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 Community Service Center**
UA Mall and Cherry Ave.  (520) 621-5130

**UofA Main Switchboard**  (520) 621-2211
Welcome to
The University of Arizona

A Message from the
Dean of the Graduate College

Whether a prospective, new, or continuing graduate student, there is much in this Catalog that should help you along your way. The University of Arizona is an exciting place to be.

We are home to some of the nation’s top-ranked graduate programs and boast a distinguished faculty. As this Catalog suggests, you are afforded an extraordinary range of opportunities for graduate study at The University of Arizona. Take advantage of this Catalog to help you plan your course of study.

I encourage you to work closely with faculty in the department of your choice. Make it your responsibility to ensure that you receive the best possible graduate education while you are with us. Also, make sure when you plan for study here, that you seek opportunities for personal growth through the many artistic, cultural, scientific, and other creative pursuits that are to be found all about the campus and the Tucson community.

The Graduate College Staff is here to assist you in making your graduate education fulfilling, rewarding, and enjoyable. This Catalog is, of course, not exhaustive with regard to information about graduate programs. If you find that you need additional information, feel free to ask for help from the Graduate College or from individual colleges or departments.

Sincerely,

Thomas J. Hixon
Dean of the Graduate College

THE UNIVERSITY OF ARIZONA RECORD
(USPS 650-800) VOL. XC NO. 3 May 1997
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. Copies may also be purchased from the UofA Bookstore. 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. A complete printed version of the General Catalog is also available in The University of Arizona Main Library.

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 UAInfo.
UAIInfo

UAIInfo 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 UAIInfo

<table>
<thead>
<tr>
<th>Access Point below:</th>
<th>Command(s) to enter</th>
</tr>
</thead>
<tbody>
<tr>
<td>No user privilege:</td>
<td>Connect by modem</td>
</tr>
<tr>
<td></td>
<td>at (520) 621-9600</td>
</tr>
<tr>
<td>WWW browser</td>
<td><a href="http://www.arizona.edu">http://www.arizona.edu</a></td>
</tr>
<tr>
<td>VAX (CCIT, BPA, HACKS)</td>
<td>setup uainfo uainfo</td>
</tr>
<tr>
<td>Aruba, GAS, Bigdog, COVXI, U.Arizona, Neuromancer</td>
<td>uainfo</td>
</tr>
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</table>

Enter these commands at the System Prompt:

- telnet uainfo.arizona.edu
- at login prompt: uainfo
- at password prompt: uainfo

For information or assistance accessing UAIInfo, 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.

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.

