674b, consent of instructor. Open to majors only.


685. Child Behavior Disorders and Adjustment (3) I II Diagnostic and assessment practices, theories, and research related to child behavior disorders. P, SERP 530 or consent of instructor.

686. Child Psychotherapy (3) I II An overview of the major methods and research related to psychotherapy with school-age children. P, SERP 685 or consent of instructor.

691. Preceptorship (1-6) [Rpt.]

693. Internship (1-3) [Rpt.]

694. Practicum (1-3) [Rpt.]

695. Colloquium
a. Issues, Trends and Futures in Special Education: Doctoral Think Tank (3) II
b. Emotional or Behavioral Disorders (3) II
c. Rehabilitation Psychology (3) [Rpt. / 2] I II
d. Learning Disabilities (3) 1
f. Sensory Impaired (3) II
g. Issues and Research in Educating the Gifted (3) [Rpt. / 2] II
h. Rehabilitation Administration and Research (3) I II
l. Diagnosis in Rehabilitation Psychology (3) II

696. Seminar
a. Issues in Special Education and Rehabilitation (1-6) [Rpt. / 6 units]
b. Neuropsychological Bases of Learning and Behavior (3) I II
c. Professional Standards, Ethics and Issues in School Psychology (3) [Rpt. / 1] I II P, SERP 530 or consent of instructor.

699. Independent Study (1-3) [Rpt.]

791. Preceptorship (1-6) [Rpt.]

793. Internship (1-12) [Rpt.]

794. Practicum (3-9) [Rpt.]

799. Independent Study (1-3) [Rpt. / 1

900. Research (1-3) [Rpt.]

910. Thesis (3-6) [Rpt.]

920. Dissertation (1-9) [Rpt.]

930. Supplementary Registration (1-6) [Rpt.]

Speech and Hearing Sciences (SP H)

Speech and Hearing Sciences Building, Room 214
Phone: (520) 621-1644
Fax: (520) 621-9901
WWW: http://www.shs.arizona.edu

Application Questions:
Julie Mills, (520) 621-1644, jamills@u.arizona.edu

Degrees Offered: M.S., Ph.D.

Professors: Richard F. Curlee, Interim Department Head, Kathryn A. Bayles, Daniel R. Boone (Emeritus), Theodore J. Glattke, Thomas J. Hixon, William R. Hodgson (Emeritus), Audrey L. Holland, Noel D. Matkin (Emeritus)

Associate Professors: LouAnn Gerken, Jeannette D. Hoit, Elena M. Plante, Yingyong Qi, Linda Swisher (Emerita)

Assistant Professors: Julie M. Barkmeier, J. Glattke, Thomas J. Hixon, William R. Hodgson (Emeritus), Aubrey L. Holland, Noel D. Matkin (Emeritus)

Graduate -level requirements include a written review of three test manuals.

100. Counseling Techniques in Communication Disorders (3) II Introduction to counseling the communication handicapped and their families.

541. Language Acquisition (3) II Principles and processes of first language acquisition described in relation to children's social and cognitive development; first language acquisition processes compared and contrasted to child and adult second language acquisition and language disorders. P, SP H 350. Graduate-level requirements include a scholarly paper/project on a selected topic relevant to the course. (Identical with LING 541, PSYC 541.)

549. Survival Skills for Students (2) I II For graduate students and postdoctoral fellows, this course provides information and experiences that will aid in successful "survival" during the graduate-student years and those following graduation. Topics include effective speaking and writing, grantsmanship, mentoring, teaching, career options, among others. Discussion of ethical issues and resources is integrated across topics. (Identical with BIOC 549, MCB 549, PSIO 549, PS 549).

552. Language Disorders in School Age Children (3) The nature and treatment of language disorders in children from grades K-12; relationships between language and learning disabilities; social skills, cognitive function; assessment and treatment strategies. P, SP H 441 or SP H 551.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>555L</td>
<td>Developmental Language Disorders (3)</td>
<td>3</td>
<td>Preschool-level. Competency-based approaches to speech and language development, including assessment, evaluation, and intervention strategies. P, SP H 441 or SP H 351.</td>
</tr>
<tr>
<td>558L</td>
<td>*Clinical Studies: Speech-Language Pathology (1-3) [Rpt./ 9 units]</td>
<td>Under supervision, students carry out prescribed intervention programs and conduct evaluation of children and adults. Students participate in weekly staffings and clinical problem-solving. P, or CR, SP H 441, SP H 471. Open to majors only. Graduate-level requirements include independent planning of treatment programs, completion of clinical progress reports, and formulation of evaluation reports as needed. Clinical research designs are also considered.</td>
<td></td>
</tr>
<tr>
<td>559L</td>
<td>*Clinical Studies: Audiology (1-3) [Rpt./ 9 units]</td>
<td>Under supervision, students assess hearing impairments, formulate objectives, and carry out remedial programs with emphasis on the application of research data and current technology to clinical treatment. P, or CR, SP H 483. Open to majors only. Graduate-level requirements include clinical progress or evaluation reports. P, or CR, SP H 589. Open to majors only.</td>
<td></td>
</tr>
<tr>
<td>560L</td>
<td>*Speech and Hearing Science Instrumentation Laboratory (1)</td>
<td>1</td>
<td>P, or CR, SP H 460R.</td>
</tr>
<tr>
<td>560R</td>
<td>Speech and Hearing Science Instrumentation (2)</td>
<td>Consideration of some common and specific instruments and methods employed in speech and hearing laboratories and their auditory and visual processing, evaluation and remedial programming for children with mild to moderate hearing impairment. P, SP H 280 or graduate standing.</td>
<td></td>
</tr>
<tr>
<td>562L</td>
<td>Psychophysical Acoustics (3)</td>
<td>II</td>
<td>Experimental procedures and instrumentation; study of psychoacoustics; stimulus integration, pitch and loudness limen and scales, masking, and auditory fatigue; binaural hearing; theory of signal detection. P, SP H 280, SP H 440.</td>
</tr>
<tr>
<td>563L</td>
<td>Microcomputer Applications (3)</td>
<td>II</td>
<td>Basic understanding of microcomputer operations and its multiple functions; emphasis on computer literacy, administrative/clinical applications and hands-on instruction.</td>
</tr>
<tr>
<td>567L</td>
<td>Experimental Phonetics: Physiology (3)</td>
<td>I</td>
<td>Systematic examination of current experimentation and research in speech as motor behavior, with emphasis on physiological investigations of normal respiration, phonation, resonance, and articulation; critical evaluation of research design. P, SP H 260. (Identical with PSYC 567).</td>
</tr>
<tr>
<td>568L</td>
<td>Speech Perception (3)</td>
<td>II</td>
<td>General overview of the field of speech perception. Topics include: role of contextual factors in the processing of speech, developmental issues in speech perception, perception of foreign language speech sounds, the recognition of speech by computers and animals, implications for hearing-impaired populations and models of speech perception. P, SP H 260. Graduate-level requirements include more extensive readings. (Identical with LING 568, PSYC 568).</td>
</tr>
<tr>
<td>571L</td>
<td>*Laboratory in Articulation Disorders (1)</td>
<td>I</td>
<td>Open to majors only. P, or CR, SP H 471R. Graduate-level requirements include a scholarly paper and/or project on a selected topic. P, or CR, SP H 571R.</td>
</tr>
<tr>
<td>572L</td>
<td>Voice Disorders (3)</td>
<td>I</td>
<td>Etiology, diagnosis, prognosis, and therapy for disorders of voice; speech for the laryngectomized. P, SP H 567.</td>
</tr>
<tr>
<td>573L</td>
<td>Nature and Treatment of Childhood Stuttering (3)</td>
<td>II</td>
<td>Examines the problem of stuttering, its evaluation and management in children.</td>
</tr>
<tr>
<td>574L</td>
<td>Cleft Palate, Other Craniofacial Disorders, and Communication (3)</td>
<td>II</td>
<td>Communication disorders associated with cleft palate and other craniofacial defects. Speech assessment, evaluation and treatment; survey of dental and surgical services. P, SP H 471L or SP H 471R.</td>
</tr>
<tr>
<td>576L</td>
<td>Communicative Aspects of Aging (1)</td>
<td>I</td>
<td>Hearing, speech, voice, and language changes in the elderly caused by aging and disease. Emphasis on management of these problems. (Identical with GERO 576).</td>
</tr>
<tr>
<td>577L</td>
<td>Communication Disorders in Traumatic Brain Injury (3)</td>
<td>II</td>
<td>Communication consequences of traumatic brain injury with special reference to the evaluation and management of persons with such injury. P, consult department before enrolling.</td>
</tr>
<tr>
<td>578L</td>
<td>Hearing Disorders and Special Tests (3)</td>
<td>II</td>
<td>Pathologies of the hearing mechanism, and their auditory manifestations. Special audiologic procedures to differentiate site of lesion. P, SP H 280, SP H 483.</td>
</tr>
<tr>
<td>583L</td>
<td>Principles of Audiology (3)</td>
<td>I</td>
<td>Basic principles and techniques of audiological testing, etiologies of hearing impairment, and intervention strategies. P, SP H 280 or graduate status. Graduate-level requirements include a scholarly paper/project on a selected topic relevant to the course. P, SP H 280 or graduate standing.</td>
</tr>
<tr>
<td>584L</td>
<td>*Introduction to Hearing Aids and Audiolinguistic Rehabilitation (3)</td>
<td>II</td>
<td>Characteristics of hearing aids and evaluation of their performance; identification and treatment of communication disorders associated with hearing loss. P, SP H 280. Graduate-level requirements include a scholarly paper and/or project on a selected topic.</td>
</tr>
<tr>
<td>585L</td>
<td>Audiologic Habilitation: Children (3)</td>
<td>I</td>
<td>Amplification, room acoustics, auditory and visual processing, evaluation and remedial programming for children with mild to moderate hearing impairment. P, SP H 483 or SP H 589.</td>
</tr>
<tr>
<td>586L</td>
<td>*Child Audiology (3)</td>
<td>II</td>
<td>Study of the development and disorders of the auditory system; audiometric evaluation and differential diagnosis in infants and children; psychological, auditory, and educational aspects of the habilitation of aurally handicapped children. P, SP H 280, SP H 483. Graduate-level requirements include a scholarly paper and/or project on a selected topic. P, SP H 280, SP H 483.</td>
</tr>
<tr>
<td>588L</td>
<td>Electrophysiologic Evaluation of the Auditory and Vestibular System (3)</td>
<td>II</td>
<td>Techniques, normative data, and clinical interpretation of auditory-evoked potential and electronystagmography tests.</td>
</tr>
<tr>
<td>589L</td>
<td>Advanced Audiologic Evaluation (3)</td>
<td>I</td>
<td>Principles and techniques of administering and interpreting the comprehensive audiologic evaluation. P, SP H 280, SP H 483.</td>
</tr>
<tr>
<td>595L</td>
<td>Colloquium</td>
<td>1</td>
<td>Current Problems in Speech and Hearing Sciences (1) [Rpt./ 5 units] I</td>
</tr>
<tr>
<td>596L</td>
<td>Seminar</td>
<td>1</td>
<td>Experimental Phonetics (1-3) [Rpt./ 9 units] I II</td>
</tr>
<tr>
<td>598L</td>
<td>Community and Industrial Audiology (2)</td>
<td>II</td>
<td>Hearing conservation in industry, schools, and the community; auditory and non-auditory effects of noise, noise assessment, control, and protective procedures.</td>
</tr>
<tr>
<td>599L</td>
<td>Independent Study (1-5) [Rpt./]</td>
<td></td>
<td>Research Methods in Communication Sciences and Disorders (3)</td>
</tr>
</tbody>
</table>
With faculty consultation and supervision, staffings. P, or CR, SP H 589. Open to majors only.

Advanced Clinical Studies: Speech-Language Pathology (1-3) [Rpt./ 9 units] With faculty consultation and supervision, students assume responsibility for all aspects of case management of adults and children. Exposure to clinical research methods and interdisciplinary staffings. P, or CR, SP H 558. Open to majors only.

Exposure to clinical research methods and interdisciplinary staffings. P, or CR, SP H 558. Open to majors only.

Advanced Clinical Studies: Audiology (1-3) [Rpt./ 9 units] With faculty consultation and supervision, students assume responsibility for all aspects of case management of adults and children. Exposure to clinical research methods and interdisciplinary staffings. P, or CR, SP H 558. Open to majors only.

Digital Processing of Speech Signals (3) II II Basic knowledge of digital signal processing for students in biological sciences. Topics include spectral analysis, fast Fourier transform, linear prediction coding, and digital filtering. P, SP H 260.

Aerodynamic Evaluation and Management of the Speech Mechanism Laboratory (1) II P, or CR, SP H 665R.

Aerodynamic Evaluation and Management of the Speech Mechanism (2) II Principles and clinical methods of aerodynamic evaluation and management of the disordered speech mechanism, with practical experience provided through case studies and class experiments. P, SP H 260, SP H 460R, SP H 460L, SP H 567.

Preceptorship (1-3) [Rpt./]

Colloquium
  a. Motor Control (2) [Rpt./ 3] II (Identical with PSIO 695a, which is home).
  b. Clinical Audiology (1-3) [Rpt./ 9 units] I II
  c. Hearing Physiology and Psycho-physiology (1-3) [Rpt./ 9 units] I II
  d. Language and Language Disorder (1-3) [Rpt./ 9 units] I II
  e. Speech Pathology (1-3) [Rpt./ 9 units] I II

Independent Study (1-3) [Rpt./]

Research (1-3) [Rpt./]

Case Studies (1-3) I II

Thesis (1-6) [Rpt./]

Dissertation (1-12) [Rpt./]

Supplementary Registration (1-9) [Rpt./]

The department offers programs leading to the Master of Science degree with majors in systems engineering, industrial engineering, and reliability and quality engineering, and the Doctor of Philosophy degree with a major in systems and industrial engineering.

Normally, the graduate student has a background in engineering, mathematics, or physics. In addition, a special program is available to students with bachelor's degrees in areas other than engineering or the physical sciences. M.S. programs vary in length from 1 to 2 years, depending upon background.

The Master of Science degree consists of either 30 or 33 units. At least 18 units must be taken within the department. Options in the 30-unit program include a 6-unit thesis, a 6-unit paper, or a 3-unit report, each of which requires an oral examination or coursework option which requires the Ph.D. qualifying exam. The 33 unit program requires only course work, subject to the stipulations above, with the further requirement of one 600-level course within the department and a final oral examination. Additional details concerning the requirements of the master's and doctoral degrees may be obtained on request from the department.

Application Questions:
Graduate Secretary, (520) 626-4644, gradapp@sie.arizona.edu

Advising Questions:
Julie Higle, (520) 621-6551, julie@sie.arizona.edu

Degrees Offered: M.S., Ph.D.


Associate Professors: Robert L. Baker (Emeritus), Jeffrey B. Goldberg, Fei-Yue Wang

Assistant Professors: Frank W. Ciaramello, Larry Head

Lecturer: John R. Lyon
Adjunct Assistant Professor: Gary Bakken
Visiting Assistant Professor: Shiwoo Lee

The department offers programs leading to the Master of Science degree with majors in systems engineering, industrial engineering, and reliability and quality engineering, and the Doctor of Philosophy degree with a major in systems and industrial engineering.

Normally, the graduate student has a background in engineering, mathematics, or physics. In addition, a special program is available to students with bachelor's degrees in areas other than engineering or the physical sciences. M.S. programs vary in length from 1 to 2 years, depending upon background.

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506. * Quality Engineering (3) I Quality, improvement and control methods with applications in design, development, manufacturing, delivery and service. Topics include modern quality management philosophies, engineering/statistical methods (including process control, control charts, process capability studies, loss functions, experimentation for improvement) and TQM topics (customer driven quality, teaming, Malcolm Baldrige and ISO 9000). P, or CR, SIE 305; SIE 430. Graduate-level requirements include additional readings and assignments/projects.


509. Integration of Reliability Testing in Systems Design (3) II Developmental tests, reliability growth tests, truncated life tests, sequential life tests, burn-in, environmental stress screens and field tests. Application of concurrent engineering and Bayesian methods to integrate reliability tests into the overall product development cycle, thereby reducing overall test time and life cycle costs. P, SIE 508, SIE 530.

510. Behavioral Judgement and Decision Making (3) II Models and theories of human judgment and decision from an engineering perspective. Subjective probability, value and utility. Methods for aiding and supporting decision making. P, SIE 330L or SIE 530; SIE 330R.

511. * Human Factors and Ergonomic Design II (3) II Advanced human-centered design with emphasis on human-system interfaces. Applications to computer and information systems, consumer products, manufacturing processes, etc., according to student interest. A project will be required. 1ES, 2ED. P, SIE 410 or consent of instructor. Graduate-level requirements include separate examinations and a major project.
513. Environmental Risk Analysis (3) I P, HWR 445 or HWR 545 or SIE 305. (Identical with HWR 513, which is home).
522. * Engineering Decision Making Under Uncertainty (3) I Application of principles of probability and statistics to the design and control of engineering systems in a random or uncertain environment. Emphasis is placed on Bayesian decision analysis. 1ES, 2ED. P, SIE 330R, SIE 330L or equivalent. Graduate-level requirements include a semester research project.
524. Maintainability Engineering (3) I Complex systems reliability; maintainability engineering; reliability and availability of maintained systems; operational readiness; system effectiveness; maintainability demonstration. P, SIE 408, SIE 330. Credit allowed for only one of these courses: SIE 528, A ME 577.
531. * Simulation Modeling and Analysis (3) I I Discrete event simulation, model development, statistical design and analysis of simulation experiments, variance reduction, random variate generation, Monte Carlo simulation. 1.5 ES, 1.5 ED. P, CR, SIE 321; SIE 330R, SIE 330L. Graduate-level requirements include a library research report.
536. Experiment Design and Regression (3) I Planning and designing experiments with an emphasis on factorial layout. Includes analysis of experimental and observational data with multiple linear regression and analysis of variance. P, SIE 530.
540. * Survey of Optimization Methods (3) I Survey of methods including network flows, integer programming, nonlinear programming, and dynamic programming. Model development and solution algorithms are covered. 3ES. P, SIE 340. Graduate-level requirements include additional assigned readings and a project paper.
541. Dynamic Programming (3) I I Modeling of stochastic dynamic systems and the application of dynamic programming techniques to optimal decision and control problems. Topics include inventory control, admission and flow control in queuing systems, stochastic scheduling, dynamic portfolio analysis and computational methods. P, SIE 321, SIE 340.
544. Nonlinear Programming (3) I I Unconstrained and constrained optimization problems from a numerical standpoint. Topics include variable metric methods, optimality conditions, quadratic programming, penalty and barrier function methods, interior point methods, successive quadratic programming methods. P, SIE 340.
546. Algorithms, Graphs, and Networks (3) I I Model formulation and solution of problems on graphs and networks. Topics include heuristics and optimization algorithms on shortest paths, min-cost flow, matching and traveling salesman problems. P, SIE 340. Credit allowed for only one of these courses: SIE 354, MIS 546.
550. Theory of Linear Systems (3) I I An intensive study of continuous and discrete linear systems from the state-space viewpoint, including criteria for observability, controllability, and minimal realizations; and optionally, aspects of optimal control, state feedback, and observer theory. P, SIE 350.
551. Modeling Physiological Systems (3) I I Development and validation of models, sensitivity analyses, and applications of systems engineering techniques to physiological systems.
554. Concurrent Engineering and System Design (3) I Process and tools for systems engineering of large-scale, complex systems: requirements, performance measures, concept exploration, life cycle, function decomposition, system coupling, quality function deployment, multi-objective trade-off analysis, system modeling, design for X, team working, project management, ISO 9000 and documentation.
558. Fuzzy Sets in Systems Analysis and Decision Making (3) I I Fuzzy numbers' definition, operations; fuzzy regression, interpolation and reliability; fuzzy logic, optimization and control; fuzzy events and decision-making applications in areas such as systems, civil, industrial, electrical, computer engineering and water management.
562. Advanced Production Control (3) I Qualitative models in the planning, analysis and control of production systems. Topics include aggregate planning, multi-level production systems, inventory control, capacitated and uncapacitated lot-sizing, just-in-time systems and scheduling. P, SIE 340, SIE 544.
564. * Facilities Layout and Design (3) I I Definition and modeling solutions of continuous and discrete, single and multifacility location problems for various objectives. Relative location and layout of facilities/departments for minimizing material handling and interaction costs. Emphasis on quantitative methods. 2ES, 1ED. P, SIE 321, SIE 340. Graduate-level requirements include additional assigned readings and an in-depth research paper on a course topic.
565. * Financial and Investment Engineering (3) I I Definitions and modeling of cash flow streams, random securities, investment and portfolio problems. Operations research and decision analysis methods for investment, capacity expansion and equipment replacement in a random environment. P, SIE 305 or equivalent calculus-based probability course. Graduate-level requirements include solving an additional problem of a more advanced nature on each of two midterm examinations. Additionally, they will be expected to submit a project with a summary report.
573. Concepts in Information and Communication Systems (3) I I Graduate-level requirements include a course project in the subject area.
574. * Decision Support Systems (3) I I Building, testing and evaluating expert systems, computer systems that emulate human and draw conclusions based on incomplete or inaccurate data. Each student will build a decision support system using commercially available expert system shells. Students will use many tools to test and validate their systems. 1ES, 2ED. P, familiarity with computers. Graduate-level requirements include a strong testing and validation study of student's expert system.
575. * Computational Methods for Games, Decisions, and Artificial Intelligence (3) I I An introduction to automata, computer representation and optimal solution of games and decision problems. Principles of heuristic programming and machine learning. A programming project is to be selected from areas such as game strategies, graphics, recreational mathematics, and manufacturing simulation. Microcomputer experience is emphasized. 1.5 ES, 1.5 ED. Graduate-level requirements include a comprehensive and intensive programming project.
576. * Numerical Analysis (3) I I An intermediate-level introduction to numerical methods and error analysis for function approximation and interpolation, integration,
solution of linear and nonlinear equations, and differential equations. 3ES, P, MATH 254, computer programming experience. Graduate-level requirements include extra reading assignments and more sophisticated programming assignments.

583. Computer Integrated Manufacturing Systems (3) I Modern manufacturing systems with emphasis on information requirements and data management. Includes CAD, CAM, CAPP, real-time scheduling, networking and system justification.

584. Manufacturing Automation (3) II Current topics in hardware for automation, selecting and implementing robots, part orientation, computer vision, automated warehousing and material handling, programmable controllers, NC machining, on-line computer control. Laboratory projects.

585. * Robotics and Automation (3) I Methods of design and operation of general purpose and industrial manipulation systems. Kinematic and dynamic models of mechanical manipulators, trajectory planning, manipulator control, robotic vision and other sensing techniques. 2ES, 1ED. P, SIE 350 or equivalent. Graduate-level requirements include two research projects.

586. Modeling Manufacturing Systems (3) II An intermediate-level introduction to topics in hierarchical design, planning, and control of manufacturing systems. Topics include modeling automated transfer lines, cellular manufacturing, and flexible manufacturing systems. Emphasis on material flow and analysis of throughput rate. 2ES, 1ED. P, SIE 321, SIE 340. Graduate-level requirements include additional assigned readings from the current literature and an in-depth paper on recent research on a course topic. SIE 599. Independent Study (1-5) [Rpt./]

606. Advanced Quality Engineering (3) II Advanced techniques for statistical quality assurance, including multivariate control charting, principal components analysis, economic design of acceptance sampling plans and control charts, inspection errors, and select papers from the recent literature. P, SIE 530, SIE 506.

608. Selected Topics in Reliability (3) I In-depth analysis of selected advanced topics in reliability engineering from the recent archival literature. Project required. P, SIE 508, SIE 520, SIE 530.


631. Digital Systems Simulation (3) II Emphasis on current research problems including random variate generation, modeling, language development and statistical analysis of output. P, SIE 431 or MIS 521a or MIS 521b.

636. Advanced Experiment Design (3) I Robust product and process design through planned experiments, emphasizing the integration of loss functions, parameter design and tolerance design.

640. Topics of Optimization (3) I Convexity, optimality conditions, duality, and topics related to the instructor's research interests; e.g., stochastic programming, nonsmooth optimization, interior point methods. P, SIE 544 or SIE 540.

645. Large-Scale Optimization (3) I Decomposition-coordination algorithms for large-scale mathematical programming. Methods include generalized Benders decomposition, resource and price directive methods, subgradient optimization, and descent methods of nondifferentiable optimization. Application of these methods to stochastic programming is emphasized. P, SIE 544.

646. Integer and Combinatorial Optimization (3) II Modeling and solving problems where the decisions form a discrete set. Topics include integer programming, branch and bound methods, cutting plane methods, relaxations, computational complexity, and solving well-structured problems. P, SIE 544.

654. Model-Based System Design (3) II Development of the system design requirements: input/output, technology, performance, cost tradeoff and system test. Defining and specifying the system and model requirements. Study of various systems design tools. P, SIE 554.

662. Topics in Scheduling and Planning (3) II Current topics in scheduling and planning including theory and models for M-machine scheduling problems, multi-echelon inventory theory, stochastic inventory control and scheduling. P, SIE 520, SIE 562.

685. Advanced Topics in Robotics and Automation (3) II Selected topics covering recent advances in robotics and automation, to be chosen from a list including applications, kinematics, dynamics, tactile sensing, vision and intelligent systems. P, SIE 585.

686. Advanced Manufacturing System Modeling (3) I Current topics in design and analysis of manufacturing systems. Topics include neural process lines, queuing networks and FMS. Student projects. P, SIE 562 or SIE 586.

695. Colloquium a. Doctoral (1-3) [Rpt./12 units] I II P, consult department before enrolling.

696. Seminar g. Internate Conflict Resolution (3) [Rpt./1] II [Identical with AREC 696g, HWR 696g].

699. Independent Study (1-6)

900. Research (2-8) [Rpt./]

909. Master's Report (1-6) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]
discipline) is a prerequisite for admission to a doctoral program. Beyond these minimal requirements, applicants must meet the specific admission requirements of the majors.

501. *Teaching and Learning Mathematics with Technology (3) I Exploration and examination of technologies to solve mathematics problems and teach mathematics; emphasis on the integration of technology into the middle and high school and entry level curriculum mathematics curriculum. P, MATH 121 or MATH 122; MATH 301, MATH 123 or MATH 124. Graduate level requirements include an additional research paper and presentation.

502. Teacher Leadership and School Change (3) II Teacher leadership and involvement as it applies to change process, school improvement, collaborative decision-making, school assessment, strategic planning, and school restructuring.

504. Trends/Issues in Elementary Schools (3) Investigation of the rationale, implementation and consequences of recent trends/ issues in elementary school organization, curriculum and methodology.

505. Trends/Issues in Secondary Education (3) I II Examination of purposes and functions of middle level and high schools, investigation of trends, issues, and organization of curriculum and programs.

507. *Principles of Vocational Education (2) II (Identical with A ED 507, which is home).

515. Observation and Supervision of Student and Inservice Teachers (3) Research-based strategies to supervise and critique teaching events, and to determine positive ways of thinking and acting in classrooms.

520. The School Curriculum: Science (3) Elementary and secondary science curricula in terms of their aims, content/processes, instructional methods and assessment. These science curricula are placed within a historical perspective and examined from a theoretical and research base. P, TTE 324 or TTE 338h.

521. Elementary and Middle School Mathematics Curriculum (3) Elementary and middle school mathematics curriculum in terms of their aims, content/processes, instructional methods and assessment. These mathematics curricula are placed within a historical perspective and examined from a theoretical and research base. P, TTE 326 or TTE 338y.

522. The School Curriculum: Social Studies (3) Elementary and secondary social studies curricula in terms of their aims/content processes, instructional methods and assessment. These social studies curricula are placed within a historical perspective and examined from a theoretical and research base. P, TTE 327 or TTE 338u.


526. Investigations in Early Childhood Education (3) Critical study and evaluation of research findings and learning theories with emphasis upon pedagogical implications related to early childhood education.

528. Developing Programs for Young Children (3) Contemporary early educational programs with emphasis upon the child's changing needs in the home, school and society. Criteria unique to particular ECE programs are analyzed to establish guidelines for program development.

529. Classroom Organization and Management (3) An analysis of concepts, research findings, and effective practices for organizing and managing classrooms. Experiences in solving management problems provided. P, or CR, TTE 539; EDUC 500.


536. Alternatives in the Secondary Classroom (3) Theoretical bases, methods and strategies for delivering instruction in secondary classrooms are examined, discussed and applied.

537. Equity in Schools and Society (3) Implicit and explicit ways in which values are introduced into the classroom and school. Research on the hidden curriculum, ethnic/racial and sex equity and prejudice and methods for combating inequities.

539. Recent Research on Teaching and Schooling (3) An overview of the concepts, methodologies and findings of recent research on teaching and schooling practices. P, TTE 539, EDUC 500.

542. The Middle School/Junior High (3) History, purposes, curriculum, instructional organization, and classroom processes for middle schools/junior high schools.

545. Curriculum Theory and Policy (3) A survey of theoretical frameworks in curriculum; the processes of content representation and enactment; planning evaluation, and change; analysis of curriculum policy.

550. School Reform in the United States (3) I This course examines the reforms being tried nationally and whether they are having the intended effects and why. Research on a wide range of reforms is reviewed, and students examine reforms they are interested in. This course will only be taught Fall 1999.

593. Internship (1-6) [Rpt./] II I Legislative Internship (1-9) [Rpt./] I II r. Action Research Internship (1-3) [Rpt./] P, TTE 597r.

594. Practicum (1-4) [Rpt./] II

595. Colloquium e. Master's Colloquium (1-3)

596. Seminar c. Topics in Teacher Education (3) [Rpt./ 12 units] I II
e. Learning Through Play (3)


599. Independent Study (1-3) [Rpt./]

610. Applied Curriculum Theory (3) The theories, techniques, and organization of curriculum construction are discussed, evaluated and applied. P, TTE 545.

612. Staff Development (3) The concept, context, content, processes and evaluation models of staff development as enacted in school settings. P, EDUC 500.


635. Policy Analysis in Teaching and Teacher Education (3) Examination of policy development and enactment related to teaching and teacher education at local, state, and national levels, as well as methods and approaches to policy analysis. P, TTE 539 and TTE 500.

640. Teacher/Student Cognition and Instruction (3) An examination of cognitive models related to teacher comprehension, planning, and decision making; and students' cognitive change and their interpretation of classroom events. P, TTE 539, TTE 690b, EDUC 500.

642. Middle-Level Curricular Process (3) Examination of procedures for curriculum/ instructional development, implementation, improvement, and evaluation at the middle-school level. P, TTE 542.
Theatre Arts (T AR)
Drama Building, Room 239
Phone: (520) 621-7008
FAX: (520) 621-2412
WWW: http://arts.music.arizona.edu/theatre/index.html

Application Questions:
Justine Collins, (520) 621-7007,
TAR@ccit.arizona.edu
Advising Questions:
Jerry Dickey, (520) 621-8740,
jdickey@ccit.arizona.edu

Degrees Offered: M.A., M.F.A.
Concentrations: MA: Theatre studies and theatre education. MFA: Acting, directing, design/technical theatre.

Professors: Albert D. Tucci, Head, Robert C. Burroughs (Emeritus), Irene F. Comer (Emerita), Harold W. Dixon, Frank K. La Ban (Emeritus), William A. Lang, Mary Z. Maher, Patricia Van Metre (Emerita)

Associate Professors: Peter Beudert, Jerry R. Dickey, Richard T. Hanson, Peggy Kellner (Emerita), Julie A. Mack, Jeffrey L. Warburton, Dianne J. Winslow

Assistant Professors: Donnalee Dux, Brent Gibbs, Laura McCammon, Nanalee Raphael

The Department of Theatre Arts is committed to providing professional training in the theatre arts through a program of performance-centered activities and creative studies. The object of the program is to insure that each student acquires a thorough understanding and appreciation of the theatre arts through classroom study, studio-laboratory training, and university theatre production. The programs of study are designed for those who intend to pursue a professional theatre career, as well as for those who may enter other fields where theatre skills are desirable. The program is designed to instill in the student the highest academic standards and professional skills required to initiate a career in educational or professional theatre.

The Department of Theatre Arts offers programs leading to the Master of Arts and the Master of Fine Arts degrees with a concentration in theatre arts.

The Master of Arts with a concentration in theatre arts is an initial graduate degree for those students who wish to complete graduate work in performance studies or in theatre education. Requirements for the performance studies concentration include 30 units of course work, 21 of which must be in the Department of Theatre Arts. The program culminates in master's degree examinations, an M.A. thesis and an oral defense of that thesis.

The Master of Arts with a concentration in theatre education requires 30 units in the Department of Theatre Arts, 12 of which must be graduate theatre education courses. The program culminates in master's degree examinations, an M.A. thesis, and an oral defense of that thesis. Students may opt to obtain certification for teaching in the State of Arizona; such an option requires a number of course work units in addition to the 30 cited above.

Students in both concentrations of the Master of Arts degree are required to complete the departmental graduate core curriculum consisting of T AR 600, 3 units of a departmentally approved 600-level course in theatre history, and 3 units of a departmentally approved 600-level course in dramatic theory or criticism. Candidates must complete all requirements within a 6-year period.

Students who elect to take an M.A. in one of the above concentrations have normally completed an undergraduate degree in theatre arts. Those who have not done so may need to take additional units to make up for deficiencies in the area of theatre. Only 6 transfer units of graduate courses in theatre arts may be applied toward the degree, and there must be documented evidence of equivalency.

The Master of Fine Arts degree is a professional training program emphasizing artistic achievement. Admission and retention are competitive and based on an evaluation of the applicant's professional potential, trainability, and talent. The program encompasses a rigorous regime of studio training, classroom study, and University Theatre production.

In cooperation with the Department of Theatre Arts, the Dance Division offers a program of advanced study which leads to a Master of Arts or a Master of Fine Arts in theatre arts with a dance concentration. For a listing of graduate courses, see Dance.

501. * Advanced Construction Techniques (3) [Rpt./9 units] I Advanced study and practice in fabrication techniques for theatrical designers and technicians. Emphasis on a wide range of materials and skills found in theatrical construction. Includes OSHA compliance, respirator training, and safety. P, T AR 111, T AR 116. Graduate-level requirements include an additional creative and/or research project.

502. * Combat for the Stage (1) [Rpt./1] II Basic study in the execution of staged combat, training in the use of theatrical weapons and hand-to-hand combat required in playscripts. Extensive physical training as well as work in relaxation and focus. P, open to majors only. Graduate-level requirements include an additional performance and/or research project.

503. * Musical Theatre II (3) I Intensive text and score analysis in relation to the process of characterization for the actor, singer, dancer in musical theatre. Individual and group performance. Audition materials and techniques for a professional career in theatre. 2S, 2L. P, T AR 205, audition. Open to majors only. Graduate-level requirements include an additional creative and/or research project.

504. * Musical Theatre III (3) II Intensive scene study and exploration of the major historical styles and genres of the American musical theatre. 2R, 2S. P, T AR 403, audition. Open to majors only. Graduate-level requirements include an additional performance and/or research project.

505. * Theatrical Engineering and Management (3) [Rpt/2] II Advanced studies in technical theatre, theatrical engineering, structures and motion-control systems for the stage. P, T AR 111. Graduate-level requirements include in-depth class presentations.

506. * Secondary School Theatre Methods (3) I Secondary drama curriculum and methodology. P, TTE 300, ED P 310, T AR 300, T AR 410 or T AR 510; CR, T AR 495 or T AR 595. Graduate-level requirements include additional text and/or book reviews.

510. * Methods of Teaching Creative Drama (3) I Principles and procedures of improvisation, role-playing, creative playwriting techniques, and program development in creative dramatics applicable to the elementary and secondary school levels. P, 12 units of theatre arts and education. Graduate-level requirements include an additional creative and/or research paper.
515. * Advanced Scenic Drafting (3) [Rpt./ 9 units] | Advanced mechanical drawing for the theatre. Includes computer-aided drafting instruction. P, T AR 224. Graduate-level requirements include an additional creative and/or research project.

516. Advanced Rendering (3) [Rpt./ 3] | Graduate-level requirements include an additional creative and/or research project.

518. * Digital Imaging for the Theatre (3) [Rpt./ 9 units] | Intensive studio work on Macintosh-based graphics programs for theatrical designers. P, T AR 224. Graduate-level requirements include more complex designs of multiple views and lighting situations.