Office of Affirmative Action
University Services Building, Room 219
P.O. Box 210158
The University of Arizona
Tucson, Arizona 85721-0001
(520) 621-3081
TDD Number (520) 621-8299
<table>
<thead>
<tr>
<th>Department/Program</th>
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<tbody>
<tr>
<td>Mathematics (MATH)</td>
<td>132</td>
</tr>
<tr>
<td>Media Arts (MAR)</td>
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</tr>
<tr>
<td>Medicine (MED/ANES/FCM/MEDI/NEUR/OBG/OPH/PATH/PED/PSYI/RONG/RAD/SURG)</td>
<td>135</td>
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<tr>
<td>Microbiology and Immunology (MBIM)</td>
<td>143</td>
</tr>
<tr>
<td>Mining and Geological Engineering (G EN/MNE)</td>
<td>144</td>
</tr>
<tr>
<td>Molecular and Cellular Biology (MCB)</td>
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</tr>
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<td>Music (MUS/MUSI)</td>
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<tr>
<td>Near Eastern Studies (NES/ARB/PRS)</td>
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</tr>
<tr>
<td>Neuroscience (NRSC)</td>
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<tr>
<td>Nursing (NURS)</td>
<td>152</td>
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<tr>
<td>Nutritional Sciences (N SC)</td>
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<td>Nutritional Sciences (NUSC)</td>
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<td>Optical Sciences (OPTI)</td>
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</tr>
<tr>
<td>Pharmaceutical Sciences (PHSC)</td>
<td>158</td>
</tr>
<tr>
<td>Pharmacology (PHCL)</td>
<td>159</td>
</tr>
<tr>
<td>Pharmacology and Toxicology (PCOL)</td>
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<td>161</td>
</tr>
<tr>
<td>Philosophy (PHIL)</td>
<td>162</td>
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</tr>
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<td>166</td>
</tr>
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<td>Planetary Sciences (PTYS)</td>
<td>167</td>
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<tr>
<td>Planning (PLAN)</td>
<td>169</td>
</tr>
<tr>
<td>Plant Pathology (PL P)</td>
<td>170</td>
</tr>
<tr>
<td>Plant Sciences (PL S)</td>
<td>171</td>
</tr>
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<td>Political Science (POL)</td>
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</tr>
<tr>
<td>Psychology (PSYC)</td>
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</tr>
<tr>
<td>Public Administration and Policy (PA)</td>
<td>176</td>
</tr>
<tr>
<td>Public Health (OSH/PHL)</td>
<td>177</td>
</tr>
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<td>Remote Sensing and Spatial Analysis (REM)</td>
<td>179</td>
</tr>
<tr>
<td>Renewable Natural Resources, School of (RNR/L AR/RA M/WS M/WFSC)</td>
<td>179</td>
</tr>
<tr>
<td>Russian and Slavic Languages (RUSS)</td>
<td>183</td>
</tr>
<tr>
<td>Second Language Acquisition and Teaching (SLAT)</td>
<td>183</td>
</tr>
<tr>
<td>Sociology (SOC)</td>
<td>184</td>
</tr>
<tr>
<td>Soil, Water and Environmental Science (SWES)</td>
<td>186</td>
</tr>
<tr>
<td>Spanish and Portuguese (SPAN/PORT)</td>
<td>187</td>
</tr>
<tr>
<td>Special Education and Rehabilitation (SER)</td>
<td>189</td>
</tr>
<tr>
<td>Speech and Hearing Sciences (SP H)</td>
<td>192</td>
</tr>
<tr>
<td>Systems and Industrial Engineering (SIE)</td>
<td>193</td>
</tr>
<tr>
<td>Teaching and Teacher Education (TTE)</td>
<td>195</td>
</tr>
<tr>
<td>Theatre Arts (T AR)</td>
<td>196</td>
</tr>
<tr>
<td>Veterinary Science (VSC)</td>
<td>198</td>
</tr>
<tr>
<td>Women's Studies (WS)</td>
<td>200</td>
</tr>
</tbody>
</table>

**University Libraries, Research and Public Service Units**

- University Libraries ........................................ 203
- Research and Public Service Units ....................... 204
- Cooperating Organizations ................................. 215
- The University of Arizona Alumni Association ........ 216
- The University of Arizona Foundation .................. 217

**Accreditations, Memberships, Administration, Affiliations, and Faculty**

- Arizona Board of Regents .................................. 220
- Administrative Officers .................................... 220
- Graduate College Officers .................................. 220
- Deans ........................................................................ 220
- Graduate Council .............................................. 221
- Regents' Professors ........................................... 221
- Faculty of the University .................................... 221