519. * Sound Design (3) [Rpt./ 9 units] II | Advanced study in theatrical sound, production and design. P, T AR 319. Graduate-level requirements include an additional creative and/or research project.

520. * Advanced Lighting Design I (3) II | Special problems, practice and trends in designed light for theatrical productions. P, T AR 220. Graduate-level requirements include an additional creative and/or research project.

521. Scene Painting I (3) I Techniques and methods of scenic painting. Graduate-level requirements include an additional creative and/or research project.

525. * Costume and Scenic Design II (3) [Rpt./ 1] II Advanced instruction and practice in theatrical costume and scenic design with an emphasis on rendering. P, T AR 223, T AR 229. Graduate-level requirements include an additional creative and/or research project.

528. * Advanced Stage Costume Construction I (3) [Rpt./ 1] II Advanced techniques in construction of stage costumes for historic periods. P, T AR 116. Graduate-level requirements include additional projects.

530. Stage Management (3) I Principles and techniques of stage management, practical applications, problems and analysis of stage managing. P, T AR 111, T AR 151. Graduate-level requirements include an additional creative and/or research project.

531. * Audience Development (3) I Publicity, press releases, sales, advertising, display techniques, subscription procedures. P, 12 units of theatre arts or related arts field. Graduate-level requirements include an in-depth research paper or project.

532. * Theatre Management (3) II Amateur, educational and professional theatre organization and management; theatrical contracts, professional unions and representative organizations. P, 12 units of theatre arts or related arts field. Graduate-level requirements include an in-depth research paper or project.

545. * Dramaturgy (3) I II | The varied roles of the production dramaturg: script analysis, rehearsal process, research, criticism, outreach, interpretation. Major project and short papers. F, for majors: 1 course in theatre history or criticism; for others: instructor consent. Graduate-level requirements include an in-depth research paper and more extensive in-class contribution.

546. Careers in Dance (3) II (Identical with DNC 546, which is home).

548a-548b. * Period Styles (3-3) | Chronological survey of the history of architecture, costume, decorative arts and furniture as it applies to theatre production. Graduate-level requirements include additional research papers and an oral presentation.

549. Acting V * (3) | Intensive study of classical acting styles with emphasis on Shakespeare. Individual and group performance. 2R, 2S, P, T AR 251, audition. Graduate-level requirements include an additional performance and/or research project.

550. Literary Resources for Choreography (3) [Rpt./ 1] II P, DNC 445. (Identical with DNC 550, which is home).

551. Acting VI * (3) II | Intensive study of classical acting styles with emphasis on Commedia dell'arte, Moliere and English Restoration. Individual and group performance. 2R, 2S, P, T AR 305, T AR 449, audition. Graduate-level requirements include an additional performance and/or research project.

552. * Acting VII (3) [Rpt./ 1] II Audition material, techniques and research into problems of a professional career in the theatre, television, motion pictures and related fields. 2R, 2S, P, T AR 305, T AR 449, audition. Graduate-level requirements include an additional performance and/or research project.

553. * Acting VIII (3) Advanced stage combat. Intensive scene study incorporating the techniques of stage combat. Survey and review of major acting theories with emphasis on integrating stage combat techniques. Students may have an opportunity to test for national recognition by the Society of American Fight Directors as an actor/combatant. 2R, 2S, P, T AR 402, audition. Graduate-level requirements include an additional performance and/or a research project.

555. Directing I (3) I Basic techniques of stage directing including play analysis, director-actor communication and technical problems of movement, composition, picturization and blocking. 2R, 2S, P, consent of instructor. Open to majors only. Graduate-level requirements include an additional performance and/or research project.

556. Directing II (3) I Techniques of stage direction with the study of factors leading to a completed production; special attention given to director-designer communication and the production process. Direction of one-act plays. 2R, 2S, P, T AR 455. Graduate-level requirements include an additional performance and/or research project.

560a-560b. * Writing for Stage and Screen (3-3) | Preparation and analysis of short scripts for stage and motion pictures. Graduate-level requirements include the preparation of full-length scripts for stage and motion pictures.

561. Artist Collaboration (2) [Rpt./ 2] | The development and communication of a visual idea for performance art; exploring all mediums of visual and aural communication. Graduate-level requirements include an additional creative and/or research project.

562. Collaborative Play Development (3) | Explores collaborative approaches to the development of theatrical performance through group improvisation, writing exercises, and the shaping of a performance project to be shown publicly. P, enrollment by audition only. Graduate-level requirements include serving as a performer or facilitator (depending on the audition results) and documenting rehearsal and performance. (Identical with DNC 562).

575. Screen Acting Techniques (3) II | Principles and techniques of various performance methods involved in acting for television and motion pictures; basic problems faced by the professional actor seeking employment in these media; on camera experience with directed exercises and dramatic scenes. 2R, 3L, P, T AR 151, audition. Graduate-level requirements include an additional performance and/or research project.

580. Graduation Production Study (1-3) | [Rpt./ 9 units] I Advanced graduate seminar and studio to examine the production process for designers, directors, dramaturgs and technicians.

595. Preceptorship (2-4) [Rpt./]

598. Internship (1-3) [Rpt./]

599. Practicum (1-3) [Rpt./]

599. Colloquium
a. * Teaching Methods for Dance (3) I P, intermediate level ballet, jazz, or modern dance techniques. (Identical with DNC 595a, which is home).

599. Workshop
a. * Technical Production (1-3) [Rpt./ 20 units] P, consent of instructor.

599. Costume Production (1-3) [Rpt./ 20 units] P, consent of instructor.

599. Lighting Production (1-3) [Rpt./ 20 units] P, consent of instructor.

599. Sound Production (1-3) [Rpt./ 20 units] P, consent of instructor.

599. Scenic Production (1-3) [Rpt./ 20 units] P, consent of instructor.

599. Performance (1-3) [Rpt./ 20 units] P, consent of instructor.

599. Management Workshop (1-3) [Rpt./ 20 units] II P, consent of instructor.

599. Independent Study (1-5) [Rpt./]

600. Introduction to Graduate Study of Drama (3) I Methods and materials for research in theatre and drama; introduction to the bibliography of these fields; organization and form of thesis.

605. Advanced Voice and Movement for the Actor I (3) [Rpt./ 1] I Advanced study and exercise in voice and movement for the actor:

606. Advanced Voice and Movement for the Actor II (3) [Rpt./ 1] II Continued advanced study and exercise in voice and movement for the actor: standard stage speech, stage dialects, period customs, manners and movement. P, audition.

636. Shakespearean Production (3) I Advanced readings and discussion in theory and criticism, analysis of filmed and video Shakespeare, and directorial approaches to Shakespeare production in performance history.

642. Advanced Studies in Theatre History (3) [Rpt./ 1] II Concentrated study in theatre history, with major emphasis on the physical theatre, standard scholarly works, and source materials.

644. American Theatre and Drama (3) II Studies in the American theatre and drama. Directed and individual projects will be assigned.

693. Internship (1-6) [Rpt./]

694. Practicum (1-3) [Rpt./]

696. Seminar
  a. Contemporary Trends (1-3) [Rpt./ 6 units] I II Students may earn a maximum of 9 units in T AR 696 with a maximum of 6 units in any area.
  b. Special Topics in Acting (1-3) [Rpt./ 6 units] I II Students may earn a maximum of 9 units in T AR 696 with a maximum of 6 units in any area.
  i. Period Design Styles (1-3) [Rpt./ 6 units] II Students may earn a maximum of 9 units in T AR 696 with a maximum of 6 units in any area.
  m. Special Topics in Design (2) [Rpt./ 2] I Students may earn a maximum of 9 units in T AR 696 with a maximum of 6 units in any area.
  t. Special Topics in Theatre Education (1-3) [Rpt./ 6 units] II Students may earn a maximum of 9 units in T AR 696 with a maximum of 6 units in any area.

699. Independent Study (1-5) [Rpt./]

900. Research (1-5) [Rpt./]

909. Master's Report (1-3) [Rpt./]

910. Thesis (2-4) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9) [Rpt./]

Veterinary Science (VSC)
Pharmacy-Microbiology Building, Room 202
Phone: (520) 621-2355
FAX: (520) 621-6366
WWW: http://fag.arizona.edu/VSC/vscheme.html

Application Questions:
Graduate Secretary, (520) 621-2355
Degrees Offered: M.S., Ph.D.

Professors: Charles R. Sterling, Head, Robert B. Chiasson (Emeritus), Ed W. Cupp, Leonard W. Dewhirst (Emeritus), Donald Lightner, Lynn A. Joens, C. John Mare, Raymond E. Reed (Emeritus), Jose M. Ribeiro (Entomology), James N. Shively (Emeritus), J. Glenn Songer

Associate Professors: Rodney Adam (Medicine), Ronald W. Hilwig, Robert J. Janssen (Emeritus), David W. Sammons

Assistant Professor: Michael W. Riggs

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees in pathobiology. The program offers an integrative approach to the basic animal and comparative health sciences with areas of study in immunology/pathology of disease; microbial pathogenesis; and epidemiology, diagnosis, and prevention of disease.

Applicants for admission must hold an undergraduate or higher degree in the basic sciences. In addition to the application materials submitted to the Graduate College, applicants must submit to the department scores from the general test of the Graduate Record Examination. The department recommends that scores in the advanced biology section be submitted if available. International students must demonstrate English proficiency by earning a score 550 or greater on the TOEFL or by completing two academic years of instruction. Three letters of recommendation and a statement of intent, written by the applicant, declaring career objectives and research experience, also must be submitted to the department.

Master of Science: Degree requirements include at least 30 units of graduate credit: 18 units of core courses in pathology, microbiology, immunology, biochemistry, and cell biology; 6 units of thesis; seminar units; an overall GPA of 3.0; an acceptable thesis; a manuscript in a form suitable for publication; and a final oral examination.

Doctor of Philosophy: Doctoral students must complete 69 units of graduate credit including the M.S. core, 36 units in the major and 18 units of dissertation. At least 6 semesters of essentially full-time graduate study is required with 30 units of graduate credit in the major field completed at The University of Arizona. Degree requirements include passage of a doctoral comprehensive examination, an acceptable dissertation, one or more manuscripts suitable for publication, and a doctoral oral defense.

Minor: At least one minor is required and may be chosen from any graduate program, including pathobiology, as approved by the Graduate Committee.

500a-500b. Animal Anatomy and Physiology (3-3) Physiology, gross and comparative anatomy; nervous, musculoskeletal, immune, hemolympathic, circulatory, and renal systems. P. ECOL 181, V SC 182, CHEM 243a. Graduate-level requirements include two in-depth research papers on related pertinent topics in animal anatomy and/or physiology, written exams, and a final oral comprehensive exam. P. ECOL 181, ECOL 182; CHEM 243a.

503L. * Parasite Laboratory (3) I Parasite morphology and diagnostic laboratory techniques. Graduate-level requirements include an in-depth research paper dealing with the differential diagnostic techniques used to identify a single parasite species. (Identical with INSC 503L, ENTO 503L, MBIM 503L, ECOL 503L).


505S. Animal Diseases (3) I Survey of selected diseases of domestic animals. Includes disease mechanisms, immunology and infectious agents; husbandry, management, and nutrition. Graduate-level requirements include a term paper.

512. Biological Electron Microscopy (4) I II P, one college level course in each of physics, chemistry, and biology. (Identical with MCB 512, which is home).


523. Mechanisms of Disease (5) I II Comparative pathology of animal and selected human diseases with emphasis on pathogenesis, pathophysiology, and morphologic changes at the macroscopic, microscopic and molecular levels. Stress on general mechanisms of disease. Laboratory will reinforce recognition of disease in organs and tissues at the gross and microscopic levels.
3R, 1L. P, V SC 400a-V SC 400b, V SC 459; or CR, MIC 205, MIC 419 or equivalent or consent of instructor. Graduate level requirements include preparation of a research proposal on a selected relevant topic and critical analysis of selected publications from the current literature. (Identical with MBIM 523, PCOL 523).

527. * Insect Chemical Ecology (4) I (Identical with ENTO 527, which is home).

529. General Virology (3) II P, MIC 205, CHEM 241b, CHEM 243b; MIC 411 suggested. (Identical with MBIM 529, which is home).

532. * Pathogenic Virology (3) [Rpt./ I] I (Identical with MIC 432, MCB 432). Graduate-level requirements include a research term paper and class presentation. (Identical with MBIM 532).

538. Ecology of Infectious Disease (3) II Ecology of the major infectious diseases of humans and animals. Term paper required for graduate credit. (Identical with MBIM 538).

543. * Research Animal Methods (3) I Regulations, care, diseases and techniques involving common laboratory animals used in research and teaching programs. Graduate-level requirements include an in-depth research paper on one of the lecture topics presented in the course plus research proposal preparation. (Identical with MBIM 543, BIOG 543, AN S 543).

549. Diseases of Wildlife (3) II Graduate-level requirements include either a term paper based on assigned readings or a research paper compiling field studies on other research experiences in wildlife disease. (Identical with WFSC 549).

550L. Medical Mycology Laboratory (2) II P, or CR, MBIM 550R. (Identical with MBIM 550L, which is home).

550R. Medical Mycology (2) II P, MIC 205. (Identical with MBIM 550R, which is home).

552. Medical-Veterinary Entomology (4) [Rpt./ 3] II P, parasitology recommended. (Identical with ENTO 552, which is home).

554. * Host-Microbial Interactions (3) II Review of bacterial-host interactions with the emphasis on mucosal immunity following bacterial infection. Important issues such as molecular mechanisms of virulence factors, bacterial resistance to host factors, immune modulation, and regulation of the host response to bacterial assault will be discussed. Graduate-level requirements include a five-page proposal. (Identical with MBIM 554).

556. * Aquaculture (3) II (Identical with WFSC 556, which is home).

559. * Comparative Vertebrate Histology (4) identification, phylogeny, and function of normal vertebrate tissues. 2R, 6L. P, 12 units of animal biology. A vertebrate anatomy and systems course is strongly recommended. Graduate-level requirements include a written report on a selected topic. (Identical with ECOL 559).

565. Shrimp Pathology (3) I Comprehensive lectures and practical laboratory training on the current methods used to diagnose, prevent and treat the principal diseases of cultured penaeid shrimp. P, B.S., M.S. and/or D.V.M. in biological and/or medically oriented field.

566. Physiology Laboratory (3) II (Identical with ECOL 566, which is home).

568. * Comparative Physiology (3) II (Identical with ECOL 568, which is home).

575. * Parasite Immunology (3) II An updated understanding and review of host-parasite interactions with emphasis on host immunological mechanisms operative in the control of parasitic infection. P, V SC 403, MIC 419 or equivalent courses with consent of instructor. Graduate-level requirements include a major research paper. (Identical with MBIM 575).

593. Internship (1-8) [Rpt./ I] I II

599. Independent Study (1-3) [Rpt./]

601. Experimental Surgery (2) II

630. Experimental Methods for Research (4) II P, MBIM 501a, MBIM 501b, MBIM 560 or MBIM 561; MIC 419, BIOG 460, consult department before enrolling. (Identical with MBIM 560, which is home).

649. Fishery-Water Quality and Toxicology (3) II 2R, 3L. P, WFSC 441 or WFSC 445R; CHEM 241a. (Identical with WFSC 649, which is home).

660. Infectious Disease Epidemiology (3) II P, EPI 596a, EPI 596b. (Identical with EPI 660, which is home).

693. Internship (1-8) [Rpt./ I] II

695. Colloquium

a. Veterinary Laboratory (1-3) [Rpt./ 9 units] I

696. Seminar

a. Research Seminar (1) [Rpt./ 2] I II

699. Independent Study (1-3) [Rpt./]

900. Research (1-9) [Rpt./]

909. Master's Report (1-8) [Rpt./]

910. Thesis (1-6) [Rpt./]

920. Dissertation (1-9) [Rpt./]

930. Supplementary Registration (1-9)

Water Resources
(See Hydrology and Water Resources)

Watershed Management
(See Renewable Natural Resources)

Wildlife and Fisheries Science
(See Renewable Natural Resources)
The Department of Women's Studies offers an interdisciplinary program leading to the Master of Arts with a major in women's studies. The program draws its courses and faculty from many different perspectives.

The graduate program offers its students a choice of two tracks: the academic option or the applied option. The academic option prepares students for doctoral work in their chosen field by providing a background in women's issues and feminist theories. The applied option is for students intending to follow a career in women's issues or one that can be enhanced by the study of women's issues.

Students applying to the Master of Arts program must hold the baccalaureate degree or its equivalent by the date of entry into the program. An undergraduate major or minor in women's studies or a strong background in feminist theory within the undergraduate major is strongly encouraged. Students must submit GRE scores to the department.

The Master of Arts requires 36 graduate credits, 18 of which must be in women's studies, including four women's studies core courses of 3 units of credit each. Students must consult with a women's studies faculty advisor to select the remaining 12 units of electives and receive approval for a course of study. Students following either option must engage in a final project of 6 credit hours. Students following the academic option must, in consultation with their advisor, write an extended research paper of publishable quality. Those following the applied option may write such a research paper or engage in an internship which culminates in a report. Oral and written examinations evaluating the student's understanding of the theoretical and empirical dimensions of feminist scholarship will be taken after all other work is finished.