**Index** ...................................................................... 262

**Campus Map** .......................................................... Inside back cover
## Academic Calendar

### First Semester 1997 - 1998

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Classes begin</td>
<td>Aug. 25 M.</td>
<td>Aug. 24 M.</td>
</tr>
<tr>
<td>Labor Day - no classes</td>
<td>Sept. 1 M.</td>
<td>Sept. 7 M.</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>Sept. 2 Tu.</td>
<td>Aug. 31 M.</td>
</tr>
<tr>
<td>Last day for dropping courses with deletion of course enrollment from record</td>
<td>Sept. 19 F.</td>
<td>Sept. 18 F.</td>
</tr>
<tr>
<td>Last day to drop classes with grade of &quot;W&quot;</td>
<td>Oct. 17 F.</td>
<td>Oct. 16 F.</td>
</tr>
<tr>
<td>Veterans Day - no classes</td>
<td>Nov. 11 Tu</td>
<td>Nov. 11 W</td>
</tr>
<tr>
<td>Thanksgiving recess</td>
<td>Nov. 27-30 Th-Su</td>
<td>Nov. 26-29 Th-Su</td>
</tr>
<tr>
<td>Classes and laboratory sessions end</td>
<td>Dec. 10 W</td>
<td>Dec. 9 W</td>
</tr>
<tr>
<td>Semester examinations begin</td>
<td>Dec. 12 F.</td>
<td>Dec. 11 F</td>
</tr>
<tr>
<td>Semester examinations end</td>
<td>Dec. 19 F.</td>
<td>Dec. 18 F</td>
</tr>
<tr>
<td>Winter Commencement</td>
<td>Dec. 20 Sa</td>
<td>Dec. 19 Sa</td>
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### Second Semester 1997 - 1998

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Classes begin</td>
<td>Jan. 14 W</td>
<td>Jan. 13 W</td>
</tr>
<tr>
<td>M. L. King Holiday - no classes</td>
<td>Jan. 19 M.</td>
<td>Jan. 18 M</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>Jan. 22 Th</td>
<td>Jan. 21 Th</td>
</tr>
<tr>
<td>Last day for dropping courses with deletion of course enrollment from record</td>
<td>Feb. 10 Tu</td>
<td>Feb. 9 Tu</td>
</tr>
<tr>
<td>Last day to drop classes with grade of &quot;W&quot;</td>
<td>Mar. 10 Tu</td>
<td>Mar. 9 Tu</td>
</tr>
<tr>
<td>Spring recess</td>
<td>Mar. 14-22 Sa-Su</td>
<td>Mar. 13-21 Sa-Su</td>
</tr>
<tr>
<td>Classes and laboratory sessions end</td>
<td>May 6 W</td>
<td>May 5 W</td>
</tr>
<tr>
<td>Semester examinations begin</td>
<td>May 8 F</td>
<td>May 7 F</td>
</tr>
<tr>
<td>Semester examinations end</td>
<td>May 15 F</td>
<td>May 14 F</td>
</tr>
<tr>
<td>Spring Commencement</td>
<td>May 16 Sa</td>
<td>May 15 Sa</td>
</tr>
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</table>

### Summer Session 1998

<table>
<thead>
<tr>
<th>Event</th>
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<tbody>
<tr>
<td>Presession</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classes begin</td>
<td>May 18 M.</td>
<td>May 17 M.</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>May 19 Tu</td>
<td>May 18 Tu</td>
</tr>
<tr>
<td>Presession classes and examinations end</td>
<td>June 6 Sa</td>
<td>June 5 Sa</td>
</tr>
</tbody>
</table>

### First Summer Session 1998

<table>
<thead>
<tr>
<th>Event</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes begin</td>
<td>June 8 M</td>
<td>June 7 M</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>June 10 W</td>
<td>June 9 W</td>
</tr>
<tr>
<td>Independence Day - no classes</td>
<td>July 3 F</td>
<td>July 5 M</td>
</tr>
<tr>
<td>First summer session classes and examinations end</td>
<td>July 9 Th</td>
<td>July 8 Th</td>
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### Second Summer Session 1999

<table>
<thead>
<tr>
<th>Event</th>
<th>1999</th>
<th>1999</th>
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<tbody>
<tr>
<td>Classes begin</td>
<td>July 13 M.</td>
<td>July 12 M.</td>
</tr>
<tr>
<td>Last day of registration for credit</td>
<td>July 15 W</td>
<td>July 14 W</td>
</tr>
<tr>
<td>Second summer session classes and examinations end</td>
<td>Aug 12 W</td>
<td>Aug 11 W</td>
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Abbreviation Guide