Graduate requirements include an in-class presentation of selected materials and the choice of writing a single, long term paper. 533. * Feminist Political Theory (3) I (Identical with POL 533, which is home).
539. Feminist Movements and Theories (3) I Historical grounding in woman-centered theory characteristic of Western discourse. Each reading will be placed in context with other contemporaneous relevant thinking of the human condition, including attention to race, class and difference.
540. * Engendering The Past (3) I II (Identical with ANTH 540, which is home).
544. Women and the Body (3) II Exploration of the ways that women have defined their bodies; how the representation of woman as body permeates the culture and affects women's sense of self and self-esteem. Examination of feminist theoretical analyses of women's power and the control of women's bodies. P, 6 units of women's studies. Graduate-level requirements include a more comprehensive research paper and preparation of a lecture/summary on several books in the topic.
545. * Women in Islamic History (3) I (Identical with HIST 545, which is home).
546. Health and the Global Economy (3) II (Identical with GEOG 546, which is home).
550. Modern Theories of Cultural Studies (3) I (Identical with CCLS 550, which is home).
554. Contemporary Feminist Theories (3) I Introduction to contemporary feminist theories, posing and analyzing the questions that propel theorizing about women's relationships to processes of gender differentiation. By examining the assumptions about gender relations that ground theoretical positions from various disciplines, analytic traditions, and subject areas, students are enabled to read, synthesize and critique across the spectrum of feminist theorizing. P, consult the committee before enrolling. (Identical with ENGL 554).
555. * History of Women in Europe (3) I II (Identical with HIST 555, which is home).
558. Gender Identities and Interactions (3) I II P, 3 graduate credits in women's studies, sociology, or economics. (Identical with SOC 558, which is home).
559. Sociology of Gender and the State (3) I II (Identical with SOC 559, which is home).
561. * Feminist and IR Theories (3) II (Identical with POL 561, which is home).
564. * Women in American Architecture (3) I P, consent of instructor. (Identical with ARCH 564, which is home).
566. * Feminist Practices in Art (3) II 2D, 2R. (Identical with ARE 566, which is home).
581. * Work, Motherhood, and Female Identity in America: 1945 to the Present (3) I II History of women in the U.S. since 1945. Explores a variety of topics including employment, sexuality, motherhood, abortion, reproductive technologies and feminism, and explore changes in these areas have affected diverse groups of women. Prior course work in women's studies or history helpful. P, 2 women's studies courses or a women's history course. Graduate-level requirements include a longer, more comprehensive research paper. (Identical with HIST 581).
583. * Gender and African History (3) (Identical with HIST 583, which is home).
584. Feminist Research Methodologies (3) I Considers some epistemological assumptions underlying research and theoretical projections of traditional disciplines; explores feminist adaptations and critiques of these assumptions.
585. * Mexican/Chicana Women's History (3) I (Identical with MAS 585, which is home).
586. Gender, Difference, and Power (3) I Focuses on gender as it has intersected in varied ways with other cultural distinctions of difference based on class, race, sexual identity, and religion.
590. * Women in Middle Eastern Society (3) I (Identical with ANTH 590, which is home).
591. Preceptorship (1)
593. Internship (1-6) [Rpt./ 6 units] I II
596. Seminar
a. Women's Studies (3) [Rpt./ 2] I II
b. Women and the Literature of Identity in Modern Middle East and North Africa (3) I II (Identical with HIST 596, which is home).
c. Research in Women's Studies (3) [Rpt./ 1] I II
w. Women's Studies (3) [Rpt./ 2] I II (Identical with ENGL 596, which is home).
599. Independent Study (1-6) [Rpt./ 1 II
606. Women's Health in the United States (3) I II (Identical with ANTH 606, which is home).
695. Colloquium
b. Gender and the Law (2) I II (Identical with LAWS 695b, which is home).
c. Advanced Studies in the History of Women (3) [Rpt./ 10] I II GRD (Identical with HIST 695e, which is home).
d. Comparative Women's History (3) [Rpt./ 4] II P, consent of department. (Identical with HIST 696n, which is home).
699. Independent Study (1-6)
799. Independent Study (1-6)
910. Thesis (1-3)
930. Supplementary Registration (1-9)
IX. University Libraries, Research Units and Public Service Units

The University Library

The University Library system contains over 7,000,000 items, including books, periodicals, microforms, maps, government publications, manuscripts, and non-book media. Basic holdings cover all fields of instruction, and there are especially strong collections in anthropology, geology, arid lands, Spanish and Latin American language and literature, American agriculture, Southwestern Americana, Arizonaiana, 20th century photography, history of science, science fiction, and 18th- and 19th-century British and American literature. The University is a member of the Center for Research Libraries and the Association of Research Libraries. The Library is also a member of the AMIGOS Bibliographic Network and through this and other agencies can borrow materials for student and faculty research on interlibrary loan. The Library offers reference services, online searching of computerized databases, and bibliographic course-related instruction. SABIO, the library's on-line information system, includes an on-line catalog, commercial databases, Spanish language menus, and access to the Internet. Through SABIO, the University Library has access to hundreds of other libraries and to electronic interlibrary loan requests. The Library's Internet home page can be found at http://www.library.arizona.edu.

The University Library system consists of the Main Library, which houses the Central Reference Department, the Media Center, the Map Collection, the Current Periodicals/Reserve Book Room, and the Newspapers and Microforms Collection; the Science-Engineering Library; and the following branch collections: the Oriental Studies Collection, the Music Collection, the Center for Creative Photography, the Southwest Folklife Center, Special Collections, and the Architecture Library. For Main Library Information Assistance call (520) 621-6406 and for hours of operation call (520) 621-6440. For the Science Library Loan Desk call (520) 621-6388 and for reference assistance call (520) 621-6380. Dial-in access to SABIO for all baud rates is available at (520) 621-9600. The communication parameters for text only, dial-in access are: VT100 emulation, full duplex, 8 data bits, 1 stop bit, no parity. Once connected, a prompt will be displayed. At this prompt, type: "telnet sabio" and follow the on-screen prompts to begin searching. For help connecting via dial-in, contact CCIT Help Desk at 621-HELP. For text and graphics (SLIP/PPP Connection), use Netscape or other graphical Web browser, open URL for SABIO: http://www/library.arizona.edu.

Main Library

Main Reference

Reference materials for the social sciences, fine arts, humanities, business, and government documents. Several SABIO terminals, CD-Rom stations and image stations are available. In-depth reference on most research projects can be obtained from a subject specialist by appointment. Call 632-6441 or visit the library home page at http://www.dizzy.library.arizona.edu. E-mail Reference is available by accessing askref@bird.library.arizona.edu or clicking on the "Help" button from the library home page. Teaching assistants and faculty can place class materials on reserve; call 621-6406 for additional information.

Current Periodicals/Reserve Book Room

Displays current issues of the 4,000-plus periodicals received in the Main Library, and manages the reading materials put on reserve for class use.

Map Collection

A depository for federal government maps, houses a fully cataloged collection of nearly 300,000 maps on every subject.

Media Center

The library's nonbook materials except microforms and music tapes and records. The Film Department was added in 1988.

Newspapers and Microforms Collection

Current issues of more than 150 newspapers to which the library has a collection of microforms which numbers nearly 2 million.

Special Collections

Collections of Arizonaiana and Southwestern Americana, special subject collections, rare books, fine printing, manuscripts, and The University of Arizona archives.
Science-Engineering Library  
The Science-Engineering Library houses all materials on science and technology. It has more than 500,000 volumes, 1,500,000 microforms, and displays current issues of its 4,000-plus periodicals.

Music Library  
The Music Library maintains a collection of approximately 50,000 music-related books, 230 periodicals, 70,000 scores, 15,000 pieces of sheet music, and 25,000 recordings. Music material from the Arizona and Sonora geographical area is represented. Other significant items include The Hill and Phillips collections containing over 125,000 titles of historical popular sheet music dating back to the early 1800's.

Center for Creative Photography  
The center is a world-class museum and research center devoted to photography as an art form. The research center features nearly 150 photographer's archives including personal papers, negatives, contact sheets, and artifacts, which are available to researchers by appointment. In addition to 17,000 books, the library has over 80 current periodicals and 500 videotapes.

Southwest Folklore Center  
The Southwest Folklife Center houses musical tapes and manuscript archives of Southwest music and folklore.

Oriental Studies Collection  
The Collection includes materials in Chinese, Japanese, Arabic, Persian, Turkish and other oriental languages. It houses over 160,000 items.

Architecture Library  
The Architecture Library houses a collection with emphasis on the topics of design, architectural history and theory, building technology, desert architecture, and design communications. It includes over 10,000 monograph titles and 300 serial titles.

Law Library  
The Law Library houses over 340,000 volumes and volume equivalents. It provides a research collection of all state and federal jurisdictions in the United States, as well as extensive holdings of legal periodicals, treatises, and loose-leaf services. The library recently became a selective depository for United States government publications related to law.

There is a large collection of English and British Commonwealth materials, and a growing collection of foreign and international legal materials, with a special emphasis on Mexican and Latin American law.

Arizona Health Sciences Library  
This specialized library serves the Colleges of Medicine, Nursing and Pharmacy, Public Health Program, health-related Internship graduate programs, and the University Medical Center. It contains over 212,000 volumes and receives approximately 2,100 serial titles. The collection includes books, journals, audiovisuals, electronic resources and other materials in the health sciences. Online access to its resources is available via http://www.ahsl.arizona.edu.

Arizona State Museum Library and Departmental Libraries  
The Arizona State Museum Library and departmental libraries such as the Division of Economics and Business Research Library, the Steward Observatory Library, the Herbarium, and the Lunar and Planetary Sciences library, are also available to serve special research needs.

Research and Public Service Units  
The following divisions are part of or affiliated with the University. Additional information regarding their organization and services may be obtained from each of the units.

The Agricultural Experiment Station (1890) is responsible for the basic and applied research programs in the schools, departments, and other units within the College of Agriculture. It is administered by the Director of the Experiment Station. Modern facilities for laboratory and field research and extension, as well as graduate and undergraduate teaching, are available on the University campus and at agricultural centers throughout the State of Arizona, including the Santa Rita Experimental Range. Research is also conducted on farms, orchards, ranches, rangelands, and forests in cooperation with farmers, ranchers, and officials of various state and federal agencies.

The Arizona Arthritis Center (1977) is a multidisciplinary organization which includes physicians, basic scientists, allied health personnel, and a variety of other health professionals interested in research, education, and the comprehensive care of patients with arthritis, rheumatic, and related diseases. The Center's activities cover both basic and clinical research. Multiple programs in the area of basic mechanisms of disease in rheumatoid arthritis, systemic lupus erythematosus, metabolic bone disease, spondyloarthropathies, and various autoimmune diseases are actively being pursued. There is a large clinical pharmacology study unit within the Center. Basic work on the immunology of inflammatory cell function and the immunology of bone formation and destruction is being pursued. There is a large area of research and the development of artificial joint prostheses and biomaterials. Basic educational and health sciences research in rheumatic diseases are also carried out at the Center. Educational activities are conducted at the level of medical student, postgraduate trainees in primary care medicine, specialists in the area of orthopedics, rheumatology, and joint replacement surgery, as well as physical and occupational therapy and podiatry. There are extensive programs in patient education, and postgraduate and continuing educational programs in the state, region, and nation. The patient care model of interdisciplinary team care is emphasized. There are large programs in both adult and pediatric rheumatic disease care that provide for statewide consultative programs. The Arizona Arthritis Center is a division of the College of Medicine. It includes faculty and staff in the College as well as on main campus, and is linked to University Physicians, Inc. and the University Medical Center.

The Arizona Cancer Center (1976) is a comprehensive cancer center officially designated by the National Cancer Institute. The Center's mission is to significantly contribute to research related to the understanding, diagnosis, treatment, and prevention of cancer. To attain its goal, the Arizona Cancer Center pursues the following objectives: (1) serve as a major geographic resource which is comprehensive in the scope of its activities; (2) promote excellence in basic and clinical cancer research, patient care, and professional training and education; (3) facilitate and coordinate cancer-related programs at The University of Arizona; and (4) develop an outreach program to serve the State of Arizona. The Arizona Cancer Center plans educational, clinical, and scientific activities. The Center offers educational opportunities for medical and graduate students as well as organizes
local and national continuing medical education programs for physicians and other health professionals. Graduate degree programs in cancer biology were initiated at The University of Arizona in 1988 with the support of faculty from the Arizona Cancer Center. Medical students and life sciences graduate students are able to work in cancer-related research projects with faculty throughout the College of Medicine. The monthly Tumor Board at the Arizona Cancer Center is open to all interested persons; presentations cover aspects of cancer patient management, cancer research, and cancer prevention. As part of the required curricula of medical students, cancer-related lectures are presented in the Departments of Biochemistry, Molecular and Cellular Biology, Microbiology and Immunology, Anatomy and Cell Biology, and Pharmacology. The clinical oncology research programs of the Arizona Cancer Center continue to bring cancer patients to the Arizona Health Sciences Center, which is the leading resource for cancer care in the state. Multidisciplinary cancer research expertise is continually developed and expanded in numerous clinical and laboratory programs that include basic research studies on oncogenes and on carcinogenesis; the study of gene therapy, heat, radiation, biological modifiers, bone marrow transplants, and targeted drugs in cancer therapy; the interaction of vitamins A and E and their synthetic derivatives with preneoplastic and neoplastic states; the definition of the pathophysiology of clonal growth of human tumors; clinical pharmacology of anticancer drugs; tissue kinetics; tumor virology; cellular and molecular biology; medical imaging of cancer; tumor immunology; cancer prevention, effectiveness of Vitamins A, E, and C, Selenium, wheat fiber, and fruits and vegetables; cytogenetics; and clinical trials of promising approaches to cancer prevention, diagnosis, and treatment.

The Arizona Center On Aging (1991) in The University of Arizona College of Medicine has these primary goals: (1) the development of multidisciplinary education and clinical training programs regarding the elderly that involve University faculty, allied health professionals, scientists, and health administrators; (2) the development of a more effective, humane, and comprehensive system for delivering medical, health, and social services to elderly persons; and (3) engagement in research programs addressing the processes of aging and the delivery of services to elderly in the context of our society. The Center has three major programmatic emphases: geriatrics, long-term care, and gerontological studies. The Center's activities are diverse and comprehensive. It has established a statewide network for education in gerontology/geriatrics. Internships, postgraduate training in geriatrics, as well as an accredited geriatric fellowship, are major features of the Center's education program. A Master of Science in gerontology, a doctoral minor in gerontology, and a graduate certificate in gerontology are also supported through the Center. Maintenance of geriatric clinical settings, including specialty clinics, a home visitation program, academic nursing home, a geriatric hospital unit, and an inpatient consultation program within the College of Medicine allow for direct involvement of students from medicine, nursing, pharmacy, and allied health professions in direct service experiences. Expanding research activities include investigations of basic mechanisms of the aging process; psychosocial issues, including dementias, depression, cognition, and quality of life; influence of aging on function, including falls, incontinence, and appropriate rehabilitation practices; government policy formulation, and models for quality service delivery to older people and their families. All programs are designed to contribute to the increased well-being of the elderly.

The Arizona Center for Mathematical Sciences (1988) provides an interdisciplinary environment for research and learning in the mathematical sciences. Its basic research themes are the modeling, understanding, and applicability of nonlinear processes in optics, fluids, ocean waves, plasma physics, and neural networks with continuing investigations into pattern dynamics, chaos and turbulence, and, in particular, their manifestation in optical contexts. The Center supports graduate students, postdoctoral fellows, long- and short-term visitors, and sponsors various workshops throughout the year. These activities serve to provide a rich environment for student and faculty interaction. The Arizona Center for Mathematical Sciences received funding as a University Research Initiative of the Air Force Office of Scientific Research for six years, 1986-1992, and is currently supported by continued funding from the same Office as well as by funds from the National Science Foundation and the Office of Naval Research.

The Arizona Cooperative Fish and Wildlife Research Unit (1951) engages in graduate education, research, and extension. The Unit is supported by The University of Arizona, the Arizona Game and Fish Department, the National Biological Survey, and the Wildlife Management Institute. The facilities and personnel of the unit are available to graduate students who wish to pursue both class work and research programs leading to advanced degrees in fisheries science and wildlife biology. The unit is housed in the School of Renewable Natural Resources.

The Arizona Cooperative National Park Resources Studies Unit (1973), located in the School of Renewable Natural Resources, is engaged in research to support the natural science program of the National Park Service. In cooperation with The University of Arizona, the Unit provides graduate research opportunities and instructional support in a broad array of natural resource problem areas.

The Arizona Emergency Medicine Research Center (1990) was established by the Arizona Board of Regents as a Center of Excellence to enhance and expand research, education, and training in Emergency Medical and Emergency Health Services (EMS). It is one of only four such units in the U. S. and the only one in the entire Southwest region. AEMRC activities (by division) include: Research: (1) epidemiology of acute medical and traumatic injuries; (2) clinical research in the pathophysiology of acute illness and injury; (3) research in operations, quality improvement, and policies of emergency health services. Training: (1) evaluation and enhancement of prehospital EMS through prehospital provider training at all levels; (2) continuing medical education and technologies update in EMS. Education: (1) development of educational pathways for physicians, nurses, administrators, and researchers dedicated to careers in EMS; (2) education of medical students, house staff officers, postgraduate fellows, and practicing physicians in emergency medicine and emergency medical services systems. The AEMRC participates in the M.P.A. and M.P.H. programs at The University of Arizona. Emergency Health Informatics and Information Systems: (1) development, implementation, and evaluation of data dictionaries and data sets; (2) provision of telecommunication and computing support services for research projects involving data collection and analysis; (3) development of methods and modalities for prehospital data collection, transmission, storage, retrieval, and evaluation; (4) facilitation and support efforts as the National Emergency Health Services Information and Injury Control Clearinghouse.
The Arizona Institute for Neurogenic Communication Disorders (1986) is a multidisciplinary academic unit designed to promote, coordinate, and administer research programs and a clinical center for speech and language disorders caused by diseases of the nervous system. Initiated by the Department of Speech and Hearing Sciences and the Department of Neurology, this unit includes the participation of cognitive science, exercise and sport sciences, linguistics, neuroscience, pediatrics, psychology, radiology, surgery, and systems and industrial engineering. In addition to its major thrusts involving research programs and a clinical center, the Institute's mission includes fostering doctoral and postdoctoral education, state-of-the-art conferences, continuing education, and public service through advocacy for individuals with neurogenic communication disorders.

The Arizona Poison and Drug Information Center (1980) is operated by the College of Pharmacy and is located in the Arizona Health Sciences Center Library. The Center provides comprehensive poison information and advice on treatment of poisoning to the public on a statewide basis. It also offers drug information and therapeutic consultations to health professionals. The Center has a toll-free telephone number (1-800-362-0101) and can be reached 24 hours a day, seven days a week. Full-time clinical pharmacists staff the center and serve as poison and drug information specialists. Serving as consultants are medical toxicologists and specialists in plant and animal poisons, drugs, and environmental and industrial poisons. The Arizona Poison and Drug Information Center also provides clinical training of pharmacy and medical students in the areas of clinical toxicology, drug, and poison information. The Arizona Poison and Drug Information Center is a component of the Arizona Poison Control System which was established at The University of Arizona by the Arizona State Legislature in 1980. The Arizona Poison Control System is certified as a regional poison control program by the American Association of Poison Control Centers.