The abbreviations listed below refer to the disciplines indicated:

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<tr>
<th>Abbreviation</th>
<th>Discipline</th>
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<tbody>
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<td>ABE</td>
<td>agricultural and biosystems engineering</td>
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<tr>
<td>ACCT</td>
<td>accounting</td>
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<td>AED</td>
<td>African American studies</td>
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<td>AGTM</td>
<td>agricultural technology management</td>
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<td>AIS</td>
<td>American Indian studies</td>
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<td>AME</td>
<td>aerospace and mechanical engineering</td>
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<td>ANES</td>
<td>anesthesiology</td>
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<td>animal sciences</td>
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<td>anthropology</td>
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<td>APPL</td>
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<td>AREC</td>
<td>agricultural and resource economics</td>
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<td>CCLS</td>
<td>comparative cultural and literary studies</td>
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<td>C E</td>
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<td>family and consumer resources</td>
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<td>FS</td>
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<td>individuals and societies</td>
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</tr>
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</table>
# Table of Contents

Who to contact at
The University of Arizona .......... inside front cover
A Message from the
Dean of the Graduate College .......... i
Connecting to UAInfo .................. iv
Academic Calendar .................... v
Abbreviation Guide ..................... vi

## General Information

A Brief History of the University .......... 1
Current Organization of the University ........ 2
The Graduate College .................. 2
Graduate Programs at
The University of Arizona ............. 3
Graduate Programs by College .......... 4

## I. Admissions

Admission Requirements ............... 9
Additional Information and Requirements for
International Students .................. 10
Application Procedures for
Admission to a Degree Program .......... 11
Graduate Non-Degree Admission .......... 13
Graduate Admissions Office ............. 13
Graduate Study In Summer Session ........ 13
Extended University ................ 13

## II. Expenses, Fees, and
Financial Assistance

Registration and Tuition Fees .......... 15
Summer Session Fees ................ 15
Special Course Fees and Deposits ......... 16
Special Course Fees Schedule .......... 16
Refund of Tuition and Fees ........... 16
Minimum Estimated Expenses .......... 16
Employment, Scholarships, and Financial Aid .......... 17

## III. Registration, Grading,
and Academic Policies

Registration .................. 21
Enrollment Policies ................ 21
Grading Policies .................. 22
Academic Policies ................ 24

## IV. Requirements for Master's Degrees

General Requirements .......... 27
Master of Arts ................ 28
Master of Science ............... 28
Master of Fine Arts ............. 28
Master of Accounting ........... 29
Master of Agricultural Education ........ 29
Master of Architecture ........ 29
Master of Business Administration .......... 29
Master of Education ............ 30
Master of Landscape Architecture .......... 30
Master of Music ............... 30
Master of Public Administration .......... 31
Master of Public Health ........... 31
Master of Teaching .............. 31

## V. Requirements for Specialist Degrees

Educational Specialist ............... 33

## VI. Requirements for Doctoral Degrees

Doctor of Philosophy .......... 35
Doctor of Education ............ 37
Doctor of Musical Arts .......... 37
### VII. Student Services