The Arizona Prevention Center (1997) consolidates key prevention and public health programs in The University of Arizona Health Sciences Center for an innovative approach to prevention and health promotion. The Center is composed of the following units: Environmental and Occupational Health; Health Promotion and Disease Prevention; Native American Health; Global Health; Epidemiology, and Biostatistics. The Arizona Prevention Center applies its strengths to work collaboratively with other Centers and Programs within the University to develop new community partnerships for prevention and health promotion. The collaborating programs include the Arizona Arthritis Center, Campus Health, Arizona Cancer Center, Sarver Heart Center, Steele Memorial Children's Research Center, Department of Anthropology, Department of Communication, Department of Nutritional Sciences, School of Family and Consumer Resources, Respiratory Sciences Center, Department of Family and Community Medicine, and Cooperative Extension. The Arizona Prevention Center program, with the support of its Community Advisory Board, is developing partnerships with Tucson and Arizona communities and expanding the resources available to programs for health promotion.

The Arizona Remote Sensing Center (1972), located in the Office of Arid Lands Studies, serves as a focus of remote sensing research in the College of Agriculture. The staff of the Center is involved in interdisciplinary remote sensing and computer mapping projects related to agriculture and natural resource management. The Center contains equipment for manual analysis of satellite and aircraft imagery and computer systems for digital processing and display of images and maps. These facilities are available to faculty, students, and collaborators from outside the University.

The Arizona Research Laboratories (ARL) (1979) is a multidisciplinary unit established to promote and support interdisciplinary collaborations which initiate new research and educational programs of high priority to the scientific community. ARL provides an important mechanism for fostering and administering programs which bridge disciplines embraced by departments from different colleges. It presently consists of nine divisions: Arizona Fullerene Consortium; Biotechnology Division; Center for Insect Science; Institute for the Study of Planet Earth; Microcirculation Division; Division of Neural Systems, Memory and Aging; Division of Neurobiology; Committee on Neuroscience; and Surface Science Division.

The Arizona State Museum (1893) houses one of the finest collections of prehistoric, historic, and contemporary Southwestern Indian material in the world. The Paths of Life exhibit explores the cultures, beliefs, and histories of ten Native American groups in Arizona and northern Mexico. The Museum also houses a library, research facilities, and a gift shop. Guided tours for school groups are provided by appointment. Free admission.

The Arizona Transportation and Traffic Institute (1959) is engaged in broad research aimed at developing advanced methods of analysis and obtaining answers to the transportation problems of Arizona. Topics considered involve the planning, design, and operation of transportation facilities, including pavement design and highway materials, as well as maintenance of these systems. The Institute acts as a technical information center, and its activities are closely tied to those of the Department of Civil Engineering and Engineering Mechanics.

The Arizona Veterinary Diagnostic Laboratory (1983) is a service unit of the Department of Veterinary Science which provides consultation and diagnostic assistance in animal health to veterinarians; livestock and companion-animal owners; wildlife managers; federal, state, and municipal agencies. Services provided include pathology, toxicology, virology, parasitology, bacteriology, and applied research and field investigation of livestock problems. Diagnostic faculty members support research and teaching programs of the department.

The Biotechnology Division (1986) of the Arizona Research Laboratories exists to provide core facilities necessary to support on-going research and educational programs. It provides access to state-of-the-art technology and instrumentation to all units within the University, state agencies, and the private sector. The division presently consists of six facilities: Biological Magnetic Resonance Facility; Cell Sorting; Biotechnology Computing Facility; Electron Microscopy; Laboratory for Molecular Systematics and Evolution; and Macromolecular Structures Facility. The facilities offer workshops and other educational opportunities as a means to educate students and researchers in the application of the most modern technologies.
The Boyce Thompson Southwestern Arboretum (1927) is operated cooperatively by The University of Arizona (College of Agriculture), Arizona State Parks Board, and the Boyce Thompson Southwestern Arboretum Board. This public botanic garden has facilities for teaching and research. Situated on the edge of the low desert near Superior, Arizona, the arboretum is a two-hour drive from the campus. Thirty acres of native and introduced plants from arid and semi-arid regions, together with about 1,000 additional acres of undisturbed fauna and flora, are under arboretum control. Additionally, large tracts of relatively undisturbed habitats in a variety of biomes lie in the surrounding Tonto National Forest. Laboratory facilities and housing are available. The arboretum is open daily except on Christmas Day.

The Bureau of Applied Research in Anthropology (BARA) (1952), a division of the Department of Anthropology, is a regional and international center for basic and applied research relating to the resolution of critical problems in human society: culture change, urban and rural living, technological innovation, cross cultural and multicultural learning, health, disease and diet, ecological transformation, social and cultural impact assessment, agricultural and institutional development, educational innovation, and research methods. As part of the University, BARA promotes interdisciplinary research efforts. BARA also actively involves students of anthropology in its on-going research projects.

The Bureau of Mineral Technology (1915), formerly the Bureau of Geology and Mineral Technology, was reorganized by the state legislature, effective July 1, 1988, to form the Arizona Geological Survey as an independent state agency. The Arizona Geological Survey replaces the former Geologic Survey Branch of the Bureau and continues to serve as the primary source of geologic information in the state. The mission of the Mineral Technology Branch is maintained through the College of Engineering and Mines. Dissemination of information relating to mining, including health and mine safety and geological engineering, is accomplished by the Department of Mining and Geological Engineering. Information about mineral processing and extractive metallurgy can be obtained from the Department of Materials Science and Engineering.

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The Center for Astronomical Adaptive Optics (CAAO) (1994) develops methods for correcting the atmospheric blurring of images made by astronomical telescopes. Currently, its program is directed toward a correction system for the 6.5 m telescope that will replace the MMT on Mt. Hopkins in 1998. It is also exploring ways to image the faint planets of other stars. The program involves graduate students from astronomy and optical sciences, and is supported by the Air Force Office of Scientific Research (AFOSR).

The Center for Computing and Information Technology (CCIT) (1983) is a UA service unit with a mission to support and enhance the University's ability to fulfill its objectives through the application of appropriate communication and computer technology. CCIT has three areas of accountability: Information Clearing Center, Backbone and Foundation Services, and Consulting and Expert Liaison. CCIT manages, supports, and operates the University's network of shared computing systems, including the "U.Arizona cluster" of IBM AIX computers for e-mail, instruction, and Internet services; a "Research cluster: of IBM SP computers; and a CONVEX cluster for research applications. A VAX/VMS cluster provides general computing and Internet support, and the administrative computing needs are met using a MVS mainframe and a HP cluster. CCIT also manages, supports, and operates a number of microcomputer (Windows and Macintosh) laboratories and terminal access sites, including two x-terminal laboratories. These sites and laboratories are available to students, faculty, and staff. CCIT is also responsible for the campus telephone switch and the campus backbone network (UAnet) that connects all major campus buildings to the Internet. Remote access is also provided through a dialup modem bank of more than 350 modems at (520) 621-9600. CCIT supports the University community in the appropriate use of technology with additional services that include The Faculty Development Center, Research Support, Help Desk (on-line, phone, and walk-in), Faculty Resources for Instruction, training classes, publications and documentation (on-line and print), consulting support, and a campus-wide software site-license program. Please access CCIT's web page at URL: http://www.ccit.arizona.edu for a complete listing of CCIT's current projects, facilities, services, and support groups, as well as assistance in getting started and using computers. For further information, listen to CCIT's pre-recorded information at (520) 621-CCIT or call the Help Desk, (520) 621-HELP. CCIT's main offices are located in the Computer Center Building, S.E. corner of Speedway and Highland.

The Center for Creative Photography (1975), a division of the University Library, is an internationally acclaimed research museum and study center devoted to the collections and archives of 20th-century photographers. Its collections include over 70,000 master prints, more than a million study prints and negatives, correspondence, manuscripts, artifacts, and related documents. It contains a major research library of over 17,000 volumes and a rare book collection. The center sponsors a lecture series of internationally prominent photographers, historians, critics, and related scholars. It also has an extensive publishing program, which includes a journal titled The Archive. This publication is a benefit of membership and is available for purchase at the Center's bookstore. Photographs and archive materials are available through both exhibition and personal print-viewing appointments.

The Center for Electronic Packaging Research (CEPR) (1991) performs research in the areas of electrical and thermal characteristics of electronic device packages and interconnected devices. The main activity is in modeling and simulation of electrical and thermal characteristics of Level 1 and Level 2 packaging, and experimental verification of the modeling results. The Center is also responsible for the campus telephone switch and the campus backbone network (UAnet) that connects all major campus buildings to the Internet. Remote access is also provided through a dialup modem bank of more than 350 modems at (520) 621-9600. CCIT supports the University community in the appropriate use of technology with additional services that include The Faculty Development Center, Research Support, Help Desk (on-line, phone, and walk-in), Faculty Resources for Instruction, training classes, publications and documentation (on-line and print), consulting support, and a campus-wide software site-license program. Please access CCIT's web page at URL: http://www.ccit.arizona.edu for a complete listing of CCIT's current projects, facilities, services, and support groups, as well as assistance in getting started and using computers. For further information, listen to CCIT's pre-recorded information at (520) 621-CCIT or call the Help Desk, (520) 621-HELP. CCIT's main offices are located in the Computer Center Building, S.E. corner of Speedway and Highland.

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The Center for Insect Science (1989) of the Arizona Research Laboratories is a multicampus, multidisciplinary program fostering collaborative research and education on a broad array of topics dealing with insect science. The research goal of the Center is to investigate fundamental questions about the biology of insects. Another goal of the Center is to produce well-trained, interactive, independent scientists who are capable of working in a variety of areas in the biological sciences and excelling in university, industrial, or governmental laboratories.

Finally, through the Educational Outreach Program, the Center strives to improve the quality of science taught at the elementary-school level, and to arouse a child's interest in science that will continue throughout his or her formal education.

To foster interactions among its members, the Center also sponsors several scientific meetings including the HexaPodium series, guest seminar series, distinguished professor series, weekly group insect science meetings, and an international symposium on insect science.

The Center for Microcontamination Control (1984) is located in the Department of Electrical and Computer Engineering. The Center conducts fundamental and applied research that will lead to better control of defects in high-density logic and memory technology. It is one of fifty centers throughout the country initiated by the National Science Foundation to increase the rate of technology interchange between the academic community and the scientists and engineers of industry. The Center sponsors interdisciplinary research in more than six departments in several colleges. In addition, the Center maintains a class-10 cleanroom, an equipment test-tower, and equipment for measuring low levels of airborne and surface contamination.

The Center for Middle Eastern Studies (1975) is one of several federally-funded programs in the United States devoted exclusively to the comprehensive study of this key region of the world. The area of the Center's concern ranges from North Africa and the Fertile Crescent to Israel, Turkey, Iran, Afghanistan, and Islamic Central Asia. As a U.S. Department of Education National Resource Center, CMES disseminates information about Middle East studies nationally and internationally. The Center includes more than 60 faculty members representing over 30 different departments and 7 colleges throughout the University. It also houses the Middle East Studies Association (MESA), which is the primary professional organization of scholars of the Middle East.

The Center for Pharmaceutical Economics (1989) is an interdisciplinary research and service unit of the College of Pharmacy. The Center was established to provide national and international leadership in the application of the economic and administrative sciences in health care and pharmaceutical research, education, and service. The Center integrates clinical and economic research to achieve a framework for the economic evaluation of new therapies. Services include economic/clinical analyses for individual client needs; training programs for industry representatives, researchers, and practitioners; consultation on the design of studies to analyze cost and benefits of drugs; and the dissemination of information about pharmaceutical issues in managed health-care systems.

The Center for the Management of Information (CMI) (1985), partially funded by grants from IBM, the National Science Foundation, the U.S. Army, and a consortium of industrial companies, supports interdepartmental research in economic, political, social, and technological aspects of information management. CMI is one of the world's leading research centers looking at Electronic Meeting Systems and Groupware research. The Center has three facilities which host classes and corporate groups as part of an extensive research program into a variety of group processes such as planning, problem-solving, process re-engineering, and decision making.

The Center for the Study of Complex Systems, a multidisciplinary unit bringing together local and external researchers, is designed to identify and explore new concepts and features of complex nonlinear systems in various areas of science. Recent advances in the understanding of fundamental aspects of nonlinear systems, coupled with progress in computer technology, permit new approaches to heretofore intractable scientific problems in diverse fields: climate; cognitive science; computational theory; elementary particle physics; evolutionary biology; materials and condensed matter science; motor control; robotics, and prosthetics; neurobiology; vascular physiology; turbulence; and others. The Center sponsors research, visiting scientists, workshops, and colloquia, all aimed at encouraging the development of new approaches to complexity at the interfaces between traditional scientific disciplines such as biology, chemistry, mathematics, and physics.

The Center for the Study of Higher Education (1978) in the College of Education conducts research studies and provides related service activities to meet state and institutional needs, as well as those of national, international, and regional governmental units and other organizations. It develops and disseminates information about higher education policy and operation, and facilitates the research of faculty members and students. Special research and service projects are provided through outside support.

The Center for Toxicology (1988) is an interdisciplinary organization that operates as a unit of the College of Pharmacy. Its mission is to strengthen and expand University and statewide efforts in toxicology. The goals of the Center are to develop new research programs in toxicology, to insure that these and present programs have an interdisciplinary approach; to participate in graduate training at the master's, doctoral, and postdoctoral levels; and to interact with local, state, and federal agencies as well as with the private sector, to predict and prevent problems associated with exposure to toxic chemicals present in the home, workplace, and environment. The underlying theme of the research activities of the Center is the elucidation of mechanisms by which chemicals produce adverse biological reactions. In 1994, the Southwest Environmental Health Sciences Center (SWEHSC) was established by a major grant from the National Institute of Environmental Health Sciences. Besides fostering the interdisciplinary research activities of the Center for Toxicology, the SWEHSC has developed a community outreach and education program.

The Cooperative Extension System (1914) has made knowledge useful for the people of Arizona through community education programs for more than 80 years. The agenda focuses on three main areas: environmental stewardship; strengthening youth, families, and communities; and economic vitality. Extension faculty, also known as county faculty or agents, deliver these programs through offices in each of Arizona's 15 counties, on Indian reservations, and in satellite centers throughout the state. Using nonformal teaching methods, extension professionals, often assisted by volunteers, present the latest research on agriculture, family living, nutrition, youth development, horticulture, management of natural resources, and community and
economic development. Their agenda has expanded from a traditional emphasis on production agriculture and home economics to a broader approach based on needs identified in both rural and urban communities. Delivery methods include workshops, demonstrations, field days, short courses, publications, videotapes, telephone consultations, and personal visits - whichever method best suits the needs of the audience and the nature of the subject matter. These outreach programs serve people of all ages and all walks of life.

The Division of Economic and Business Research (DEBR) (1949) is a research and service organization within the College of Business and Public Administration. Its broad objectives are to conduct research relating to business, economics, and public policy in Arizona; to complement the formal education of students with research experience; and to disseminate information. To achieve its objectives, DEBR builds and maintains regional economic models for applications in forecasting and impact simulation, conducts research on state and local market conditions, and analyzes the effects of public policy alternatives. It publishes the quarterly Arizona's Economy, the semi-annual chart book Arizona Economic Indicators, and the Arizona Statistical Abstract. It also produces forums and seminars for the public. In addition, DEBR answers requests from business, government, and the general public for tabular information and maps showing local demographic and business patterns and, as a member of the State Data Center, of computerized census information.

The Division of Learning, Technology, and Assessment (1997) of the Arizona Research Laboratories provides an environment in which University of Arizona researchers work collaboratively with leading scholars from around the world to conduct innovative research on learning, technology, and assessment that will produce better student learning outcomes through the improvement of instructional technology and its application. Students and post-doctoral scholars work with Division faculty to acquire the requisite knowledge and critical research skills in learning, technology, and assessment for a productive future in their professions. The Division has six ongoing activities: (1.) conducting research on learning outcomes, especially in large enrollment courses; (2.) offering a Graduate Minor, a Graduate Major is in the planning stages; (3.) training students for careers in learning, technology, and assessment; (4.) collaborating with faculty to bring the latest research developments to the design and assessment of college courses; (5.) bringing distinguished visiting scholars to the University of Arizona community; and (6.) sponsoring a lecture series about the latest developments in learning, technology, and assessment featuring University of Arizona faculty and outside speakers. Research is currently being conducted in various areas of cognition, cognitive development, and technology including: human-computer interaction, human learning and memory processes, individual differences in learning styles and other cognitive factors and individual differences in social and personality factors. For more information please contact Dr. Valerie F. Reyna, vrey@u.arizona.edu, 626-7377 or Dr. Charles Brainerd, brainerd@u.arizona.edu, 621-7831.

The Division of Neural Systems, Memory and Aging (1990) of the Arizona Research Laboratories is an interdisciplinary research unit whose main focus is memory, studied from a variety of perspectives. There is a particular focus on spatial cognition and memory, and the neural mechanisms involved in carrying out this important function. Most members of the unit work on the hippocampal formation and related structures thought to be involved in this capacity. Particular faculty have special interests in development, aging, plasticity at the cellular and molecular level, computational aspects of memory, and neurochemical aspects of memory and aging. Postdoctoral fellows and graduate and undergraduate students work in all these areas, and receive broad training in behavioral and computational neuroscience.

The Division of Neurobiology (1985) of the Arizona Research Laboratories is a research unit whose main focus is neurobiology and behavior of insects. Investigations under way in the division, probing experimentally favorable insect neural preparations at the cellular, developmental, molecular, and systems levels, seek to reveal fundamental neurobiological processes and mechanisms common to many animal species including human beings. These studies also promise to advance our understanding of agriculturally and medically harmful insects.

The Division of Social Perspectives in Medicine (1968) was established within the College of Medicine in recognition of the increasingly compli-
developed systems for the intensive culture of marine shrimp. ERL is developing halophytic crops for livestock feeds, soil and water remediation, and other uses. ERL consults on many environmental projects such as the EPCOT Center at Walt Disney World in Florida. ERL has also developed a series of demonstration solar homes at Tucson International Airport. The work in biospherics research is reflected in the development of Biosphere 2 currently owned by Columbia University, and in global studies of the greenhouse effect.

Flan drau Science Center and Planetarium (1975), a part of the College of Arts and Sciences, was built as a result of a gift to the University by Grace H. Flan drau. It houses a 30-foot projection dome, a Minolta Series IV planetarium projector, and a hemispheric 35mm motion picture projector. It is used as a teaching facility for University classes in astronomy, and 25,000 Tucson public school children attend its special educational programs each year. The Planetarium presents dramatic public programs on astronomy and general science that take audiences on cosmic journeys through time and space. The science exhibit halls and 16-inch telescope are open to the public, daily except Mondays, for a small fee.

The Institute for the Study of Planet Earth (1994) of the Arizona Research Laboratories is a multidisciplinary research unit designed to promote research, education, policy formulation, and information exchange on global environmental issues. The global change research is concentrated in five major areas: biophysical aspects of arid regions; study of past global change; remote sensing; global climate modeling; and human dimensions of global change. Funding from federal agencies has enhanced the development of undergraduate courses in global change by providing access to state-of-the-art computer laboratory facilities for both science and non-science majors. Graduate students can minor in Global Change while pursuing studies within a traditional discipline or within one of several interdisciplinary degree programs. The Institute facilitates campus-wide communication through a seminar series and a visiting scholar program that brings leading researchers to campus.

The Institute of Atmospheric Physics (1954) conducts research on fundamental aspects of climate and global change, mesoscale meteorology, atmospheric dynamics, radiative transfer, remote sensing, atmospheric aerosols, atmospheric chemistry, cloud and precipitation physics, lightning, and atmospheric electricity.

The Jeffrey M. Golding Clinical Research Unit (1984) is a specially equipped facility located in the College of Pharmacy. Its primary objective is to provide clinical scientists at The University of Arizona with the opportunity to study the action of drugs in humans with the ultimate goal of developing improved methods of treatment. The Unit has three rooms: a patient waiting room, a private office for conducting patient interviews or preliminary examinations, and a main room which houses two hospital beds and is equipped with specialized medical equipment.

The Karl Eller Center for the Study of the Private Market Economy (1983) is a research and education organization within the College of Business and Public Administration. It has three broad objectives: (1) to promote research in basic market processes, (2) to sponsor an Entrepreneurial Studies Program, and (3) to provide for business/academic exchange. Research is supported through limited faculty research fellowships and chaired professorships awarded to the Center. The Entrepreneurial Studies Program offers both academic courses for students interested in entrepreneurship and practical courses on the development of business plans. Approximately 50 students are included in the program annually.

KUAT Communications Group (1959) provides a wide range of instructional media, production, and public broadcasting services to the University, community, and state. The division operates five maximum-power public broadcasting stations: KUAT-TV Channel 6; KUAU-TV Channel 27 (in the Catalina Foothills) and TV Translator K23CK, Duncan, Arizona; KUAT-AM (1550 kHz); KUAU-FM (89.1 MHz); and KUAU-FM (90.5 MHz) with Translator Frequencies, 89.7 MHz in northwestern Tucson and Sierra Vista, 91.7 MHz in Nogales and 88.9 MHz in Bisbee-Douglas, Arizona. The stations are affiliated with the Public Broadcasting Service (PBS), National Public Radio (NPR) and Public Radio International (PRI). Professional production facilities are maintained in the Modern Languages Building and the Harvill Building. Production capability includes a color studio. The VideoServices unit produces and distributes University of Arizona credit and noncredit courses to business and industry in the Tucson area through an 8-channel ITFS system called the Tucson Education Delivery System (TEDS), and across the nation by videotape and live satellite transmission. The University is a member of the National Technological University (NTU) consortium. The VideoServices unit provides production and engineering support for the campus including: pre-production and post-production consultation, video production, television distribution nationwide via KU Band uplink facilities, locally through the TEDS system, microwave and ITFS transmission to Ft. Huachuca and Sierra Vista. The unit also provides satellite reception and recording and a 2-way video teleconference origination facilities.

The Laboratory of Tree-Ring Research (1937) is an outgrowth of the pioneering tree-ring studies initiated by Andrew Elliott Douglass at The University of Arizona in 1906. The Laboratory conducts a unique program of teaching and research in all aspects of dendrochronology. Graduate-level instruction is offered through cooperating academic departments, and a limited number of graduate research assistantships are available to qualified students. Current research efforts are directed toward the quantification of tree-ring parameters, the establishment of new tree-ring chronologies throughout the world, the understanding of basic tree growth and environmental relationships, the reconstruction of paleohydrologic, paleoclimatic, and paleoecological variables, and the documentation and development of prehistoric chronological controls. Along with the world's largest collection of tree-ring specimens from living trees and ancient timbers, the laboratory maintains a variety of specialized equipment and data files containing processed tree-ring chronologies, relevant climatic and hydrologic records, and archaeological tree-ring dates and site information.

The Latin American Area Center (1974) is a unit of the College of Social and Behavioral Sciences that fosters opportunities for students and researchers in Latin American Studies. In addition to offering undergraduate and graduate programs through its Committee on Latin American Studies, the Center is a focal point of Latin American related research undertaken by scholars from every college of the University, whose interests range from medicine to law, from anthropology to ecology, from agriculture to history, and from political science to international business. Each year the Center engages in
a variety of outreach activities: editing and publishing, television and radio programming, institute uncommitted development for the public schools, conferences, lecture and film series, and government funded training programs for Latin American professionals. The Center also works with students to arrange internship and study abroad programs designed to enhance career opportunities.

The Lunar and Planetary Laboratory (1960) is the research unit connected with the Department of Planetary Sciences. Planetary Sciences faculty also hold appointments in the laboratory, which, in addition, has a large research staff to conduct investigations spanning a wide range of planetary and related astrophysical and space science. Laboratory staff participate closely in the graduate research instruction of the department. Close relationships and cooperative programs are maintained with a number of other units on the campus, including Astronomy, Geosciences, Optical Sciences, Physics, and the Steward Observatory. Together, the Department of Planetary Sciences and the Lunar and Planetary Laboratory form an institute uncommmonly broad and complete in its approach to planetary science education research. The department and laboratory participate in many NASA space science missions. Among the current missions in which the faculty are participating are the Voyager Mission, the Near Earth Asteroid Rendezvous, the Galileo Mission to Jupiter, the Cassini/Huygens Mission to Saturn, the Mars-Pathfinder, the Discovery Missions, NASA space shuttle missions and the Ulysses Heliospheric Probe. In addition LPL scientists make use of Earth orbiting observatories, including the Hubble Space Telescope and the Ultraviolet Explorer. The Laboratory's Space Imagery Center contains one of the most extensive collections of planetary images in the world, beginning with those obtained from the earliest space projects and continuing to most current missions. LPL's Planetary Imaging Research Laboratory is a modern image processing facility for the analysis of planetary and astronomical data. Also available for student research are cosmochemistry and geochemistry laboratories, including a scanning electron microscope and microprobe facility, an experimental petrology laboratory, a radiochemistry separation and neutron activation laboratory, and a noble gas mass spectrometry laboratory. The numerous telescopes of The University of Arizona observatories are available for research projects, includ-
research for the Specialized Center of chronic bronchitis, and emphysema). It is a pulmonary disease with a special emphasis on airways obstructive diseases (asthma, training programs in Adult and Pediatric Pulmonary Function Laboratories, Blood Gas Laboratory, and University Medical Center's Adult-Pediatric Chest -Allergy Clinic as well as University Medical Center, the Arizona Research Laboratory, the Optical Circuitry Cooperative, and the Optical Data Storage Center. Special facilities of the Optical Sciences Center include optics shops for fabrication and testing of both small and large (up to 2.5 meters) optics, optical detector testing facilities, an instrument shop, an optomechanical design facility, a molecular beam epitaxy machine, clean rooms, numerous laser systems including ultra-fast femtosecond lasers, a thin film deposition laboratory and a multitude of networked computing facilities.

The Peter Treistman Fine Arts Center for New Media (1993) provides a high technology infrastructure for faculty research and instructional development, and encourages interdisciplinary work across the campus at large. It houses a state-of-the-art computer facility specializing in high technology applications within the fine arts. It includes the latest in hardware and software for graphics, music, sound, multimedia, and the internet. The Treistman Center provides technical support to faculty, and workshops on web design, multimedia presentations, computer skill development, and other topics. It is located in Room 137 of the Music Building in the Fine Arts Complex.

The Respiratory Sciences Center (1975) has members from many different academic departments. It is responsible for interdisciplinary pulmonary-allergy programs in research, training, and clinical services. It coordinates activities of the Adult-Pediatric Chest-Allergy Clinic as well as University Medical Center's Adult and Pediatric Pulmonary Function Laboratories, Blood Gas Laboratory, and Respiratory Care Service. It is also responsible for collaborative postdoctoral training programs in Adult and Pediatric Pulmonary Medicine. A major function of the Center is to coordinate multidisciplinary research programs in pulmonary disease with a special emphasis on airways obstructive diseases (asthma, chronic bronchitis, and emphysema). It is responsible for the Specialized Center of Research (SCOR) in Airways Obstructive Diseases established at the College of Medicine with funding from the National Institutes of Health. The Center is widely known for its epidemiologic studies, including a longitudinal study of a representative sample of the Tucson population (The Tucson Epidemiologic Study of Airways Obstructive Diseases), a longitudinal study of newborns and their families (The Children's Respiratory Study), and studies of the health effects of environmental pollution (The Health and Environment Study). It is now very involved in more basic research, particularly in regard to the immunological, biochemical, pharmacological, neural, and physiological mechanisms which affect airway function and which may be relevant to the pathogenesis of airways obstructive diseases.

The Rombach Institute on Crime, Delinquency and Corrections (1997), located in the School of Public Administration and Policy (College of Business and Public Administration), was formed to advance public policy in the field of criminal justice. The Institute provides student financial assistance; supports public policy research through reports, conferences, and publications; assists State criminal justice officials with evaluation, analysis, and training; sponsors lectures and other public events related to important public policy issues; and presents student and faculty awards and fellowships.

The Roy P. Drachman Institute for Land and Regional Development Studies (1986) is a research and public service unit of The University of Arizona, dedicated to the environmentally sensitive and resource conscious development of land and communities. The Institute provides intellectual leadership on land use and development questions by focusing on four major crucial issues: (1) conflicts in the development and planning process; (2) the unintended consequences of environmental and planning regulations; (3) the relationship between the built environment and the changing needs of the American family; and, (4) development and transportation patterns. Within this focus, the Institute's interdisciplinary staff extends the knowledge base of the University to the public by conducting policy-relevant research on important questions, organizing topical conferences and seminars for planning, development, and real estate professionals; disseminating widely current and vital research; and cooperating with communities and community leaders to develop appropriate responses to local problems.

The Ruth E. Golding Clinical Pharmacokinetics Laboratory (1977) in the College of Pharmacy is primarily an analytical unit where new assays are developed to quantify drugs and their metabolites from biological fluids. These assays are used in conjunction with animal and clinical research projects to better define the disposition of and response to drugs. The results of these studies along with the monitoring of drug plasma concentrations in patients are used to optimize therapy by individualizing drug administration.

The Sarver Heart Center (1986) is an interdisciplinary center dedicated to the prevention and cure of heart and vascular disease through research, patient care, and education. Its many members with Ph.D.'s, M.D.'s, or both, are located throughout the campus. They hold joint appointments and are organized into research focus, educational, and patient care sections. The Sarver Heart Center operates as a division of the College of Medicine. Programs are linked to the faculty and staff in the college, in University Medical Center, and other colleges and units of the University.

The Sematech Center of Excellence for Contamination/Defect Control and Assessment (1988) is a joint effort by industry and the federal government to reverse a decline in U.S. competitiveness in semiconductors, particularly in the
production of integrated circuits. Centers of Excellence established at universities represent SEMATECH's external research arm and are selected based on the quality and relevance of the programs proposed. They bring graduate students into semiconductor manufacturing and create major academic manufacturing research capability. In May 1988, The University of Arizona became one of the first five universities selected to become a Center of Excellence. Engineers working in the Center are developing methods for measuring and removing impurities, contamination, and defects that are a major problem for semiconductor manufacturing. The Department of Electrical and Computer Engineering, home to the SEMATECH Center of Excellence, provides a director that coordinates the efforts of principal investigators from Electrical and Computer Engineering, Materials Science and Engineering, Chemical Engineering, and Systems and Industrial Engineering. Part of the research is being carried out with Sandia National Laboratories in Albuquerque. The technical objectives of the Center are four-fold: (1) to understand and eliminate sources of contamination during wafer surface preparation, (2) to understand and utilize chemical reactions and electric charge effects to develop methods and systems for the removal of impurities and particles from process materials, (3) to understand and develop control techniques for contaminants and defects originating from process equipment, such as oxidation, deposition, dry etch (plasma, RJE, etc.) and ion implantation equipment, and (4) to understand through test pattern technology the role of specific contaminants in generating defects and the role of specific defects limiting yield, and to prioritize efforts in contamination/defect reduction. The Center transfers technology through reports, workshops, students, and cooperative research projects. The University of Arizona Center has been complimented as exemplary in its technology transfer activities.

The Social and Behavioral Sciences Research Institute (1984) supports and coordinates organized research efforts within the College of Social and Behavioral Sciences. Through a series of regular competitions, the Institute provides support for faculty members and academic professionals undertaking pilot projects or small-scale studies likely to lead to externally-funded research. In addition, funds are available to underwrite small projects designed to involve undergraduates in the research process. The Institute encourages both disciplinary and interdisciplinarian research and takes initiatives to promote work in new areas of study.

SBSRI contains two smaller units, the Data and Software Laboratory (DASL) and the Survey Research Center (SRC). DASL provides support for faculty and their graduate students who are working on research problems requiring any form of data purchase and/or analysis, or who require word processing support; in addition, help is provided with the purchase of hardware and software for instructional improvement. SRC provides various forms of support for contract-based questionnaire delivery and analysis. SBSRI also interfaces with other research units, including the Southwest Center. Annually, the Institute sponsors a competition for the best research monograph or article published by a member of the College of Social and Behavioral Sciences, including graduate students.

The Southwest Center (1982) is a unit of the College of Social and Behavioral Sciences that fosters research, teaching, academic development, publication, and public programming on the history, culture, and development of the Greater Southwest (including northwestern Mexico). Southwest Center initiatives are designed for their multiplier effects on the research and service mission of the University, creating new opportunities for interdisciplinary scholarship. As an agency dedicated to the enhancement of regional scholarship and intellectual service, the Southwest Center acts as a liaison to funding sources; creates and implements interdisciplinary regional research projects; pursues a vigorous publishing program; and engages in a broad range of public outreach and programming: conferences, seminars, lectures, speakers' bureau, cultural events. The Center publishes Journal of the Southwest, a scholarly regional quarterly, and sponsors the Southwest Center book series with the UA Press, as well as an imprint with the University of New Mexico Press.

The Southwest Institute for Research on Women (SIROW) (1979) is a regional research and resource center within the Department of Women's Studies. The Institute develops and conducts research on women in the Southwest (Arizona, Colorado, New Mexico, Utah, and west Texas) of interest to scholars in the region. SIROW publishes a newsletter and a working paper series, links researchers with community organizations and policy makers through a research clearinghouse, and provides professional development and training for people in education, research, business, and government.

The Southwest Retail Center (SWRC) (1994), an arm of the division of Retailing and Consumer Studies, offers students an opportunity to interact with retail executives and personnel by creating partnerships between The University of Arizona and the retail industry. Opportunities provided by the Center include: retail internships, a variety of scholarships, the UA Student Retailing Association, retailing speaker series, retail workshops, retail industry tour, and the retailing resource center. Outstanding students also have an opportunity to be a member of the SWRC Student Advisory Board to promote the Center's activities and to develop leadership skills.

The Southwest Retail Center (SWRC) (1986) represents a multidisciplinary and interdisciplinary approach to research related to various medical problems facing children. The goals of the Center include: (1) to coordinate, focus, facilitate, and increase research related to children's health; (2) to foster multidisciplinary research on medical problems related to children; (3) to expand research training and education programs; and (4) to enhance the rapid application of research observations to patient care. Special emphasis is placed on molecular genetics, immunology, neurology, gastroenterology and nutrition, behavioral sciences, and developmental biology. The Center's research programs are closely tied to the educational and clinical activities of the Department of Pediatrics which include extensive outreach programs in numerous communities throughout the state, and general and subspecialty pediatric clinics and inpatient services at University Medical Center, Tucson Medical Center, and Kino Community Hospital.

Steward Observatory (1916) was established by a generous gift from Lavinia Steward, in honor of her husband, George Steward. For many years, the Observatory's principal telescope was its 36-in (91-cm) reflector, constructed with the aid of the Steward bequest. Currently, the primary research telescopes of the Observatory include the Multiple Mirror Telescope (MMT), located on the Mt. Hopkins summit in the Santa Rita Mountains, the 90-in (2.3-m) reflector on Kitt Peak, and the 61-in (1.55-m) reflector at the Mt. Bigelow station in the Santa Catalina Mountains. The MMT, operated jointly with the Smithsonian Astrophysical Observatory, represents an innovative and highly successful concept for construction of very large optical telescopes. The Steward Observatory offices and laboratories are located on then
northeast part of the University campus adjacent to the original 36-in dome. The main areas of research include quasars and active galaxies, degenerate stars, infrared sources, radio galaxies, and the formation of stars and galaxies. Observational programs are concentrated in the optical and infrared (using the facilities of the observatory), but outside facilities are also used at radio, ultraviolet, and x-ray wavelengths. The observatory activities are closely integrated with the University's Theoretical Astrophysics Program. The Observatory has recently completed a major new telescope on Mt. Graham for work in the mm- and submm-wave region, in collaboration with the Max Planck Institute for Radio-Astronomy in Bonn, West Germany. The Mirror Laboratory is developing optics for the next generation of giant optical/infrared telescopes. It will furnish the optics for an upgrade of the MMT, the Carnegie Foundation's Magellan Project (a 6.5-m telescope in Chile), and for the Columbus project, a collaboration of Steward Observatory with Arcetri Observatory, the Research Corporation, and other partners which will use two 8.4-m mirrors and be placed on Mt. Graham. Two construction efforts for space astronomy are also centered at the observatory: the Near Infrared Camera, which was mounted in the Hubble Space Telescope to replace one of the existing instruments, and the Multiband Infrared Photometer, which is one of three instruments for the Space Infrared Telescope Facility, planned for launch early in the next century. The offices and laboratories of the National Optical Astronomy Observatories are located across Cherry Ave. from Steward Observatory, and a division of the National Radio Astronomy Observatory occupies the top floor of the Steward Observatory building. The three observatories jointly sponsor a weekly series of professional colloquia. Steward Observatory also works closely with the Department of Planetary Sciences, the Optical Sciences Center, the Department of Physics, the Vatican Observatory, and the Flandrau Science Center and Planetarium, as well as with the astronomy departments of the other Arizona state universities.