<table>
<thead>
<tr>
<th>Service</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus Health</td>
<td>39</td>
</tr>
<tr>
<td>Campus Recreation</td>
<td>39</td>
</tr>
<tr>
<td>Career Services</td>
<td>39</td>
</tr>
<tr>
<td>Center for Disability Related Resources</td>
<td>39</td>
</tr>
<tr>
<td>Center for English As A Second Language</td>
<td>39</td>
</tr>
<tr>
<td>Center for Global Student Programs</td>
<td>40</td>
</tr>
<tr>
<td>Counseling and Psychological Services</td>
<td>40</td>
</tr>
<tr>
<td>Cultural Events</td>
<td>40</td>
</tr>
<tr>
<td>Dean of Students</td>
<td>40</td>
</tr>
<tr>
<td>Graduate and Professional Student Council</td>
<td>40</td>
</tr>
<tr>
<td>Housing</td>
<td>40</td>
</tr>
<tr>
<td>Minority Cultural Resource Centers</td>
<td>41</td>
</tr>
<tr>
<td>Office of Child-Care Initiatives</td>
<td>41</td>
</tr>
<tr>
<td>Speech-Language and Hearing Clinics</td>
<td>41</td>
</tr>
<tr>
<td>Student Union</td>
<td>41</td>
</tr>
<tr>
<td>Testing Office</td>
<td>41</td>
</tr>
<tr>
<td>University Learning Center</td>
<td>41</td>
</tr>
</tbody>
</table>

### VIII. Departments and Courses of Instruction

<table>
<thead>
<tr>
<th>Department</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting (ACCT)</td>
<td>46</td>
</tr>
<tr>
<td>Aerospace and Mechanical Engineering (A ME/NEE)</td>
<td>46</td>
</tr>
<tr>
<td>Agricultural and Biosystems Engineering (ABE)</td>
<td>49</td>
</tr>
<tr>
<td>Agricultural and Resource Economics (AREC)</td>
<td>50</td>
</tr>
<tr>
<td>Agricultural Education (A ED/AGTM)</td>
<td>51</td>
</tr>
<tr>
<td>Agriculture</td>
<td>52</td>
</tr>
<tr>
<td>American Indian Studies (AIS)</td>
<td>52</td>
</tr>
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<td>Animal Sciences (AN S)</td>
<td>54</td>
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<tr>
<td>Anthropology (ANTH)</td>
<td>55</td>
</tr>
<tr>
<td>Applied Mathematics (APPL)</td>
<td>58</td>
</tr>
<tr>
<td>Architecture (ARCH)</td>
<td>59</td>
</tr>
<tr>
<td>Arid Lands Resource Sciences (AR L)</td>
<td>60</td>
</tr>
<tr>
<td>Art (ART/ARE/ARH)</td>
<td>61</td>
</tr>
<tr>
<td>Astronomy (ASTR)</td>
<td>64</td>
</tr>
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<td>Atmospheric Sciences (ATMO)</td>
<td>66</td>
</tr>
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<td>Biochemistry (BIOC)</td>
<td>67</td>
</tr>
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<td>Biomedical Engineering (BME)</td>
<td>68</td>
</tr>
<tr>
<td>Business Administration (B AD)</td>
<td>69</td>
</tr>
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<td>Cancer Biology (CBIO)</td>
<td>71</td>
</tr>
<tr>
<td>Cell Biology and Anatomy (CBA)</td>
<td>72</td>
</tr>
<tr>
<td>Chemical and Environmental Engineering (CHEE)</td>
<td>73</td>
</tr>
<tr>
<td>Chemistry (CHEM)</td>
<td>75</td>
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<tr>
<td>Civil Engineering and Engineering Mechanics (C E/E M)</td>
<td>76</td>
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<td>Classics (CLAS/GRK/LAT)</td>
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</tr>
<tr>
<td>Cognitive Science</td>
<td>80</td>
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<tr>
<td>Communication (COMM)</td>
<td>81</td>
</tr>
<tr>
<td>Comparative Cultural and Literary Studies (CCLS)</td>
<td>82</td>
</tr>
<tr>
<td>Computational Science and Engineering</td>
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</tr>
<tr>
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<td>83</td>
</tr>
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<td>Dance (DNC)</td>
<td>84</td>
</tr>
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<td>84</td>
</tr>
<tr>
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<td>86</td>
</tr>
<tr>
<td>Economics (ECON)</td>
<td>88</td>
</tr>
<tr>
<td>Education (EDUC)</td>
<td>90</td>
</tr>
<tr>
<td>Educational Administration and Higher Education (ED A/H ED)</td>
<td>91</td>
</tr>
<tr>
<td>Educational Psychology (ED P)</td>
<td>92</td>
</tr>
<tr>
<td>Electrical and Computer Engineering (ECE)</td>
<td>93</td>
</tr>
<tr>
<td>Engineering and Mines (ENGR)</td>
<td>96</td>
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<tr>
<td>English (ENGL)</td>
<td>97</td>
</tr>
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<td>Entomology (ENTO)</td>
<td>99</td>
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<tr>
<td>Epidemiology (EPI)</td>
<td>100</td>
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<tr>
<td>Family and Consumer Resources (FCR/FS/RCS)</td>
<td>101</td>
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<tr>
<td>Finance (FIN)</td>
<td>103</td>
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<tr>
<td>French and Italian (FREN/ITAL)</td>
<td>103</td>
</tr>
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<td>104</td>
</tr>
<tr>
<td>Genetics (GENE)</td>
<td>105</td>
</tr>
<tr>
<td>Geography and Regional Development (GEOG)</td>
<td>106</td>
</tr>
<tr>
<td>Geosciences (GEOS)</td>
<td>107</td>
</tr>
<tr>
<td>German Studies (GER)</td>
<td>110</td>
</tr>
<tr>
<td>Gerontological Studies (GERO)</td>
<td>111</td>
</tr>
<tr>
<td>Global Change (GC)</td>
<td>112</td>
</tr>
<tr>
<td>Graduate Interdisciplinary Programs</td>
<td>112</td>
</tr>
<tr>
<td>Health Professions (HLTH/EXSS/MEDT)</td>
<td>112</td>
</tr>
<tr>
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<td>114</td>
</tr>
<tr>
<td>Hydrology and Water Resources (HWR)</td>
<td>117</td>
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<tr>
<td>Information Resources and Library Science (IRLS)</td>
<td>119</td>
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<td>120</td>
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The University of Arizona is both a Research I institution and a land grant university. It belongs to the prestigious Association of American Universities. It is also ranked 10th among public universities and 14th among all public and private universities by the National Science Foundation. This combination makes it one of the nation's leading universities. Graduate students number approximately 7500 in 90 doctoral and 132 master's and specialist programs. Numerous departments are ranked in the top ten nationally. The University is world renowned for its Graduate Interdisciplinary Programs; faculty who participate in these programs have appointments in 14 colleges and 75 academic departments.