Steward Observatory Mirror Laboratory (1983), housed under the football stadium, has a spinning furnace where large honeycombed glass mirror blanks are cast. These are for several research telescopes being built by national and international collaborations with University of Arizona participation. After casting, the mirrors are also ground, polished, and tested at the laboratory. The 6.5 m primary mirror for the MMT (a joint project with the Smithsonian) has been completed in the laboratory's, and other 8.4 m and 6.5 primaries are being made for the Large Binocular and Magellan telescopes. The laboratory's program involves graduate students from astronomy and optical sciences, and has research programs in optical testing and in new technology for future space telescopes and deformable mirrors for correcting atmospheric blurring. The Udall Center for Studies in Public Policy (1987) facilitates, analyzes, and provides options for the solution of major policy issues through research, education, and public service. The Center's focus has been on issues relating to the U.S.-Mexico border environment, environmental conflict resolution, water resources in the southwestern United States, environmental health policy, the social and policy dimensions of global change, and other areas of public policy. Additionally, in keeping with a legislated mandate, the Center collaborates with the federal Morris K. Udall Scholarship and Excellence in National Environmental Policy Foundation on programs related to national environmental policy and Native American policy. The Udall Center does not have an instructional component, but works closely with units and programs across campus that offer degrees relating to public policy. More directly, each academic year the Center supports a number of graduate research assistants who are assigned to research projects, public programs, and publications.

The USDA Forest Service Cooperative Research Unit (1993) is a research component of the Rocky Mountain Forest and Range Experiment Station (RMS) located in the School of Renewable Natural Resources. The Unit promotes and supports cooperative research efforts among the RMS, the Coronado National Forest, and The University of Arizona. The Unit provides graduate research opportunities and scientist assistance in a broad range of natural resource problem areas. The Unit is committed to a long-term systematic program of basic and applied research and monitoring on the physical, biological, and social issues associated with managing the borderlands area of southeastern Arizona, southwestern New Mexico, and northern Mexico.

University Animal Care (UAC) (1987) oversees the Animal Care and Use Program of the University and provides services for care of all University-owned animals. The unit reports to the Office of the Vice President for Research. Animal care facilities may be found at several locations on the University campus, and each facility is operated and controlled by UAC. The entire Animal Care and Use Program, which includes both laboratory and farm animals, is fully accredited by the American Association for Accreditation of Laboratory Animal Care. The program also meets and exceeds all federal laws and policies which regulate the use of animals in research and education. Six veterinarians and a staff of specially trained animal technologists and technicians provide high-quality animal care. UAC staff and faculty are available to train and assist investigators, research technicians, and students on proper methods of animal handling and use. Expertise in the choice and selection of specific animal models is provided to investigators, thus eliminating unnecessary use of animals. A student manual for animal research is available by contacting the UAC office (520) 626-6702. Federal laws and local policies require that all research, teaching, and/or testing protocols involving the use of animals must be reviewed and approved by the Institutional Animal Care and Use Committee. This Committee, as well as the staff of UAC, is involved in assuring that all animals receive humane treatment. Concern for the welfare of animals and provision of support for the biomedical and agricultural research and teaching programs of the University are the primary objectives of University Animal Care.

The University of Arizona Museum of Art (1942). With two large gallery floors and 14,000 square feet of exhibition space, the Museum of Art maintains and exhibits one of the finest university collections of Renaissance and later European and American art in the Southwest. Works by Rembrandt, Piranesi, Picasso, O'Keeffe, and Rothko are part of a permanent collection of more than 4,000 paintings, sculptures, drawings and prints. The museum is home to masterpieces of the Samuel H. Kress Collection, which include 26 panels of the 15th century Spanish altarpiece of the Cathedral of Ciudad Rodrigo. Part of the first floor is occupied by the "Jacques Lipchitz: Sketches and Models" gallery, featuring 61 clay and plaster models and sketches by this leading 20th century sculptor. Contemporary international painting and sculpture are well-represented in the Edward Joseph Gallagher III Memorial Collection, while the C. Leonard Pfeiffer Collection includes American paintings from the 1930's. The Gallagher Acquisition Fund, plus donations, allow the collection to selectively grow each year. An active program of temporary exhibitions complements the permanent collection, part of which is always on display. The Museum also schedules lectures, seminars and informal
lunch time "ArtBreaks". Guided tours can be arranged two weeks in advance. Art publications and art-related gifts are on sale in the museum shop. There is no admission fee. Call 621-7567 for hours and for more information.

The University of Arizona Press (1959), is a nonprofit publisher of scholarly and regional books. As a delegate of The University of Arizona to the larger world, the press publishes the work of scholars wherever they may be, concentrating upon scholarship that reflects the special strengths of The University of Arizona, Arizona State University, and Northern Arizona University. The Press publishes scholarly books in anthropology and archaeology, space sciences, Latin American studies, Native American studies, environmental studies, Western history, women's studies, and other fields. Also on the Press list are volumes of Native American and Chicano literature and trade books on the Southwest borderlands, including accounts by scholars and professional writers of the natural history, geography, history, folklore, and life-ways of the region. The Press does not publish children's books. The University of Arizona Press invites inquiries from the authors of works - whether scholarly books or works of general interest - that are appropriate to its list. Also appearing under the Press imprint is the quarterly Journal of the Southwest, with separate editorial and subscription offices at the Southwest Center.

The University Research Instrumentation Center (URIC) (1988), provides support through its Cryogenics and Gas Facility, Electronics Design Facility, Welding Facility, Metal Stockroom, and Prototype Machining and Design Facility. The unit reports to the Office of the Vice President for Research. The Cryogenics and Gas Facility is located in the Physics and Atmospheric Sciences Building, Room 164, and the telephone number is (520) 621-2374. The Cryogenics Facility offers both liquid and gas products for sale, i.e., nitrogen, helium, argon, carbon dioxide, and dry ice. The products are available for pick up or delivery. This facility also offers cryogenics storage vessels for rent. In addition, cryogenic consultation is available for product usage, safety issues, and cryogenic equipment. The Electronics Facility is located in the Gould-Simpson Building, Room 235, and the telephone number is (520) 621-4771. This facility offers a wide variety of electronics design programming, and technical support, i.e., surface mount fabrication, microcontroller designs, FPGA chip design capabilities, and circuit board design capabilities. There is a cleanroom available for use. The Welding, Machining, and Metal Stockroom Facilities are located in the Gould-Simpson Building, Room 235, and the telephone number is (520) 621-6758. The Machining Facility designs, repairs, fabricates, inspects, and assembles mechanical devices using manual and computer controlled machines. The Welding Facility offers gas metal arc, tungsten inert gas, controlled atmosphere chamber, and metal inert gas welding services. The Metals Stockroom offers a wide variety of metals that are available in the on-site inventory or can be special-ordered.

Valley Fever Center for Excellence (1995) was established to promote education, research, and patient care for Valley Fever (coccidioidomycosis) in the community. The Center is jointly sponsored by The University of Arizona and the Veterans Affairs Medical Center. It provides information to the public, physician consultations with Center physicians, and physician referrals for patients. Clinical evaluations are also available through Valley Fever evaluations units through the Veterans Affairs Medical Center and the University Medical Center. The Center's Hotline for public information is (520) 629-4777.

The Water Resources Research Center (1965) is an Arizona state water resources research institute, established under the Water Resources Research Act of 1964 to promote and assist water-related research at the three state universities and enhance their contribution to the solution of critical water problems within the state. To accomplish this mission, the Center administers a federal water resources research grant program that provides funds for research on water-related issues. Research findings are brought to the attention of potential users and disseminated throughout the state. As Arizona's water information Center, the unit provides access to water data and publications; produces informational directories and monographs, newsletters, and presentations; and sponsors conferences, symposia, and workshops. In addition, the Center promotes and facilitates interdisciplinary research and carries out a policy analysis research program on water issues requiring examination from multidisciplinary perspectives.

Cooperating Organizations

Certain other independent agencies, not administratively a part of The University of Arizona, cooperate closely with the University and provide opportunities for study and research for faculty and qualified graduate students. Several are located on the University campus, and certain staff members of these organizations also hold University staff appointments.

The Arizona-Sonora Desert Museum is a self-supporting, nonprofit institution situated 14 miles west of the city of Tucson in a saguaro and palo verde landscape of the Sonoran desert. This living indoor and outdoor museum of natural history enables one to gain, in a few hours, a knowledge of the flora and fauna of the Southwest that would otherwise require many years. Unique habitat groups and other displays of desert animals and plants have been developed at this unusual Museum. The Museum cooperates with educational institutions at all levels as an outdoor education center and provides laboratory and field space for research in the natural history of Arizona and Sonora, Mexico, with special emphasis on the Sonoran desert common to both states.

The Arizona Historical Society was organized in 1884 for "the collection and preservation of materials illustrative of the history of Arizona in particular and of the West generally," the Society receives support from the state, and maintains both a historical museum and a research library. The museum and library are located adjoining the University campus and contain 50,000 books, 2,000 manuscript collections, and 250,000 photographs, as well as film and oral history interviews. The manuscript collections are especially rich, with letters, diaries, journals, business records, and other documents, many of which are still partially or completely unpublished. State and federal historical records are on microfilm, as are records from Spanish colonial archives. Membership is open to everyone. Museum collections of historical artifacts are available by appointment for study and research.

The Museum of Northern Arizona and its Research Center, located in Flagstaff, Arizona, provide unusually fine training and research facilities in many areas of anthropology, art, biological sciences, and geology. A close association is maintained between the staff of the Museum and Research Center and certain
teaching and research departments of The University of Arizona. Field work and independent research for a limited number of graduate students can be undertaken at the Museum’s Research Center with the approval of the departments concerned, the Director of the Museum, and the Dean of the Graduate College. Registration may be arranged by the procedure commonly used for work done in absentia for credit in 900 Research, 910 Thesis, and 920 Dissertation to apply toward requirements for an advanced degree.

The Southwestern Research Station of the American Museum of Natural History, New York, is located within a few hours of the University campus in the Chiricahua Mountains of southeastern Arizona. The station proper is located at an elevation of 5,400 feet in a moderate evergreen woodland climate, midway between the desert below and the coniferous forest above. A wide variety of life zones is represented within a few miles of the Station between the desert floor and the fir-covered peaks at 9,800 feet. This unspoiled area within the Coronado National Forest includes many protected wilderness areas accessible only on foot or horseback. Station living facilities and equipment are available, and the laboratory is well equipped for many kinds of modern field and laboratory research in ecology and physiology. The Station is a field base for almost any kind of field work in biology, geology, paleontology, resource management, and wildlife management.

United States Government Agencies, a number of agencies of the United States Government, including several divisions of the Agricultural Research Service and the Soil Conservation Service of the United States Department of Agriculture, the United States Bureau of Mines, and the United States Geological Survey, are located on or near the campus of the University. These research organizations work closely with the University, and a number of their personnel also hold University appointments.

The University of Arizona Alumni Association

The University of Arizona Alumni Association was organized June 2, 1897. It is incorporated under Arizona state law and operates in accordance with the Articles of Incorporation and By-Laws adopted by the membership in open meeting at Homecoming October 27, 1956, and amended October 20, 1981 and October 17, 1987.

Structure

The Alumni Association is guided by a Board of Directors. The activities of the association are managed by a full-time Director of Alumni responsible to the Board of Directors and a staff of 25. The Director manages the Alumni Office on campus, the Phoenix office, and the California Office. The campus Office, headquarters for all alumni activities, houses computerized record files on more than 465,000 graduates, former students, and donors.

Activities

The Alumni Association fosters the involvement of alumni with their alma mater in several ways:

- Clubs - There are active University of Arizona alumni clubs in 60 cities throughout the United States, Mexico and several European Countries, with plans to organize in an additional 20 cities. The clubs assist the University in its student recruitment efforts, raise funds for and award scholarships, and support University events in their cities. The Alumni Office provides speakers from campus for club meetings, as well as mailing event notices. Students and former students may obtain information about the club in their home area from the Alumni Office.

- Councils - Within The University of Arizona, nine colleges have organized alumni councils, which serve to strengthen the ties between the college's students, its faculty, and its alumni. The councils provide service both to the community and to the college.

- Homecoming and Reunions - Alumni are encouraged to return to the University to interact with other alumni and students and to view the progress of their alma mater.

- Lifelong Learning and Travel - The Association sponsors an international and action travel program designed to meet educational objectives of alumni, while generating revenue for the Alumni Association.

Membership

All persons who have received a degree from The University of Arizona or former students who have completed at least 30 units are members of the Alumni Association and receive all of the publications and services afforded by the Association. In 1982, the Alumni Association initiated the Endowed Membership Program. The principal of the endowment remains intact and only the interest is used toward essential Alumni Association programs. An endowment contribution is not required for former students to receive the services afforded by the Alumni Association.

Objectives

The objectives of the Alumni Association generally are to promote the interest and welfare of the State of Arizona, The University of Arizona, and the cause of education. More specifically, they are to successfully support the interests of The University of Arizona, its alumni, and its current and future students, through the development of mutually beneficial relationships. The Association operates as a liaison between the University and former students. It is the former student's immediate and direct contact with his or her alma mater. Its basic motivating principle is service, both to the former student and the University. Because of the large number of alumni in Phoenix and California, offices are maintained in both geographic areas.
Awards and Recognition - Each year alumni are honored for outstanding service to the University and/or for outstanding personal achievement.

Communications - The Alumni Office publishes the Arizona Alumnus, the official publication of the Alumni Association. Published three times a year, it is sent to all members. This publication represents the most immediate contact for alumni with University programs and progress, with news of former classmates, all alumni activities, and news about the University and its faculty and staff. An alumni leadership newsletter is published quarterly and the association has an extensive web site on the Internet at: http://www.al.arizona.edu.

The Alumni Association, recognizing the need to inform current students about the mission of the association, sponsors a student alumni organization. The objective of the organization is to involve current students in alumni activities, thereby promoting the concept of a lifelong commitment to the University through Alumni Association programs. All students and alumni are invited to visit the Alumni Office at 1111 N. Cherry Ave. on the campus.

The University of Arizona Foundation

Every institution of higher learning, whether supported by public or private funds, needs a group of friends who has a special interest in its welfare. The need is great and the opportunities are many for contributions of private funds to improve and develop educational, research, and public service programs outside the scope of state funds and tuition income.

In Arizona and elsewhere, many people aware of the importance of private funding are assisting The University of Arizona. To unite these efforts, the UA Foundation was established in 1958 as a nonprofit corporation to ensure academic excellence at the University through the development of private support. A 33-member volunteer board of directors governs the foundation.

The Foundation's principal objectives are met in three basic ways: Fund Raising, Asset Management, and Facilitations.

Fund raising

By virtue of a development services contract, all fund development at The University of Arizona is managed by the UA Foundation. University administrators and faculty work with the foundation to determine fund-raising priorities and goals. The foundation works to ensure that gifts are spent according to donors' wishes and in ways that are consistent with the mission of the University.

Asset management

The foundation's fiduciary responsibility is outlined in a formal investment policy. Specifically, the policy calls for the foundation to protect the value of its assets against inflation and obtain maximum income. By maintaining a balanced package of investments, including stocks, corporate and government bonds, and real estate, the foundation attempts to balance the University's needs for current income with estimated future needs. The foundation is exempt from state income taxes. It is also exempt from federal income taxes under Section 501 (c)(3) of the Internal Revenue Code.

Facilitation

The UA Foundation facilitates the accomplishments of countless University objectives by providing services such as bridge loans to donor pledges, construction and finance assistance, and funding and development of educational programs. The foundation is also a grant-making institution. Its annual grants and awards program recognizes the achievements of faculty, researchers, undergraduates, and graduate students. This united effort of friends of the University is helping to meet the changing requirements of education and to enrich higher education to the ultimate benefit of the people of Arizona.

The University of Arizona Foundation Board of Directors 1999-2000

Officers

C. Donald Hatfield - Chair of the Board
Burton J. Kinerk - Vice-Chair/Chair Elect of the Board
Ray Clarke - Secretary
J. Michael Sarikas - Treasurer
Richard F. Imwalle - President
Gary N. Scrivner - Vice President for Finance and Administration
S. James Manilla - Vice President for Development Operations
Ken R. Dildine - Vice President for Planned Giving/Donor Relations
Dana L. Wier - Vice President for Communications and Public Affairs

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Mary Margaret Raymond
Helen S. Schafer
Donald N. Soldwedel
X. Administration and Faculty

Arizona Board of Regents

*Ex Officio*

Jane Dee Hull
Governor of Arizona

Lisa Graham Keegan
State Superintendent of Public Instruction

**Appointed**

Jennifer Reichelt
June 1999

John F. Munger, J.D.
January 2000

Rudy Campbell
January 2000

George Amos
January 2002

Judy Gignac
January 2002

Kurt Davis
January 2004

Don Ulrich
January 2004

Chris Herstam
January 2006

Jack Jewett
January 2006

(Date shown is term expiration date)

Administrative Officers

Following is a partial list of administrative officers at The University of Arizona. The list includes senior academic officers and others with academic-related responsibilities.

(Year of first University appointment is in parentheses after each name)

Peter W. Likins (1997) President of the University; Ph.D., Stanford University.


John Paul Schaefer (1960-82) President Emeritus; Ph.D., 1958, University of Illinois.

Paul S. Sypherd (1993) Senior Vice President, Academic Affairs and Provost; Ph.D., 1963, Yale University.

Joel D. Valdez (1990) Senior Vice President, Business Affairs; B.S., 1957, The University of Arizona.


Michael R. Gottfredson (1985) Vice President, Undergraduate Education; Ph.D., 1976, State University of New York at Albany.


Richard C. Powell (1992) Vice President for Research and Graduate Studies; Ph.D., 1967 Arizona State University.

Saundra L. Taylor (1992) Vice President, Campus Life, Resources; Ph.D., 1969, Ohio University.

Adela A. Allen (1968) Associate Vice President, Latin American Relations; Ph.D., 1974, The University of Arizona.


Thomas J. Hixon (1976) Associate Vice President, Research; Ph.D. 1965, University of Iowa.


Julius Parker (1989) Associate Vice President, Business Affairs; M.P.A., 1975, Shippensburg State University.

Randall M. Richardson (1978), Assistant Vice President, Undergraduate Education; Ph.D., 1978, Massachusetts Institute of Technology.


Richard C. Powell (1992) Vice President for Research and Graduate Studies; Ph.D., 1967, Arizona State University.


Eugene H. Levy (1975), Dean; Ph.D., 1971, University of Chicago.

Maria Teresa Velez (1986) Associate Dean of the Graduate College; Ph.D., 1983, Wright Institute.

Deans

J. Lyle Bootman (1978), Dean, Pharmacy; Ph.D., 1978, University of Minnesota.


Eugene H. Levy (1975), Dean; Ph.D., 1971, University of Chicago.

Patricia MacCorquodale (1978), Dean, Honors College; Ph.D., 1978, University of Wisconsin.

Toni Marie Massaro (1990), Dean, Law, J.D., 1980, College of William and Mary.

Anita D. McDonald (1994), Dean, Extended University and Summer Session, Ph.D., 1983, St. Louis University.

Tom Peterson (1993), Dean, Engineering and Mines; Ph.D., 1977, California Institute of Technology.


Maurice Sevigny (1991), Dean, Fine Arts; Ph.D., 1977, Ohio State University.

Holly M. Smith (1983), Dean, Social and Behavioral Sciences; Ph.D., 1972, University of Michigan.


Chuck Tatum (1987), Dean, Humanities; Ph.D., 1971, University of New Mexico.

John Taylor (1991), Dean, Education; Ph.D., 1976, Stanford University.

Suzanne Van Ort (1967), Dean, Nursing; Ph.D., 1977, The University of Arizona.

Melissa Vito (1990), Dean of Students; M.Ed., 1983, The University of Arizona.

Mark A. Zupan (1997), Dean, Business and Public Administration; Ph.D., 1987, Massachusetts Institute of Technology.
Graduate Council

The Graduate Council consists of a member representing all colleges of the University. The council works with the Graduate College to review and establish policies affecting graduate education.

Adela A. Allen, Associate Dean of the Graduate College.
Ronald E. Allen, Professor, Nutritional Science.
Bruce R. Barrett, Professor, Physics.
Meg Lota Brown, Professor, English.
Aurore M. Chabot, Professor, Art.
Nader V. Chalifoun, Associate Professor, Architecture.
Clem G. Chase, Professor, Geosciences.
Albrecht Classen, Professor, German.
William Dixon, Professor, Political Sciences.
Richard M. Enns, Assistant Professor, Animal Science.
Louann Gerkin, Associate Professor, Speech and Hearing Sciences.
Elizabeth L. Glisky, Associate Professor, Psychology.
Yetta M. Goodman, Regents' Professor, Language, Reading and Culture.
Joan E. Haase, Associate Professor, Nursing.
J. Miller McPherson, Professor, Sociology.
John M. Kemeny, Professor, Plant Pathology.
Janet L. Sturman, Assistant Professor, Music.
Marvin Waterstone, Associate Professor, Geography and Regional Development.

Regents' Professors

Angel, J. Roger P. (1973) Regents' Professor; Ph.D., 1967, Oxford University.
Babcock Barbara A. (1980) Regents' Professor; Ph.D., 1975, University of Chicago.
Dayan, Joan (1992) Regents' Professor; Ph.D., 1980, City University Graduate Center.
Desai, Chandrakant (1981) Regents' Professor; Ph.D., 1968, University of Texas.
Dickinson, Robert E. (1990), Regents' Professor; Ph.D., 1966, Massachusetts Institute of Technology.
Enemark, John H. (1968) Regents' Professor; Ph.D., 1966, Harvard University.
Hausler, Mark R. (1971) Regents' Professor; Ph.D., 1968, University of California at Riverside.
Hildebrand, John G. (1985) Regents' Professor; Ph.D., 1969, Rockefeller University.
Holland, Andrey (1991) Regents' Professor; Ph.D., 1961, University of Pittsburgh.
Hruby, Victor J. (1968) Regents' Professor; Ph.D., 1965, Cornell University.
Huffman, Donald R. (1967) Regents' Professor; Ph.D., 1966, University of California at Riverside.
Jokipii, Jack R. (1973) Regents' Professor; Ph.D., 1969, University of California at Berkeley.
KAY, Margaret G. (1993) Regents' Professor; M.D., 1974, University of California at San Francisco.
Neuman, Shlomo P (1975) Regents' Professor; Ph.D., 1968, University of California at Berkeley.
Smith, Vernon L. (1975) Regents' Professor; Ph.D., 1955, Harvard University.
Tolin, Gordon (1959) Regents' Professor Ph.D., 1956, Iowa State College.
Yamamura, Henry (1975) Regents' Professor; Ph.D., 1969, University of Washington.

Distinguished Professors

Aiken Hardy, Susan (1973), Distinguished Professor; Ph.D., 1971, Duke University.
Bickel, William S. (1965), Distinguished Professor; Ph.D., 1964, Pennsylvania State University.
Carroll, Christopher F. (1965), Distinguished Professor; Ph.D., 1969, Yale University.
Cosgrove, Richard A. (1967), Distinguished Professor; Ph.D., 1967, University of California.
Demers, Richard A. (1975), Distinguished Professor; Ph.D., 1968, University of Washington.
Hogle, Jerrold E. (1974), Distinguished Professor; Ph.D., 1974, Harvard University.
Hsieh, Ke Chiang (1971), Distinguished Professor; Ph.D., 1969, University of Chicago.
Lomen, David O. (1966), Distinguished Professor; Ph.D., 1964, Iowa State University.
Lyttle, Clifford M. (1962), Distinguished Professor; Ph.D., 1963, University of Pittsburgh.
Velez Yslas, William (1977), Distinguished Professor; Ph.D., 1975, The University of Arizona.
White Jr., Raymond E. (1964), Distinguished Professor; Ph.D., 1967, University of Illinois.
Faculty of the University

Aamodt, Agnes M (1957-88), Professor Emerita, Nursing; BS, 1944, College of St. Scholastica; MA, 1950, University of Minnesota; Ph.D., 1971, University of Washington.

Ahmann, Frederick R (1980), Professor, Medicine; Associate Professor, Surgery; BA, 1970, Duke University; MD, 1974, University of Missouri School of Medicine.

Ahmann, Herbert K (1968-83), Professor Emeritus, Family and Community Medicine; BS, 1936, Northwestern University; MD, 1940, MS, 1940, University of Illinois; MPH, 1947, Johns Hopkins University.

Ahmad, Nafees (1994), Associate Professor.

Ahmed, Junaid (1963), Lecturer Emeritus;

Ahern, Geoffrey L (1990), Associate Professor, Neurology; Associate Professor, Psychology; BA, 1976, State University of New York College at Purchase; MS, 1978, Ph.D., 1981, Yale University.

Ahmann, Naeem (1999), Associate Professor, Microbiology and Immunology; BS, 1976, MS, 1978, Ph.D., 1980, Ph.D., 1983, Aligarh Muslim University.

Alcova, Josephine (1997), Associate Professor.

Alden, Ronald E (1980), Professor, Nutritional Sciences; BS, 1972, Texas A & M University.

Alden, John Jb (1992), Associate Professor, Psychology; BA, 1992, Ph.D., 1995, University of North Dakota.

Allen, Janice R (1992), Senior Lecturer, Nursing; BS, 1968, University of Colorado; MS, 1981, The University of Arizona.


Almon, Lawrence M (1975), Department Head, Special Education/Rehabilitation; Professor, Speech; Joint Appointment as Professor of Pharmacology; BS, 1962, Trinity College; MD, 1966, University of Virginia Main Campus.

Almquist, Charles A (1963), Professor Emeritus, Plant Pathology; BS, 1948, Ph.D., 1954, University of California at Berkeley.

Alpern, Lawrence B (1973), Professor Emeritus, Surgery.

Almeida, David M (1996), Assistant Professor, Family and Consumer Resources; BA, 1987, California State University at Northridge; MA, 1990, Ph.D., 1993, University of Victoria.

Alpert, Joseph S (1992), Department Head, Medicine; Professor, Medicine; BA, 1963, Yale University; MD, 1969, Harvard University.


Alvarado, Elizabeth C (1996), Lecturer, English; MFA, 1989.

Anders, Patricia L (1976), Professor, Language, Reading and Culture; BS, 1971, MS, 1972, Ph.D., 1976, University of Wisconsin at Madison.

Anderson, Jon (1980), Associate Professor, English; BS, 1963, Northeastern University; MFA, 1967, University of Iowa.


Anderson, Robert M (1978-86), Associate Professor Emeritus, Surgery; MD, 1946, Marquette University.

Anderson, Ruth M (1965-81), Lecturer Emerita, Speech and Hearing Science; BM, 1965, University of Wisconsin; MS, 1967, University of Iowa.

Anderson, Waldo K (1966-86), Professor Emeritus, Art; AB, 1945, Ottawa University; M.Ed., 1953, University of South Dakota; Ph.D., 1963, University of Minnesota.

Anderson, Warren H (1956-86), Professor Emeritus, Art; BS, 1950, Western Illinois State College; MA, 1951, University of Iowa; Ph.D., 1961, Stanford University.

Andreen-Shipp, Shannon R (1997), Assistant Agent, 4-H Youth Development; BS, 1993, MS, 1995, New Mexico State University.

Andrews, Armand (1975), Professor, Archaeology; MS, 1975, Ph.D., 1977, University of California at Berkeley.

Andrews, Waldo K (1966-86), Professor Emeritus, Art; AB, 1945, Ottawa University; M.Ed., 1953, University of South Dakota; Ph.D., 1963, University of Minnesota.

Angel, Roger P (1973), Regents Professor; Professor, Astronomy; Professor of Optical Sciences; Astronomer, Steward Observatory; BA, 1963, St Peters College; MS, 1966, California Institute of Technology; Ph.D., 1967, Oxford University.


Annas, Julia E (1986-90; 1992), Regents Professor; Professor, Philosophy; BA, 1968, St. Hugh's College; AM, 1970, Ph.D., 1972, Harvard University.

Barfield, Michael (1965), Professor, Chemistry; BA, 1957, San Diego State College; Ph.D., 1962, University of Utah.

Barickman, Bert J (1990), Associate Professor, History; MA, 1964, Ph.D., 1960, University of Illinois Urbana Campus.

Barker, Steven J (1995), Department Head, Anesthesiology; Professor, Anesthesiology; Professor, Aerospace and Mechanical Engineering; BS, 1967, Harvey Mudd College; MS, 1968, Ph.D., 1971, California Institute of Technology; MD, 1981, University of Miami School of Medicine.

Barkmeier, Julie M (1997), Assistant Professor, Speech/Hearing Sciences; BS, 1985, MA, 1988, Ph.D., 1994, University of Iowa.

Barnes, Carol A (1990), Associate Professor, Psychology; BA, 1963, Hunter College; MA, 1965, Ph.D., 1969, University of Chicago.

Bates, Robert B (1963), Professor, Chemistry; BS, 1954, Rutgers University; Ph.D., 1957, University of Wisconsin.


Bayless, Kathryn A (1987), Professor, Speech and Hearing Science; Associate Research Scientist, Neurogenetic Communication Disorders; BS, 1980, Rice University; MA, 1981, Ph.D., 1991, Princeton University.


Beals, Robert M (1996), Assistant Professor, Computer Science; BS, 1980, Rice University; MA, 1981, Ph.D., 1993, University of Chicago.

Beattie, Bruce R (1990), Professor, Agricultural / Resource Economics; BS, 1963, MS, 1964, Montana State University; Ph.D., 1970, Oregon State University.

Bechtel, Robert B (1976), Professor, Psychology; Professor, Renewable Natural Resources; BS, 1962, Susquehanna University; MA, 1964, Ph.D., 1967, University of Kansas at Lawrence.

Bechtold, Jill (1990), Associate Professor, Astronomy; Steward Astronomer; BS, 1978, California Institute of Technology; Ph.D., 1985, The University of Arizona.

Bennett, Sara (1993), Associate Professor, Psychology; BA, 1982, Princeton University; MA, 1984, Ph.D., 1987, Harvard University.

Berk, Robert A (1993), Professor, Pediatrics; BS, 1971, University of Michigan at Ann Arbor; MD, 1975, University of California at San Francisco.
Bickel, William S (1966-95), Professor, Emeritus, Educational Psychology; AB, 1953, Kalamazoo College; MA, 1960, Wayne State University; Ph.D., 1963, University of Michigan.

Bergersen, Albert J (1973), Professor, Sociology; BA, 1964, University of California at Santa Barbara; MS, 1971, Ph.D., 1974, Stanford University.

Berk, Howard T (1982), Associate Professor, English; BA, 1966, Benedictine College; MS, 1968, Marquette University; Ph.D., 1975, University of Notre Dame.

Bernardi, Rosemarie T (1988), Associate Professor, Art; BFA, 1974, St. Mary's College; MFA, 1977, University of Cincinnati.


Bloom, John W (1993), Associate Professor, Emeritus, Chemistry; AB, 1951, University of Redlands; MA, 1954, Ph.D., 1958, University of Wisconsin.

Borgo, David (1990), Associate Professor, Linguistics; BA, 1968, Whittier College; MA, 1970, University of Wisconsin; Ph.D., 1977, University of California at Berkeley.

Boothe, Gregory (1988), Associate Professor, Philosophy; AB, 1979, Johns Hopkins University; MA, 1982, University of Wisconsin; Ph.D., 1988, University of California at Santa Barbara.

Bootzin, Richard R (1987), Professor, Psychology; Joint Appointment as Professor of Psychiatry; BS, 1963, University of Wisconsin at Madison; MS, 1966, Ph.D., 1968, Purdue University.

Bornstein, Michael E (1975), Professor, Near Eastern Studies; Professor, Geography/Regional Development; BA, 1964, MA, 1966, Ph.D., 1975, University of Texas.

Bouvier, Charles (1990), Professor, Law; AB, 1964, AM, 1969, University of Wisconsin; MS, 1979, Wallace College; MS, 1987, University of Miami; Ph.D., 1987, The University of Arizona.

Bowen, Charles (1972), Associate Professor, History; MA, 1963, University of Wisconsin; Ph.D., 1973, University of California at Berkeley.

Bowers, Donald Jr (1965), Professor, Philosophy; AB, 1961, Reed College; MA, 1962, University of California at Los Angeles; Ph.D., 1967, University of Wisconsin at Madison.

Bower, Thomas (1993), Department Head, Linguistics; Professor, Psychology; Research Professor, Linguistics; Research Professor, Cognitive Science; AB, 1961, Harvard College; Ph.D., 1967, Massachusetts Institute of Technology.

Buck, William S (1965), Professor, Physics; BS, 1939, Ph.D., 1964, Pennsylvania State University.
Bowden, George T (1978), Professor, Radiation Oncology; Joint Appointment as Professor of Pharmacology and Toxicology; Professor, Molecular and Cellular Biology; Coordinator, Research Training-Cancer Center, Investigator, Center for Toxicology; BA, 1967, Ohio Wesleyan University; Ph.D., 1974, University of Wisconsin.

Bowen, Don L (1978-87), Professor Emeritus, Management and Policy; BS, 1944, Utah State University; MS, 1945, University of Denver; Ph.D., 1949, Syracuse University.


Bower, Cynthia E (1978), Librarian; BA, 1972, Stanford University; MLS, 1976, University of California at Berkeley.

Bowers, William S (1984), Professor Emeritus, Entomology; AB, 1937, Indiana University; MS, 1958, Ph.D., 1962, Purdue University.


Boyd, Thomas W (1975), Associate Professor, Medicine; BA, 1967, University of California at Los Angeles; MD, 1971, Loyola University.

Boyer, John Thomas (1968-98; 1999), Professor Emeritus, Medicine; BS, 1951, Denison University; MD, 1955, Harvard University.


Boyse, Edward A (1989-94), Professor Emeritus, Microbiology & Immunology; BS, 1952, MD, 1957, University of London.


Brady, John M (1973), Associate Professor, Language, Reading & Culture; BS, 1962, California State University; MA, 1967, California State University at Sacramento; Ed. D., 1973, University of Pennsylvania.

Brady, Lucy K (1994), Associate Agents, Agriculture; BS, 1981, Florida State University; MS, 1984, Purdue University.

Brady, Michael D (1972), Associate Professor, Hydrology and Water Resources; Adjunct Associate Professor, Planning; BA, 1967, University of New Mexico; MA, 1970; Ph.D., 1971, University of Michigan.


Brown, Bruce R (1982-95), Professor Emeritus, Molecular and Cellular Biology; Professor, Molecular and Cellular Biology; Professor, Biochemistry; BS, 1972, Stanford University; Ph.D., 1978, University of Colorado.

Brown, Donald F (1990), Professor Emeritus, Veterinary Science; BS, 1952, Washington State University; MS, 1955, Purdue University; Ph.D., 1960, Michigan State University; DVM, 1966, University of California at Berkeley.

Brown, James M (1968), Associate Professor, Veterinary Medicine; BS, 1959, MS, 1966, PhD, 1969, Colorado State University.


Brown, Paul W (1977), Specialist, Soil, Water Environmental Sciences; Research Specialist, Soil, Water & Environmental Sciences; BS, 1977, University of Missouri; MS, 1979, Ph.D., 1981, University of Wisconsin.

Brown, Robert H (1996), Professor, Planetary Sciences; Professor, Lunar and Planetary Laboratory; Professor, Astronomy; BS, 1971, MS, 1975, Purdue University; MS, 1979, Ph.D., 1982, University of Hawaii.


Brownie, Samuel J (1959-94), Professor Emeritus, Veterinary Science; BS, 1953, University of California at Berkeley; MS, 1957, Ph.D., 1964, University of California at Los Angeles.


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For Other University Catalogs:

General Catalog
http://catalog.arizona.edu

College of Law Catalog
Write: The College of Law

College of Medicine Catalog
Write: The College of Medicine

Extended University Schedule or Sierra Vista Campus Schedule
Write: Extended University

Summer Session Schedule
Write: Summer Session

For Further Information on:

Applications to the Graduate College
Write: Graduate College Admissions

Degree Programs
Write: Head of particular department

Financial Assistance
Write: Director of Financial Aid

Housing Facilities
Write: Director of Residence Life

Medical Facilities
Write: Director of Campus Health

Certification for Teachers
Write: Dean of College of Education

Part-Time Employment
Write: Career Services

Transcripts
Write: Office of the Registrar