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. 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 School of Health Professions.

The 40-acre campus of the 1890s has grown to 351 acres and 157 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. Four vice presidents report to the Provost: Health Sciences, Research and Graduate Studies, Student Life and Human Resources, and Undergraduate Education.

Fifteen colleges comprise the academic divisions of the University. They are: Agriculture, Architecture, Business and Public Administration, Education, Engineering and Mines, Fine Arts, Graduate, 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 School of Health Professions and the Optical Sciences Center. Graduate Interdisciplinary Programs are administered by the Graduate College.

Within colleges are schools, departments, 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 continuously 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, the membership of which is 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 programs, including those which provide competitive fellowships, offer research and travel support, and recruit and retain underrepresented minority graduate students.

Building on a well-balanced undergraduate education, graduate students are expected to develop a thorough understanding 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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### University Department

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<tr>
<td>Biochemistry</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>Molecular and Cellular Biology</td>
<td>Molecular and Cellular Biology</td>
</tr>
</tbody>
</table>

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1. At the time of publication of this Catalog, consideration is being given to possible consolidations among certain degree programs and possible name changes for certain degree programs in conjunction with consolidations. Contact the Graduate College or relevant departments for updated information.

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

3. This program is currently under review. Contact the Graduate College before applying.

4. 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.
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 Chapter VIII, 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 chapter of the Catalog.

Recognized Degrees

Degrees that are recognized are 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.
Grade-Point Average

Applicants who apply for admission to the Graduate College are evaluated on the individual merits of their academic achievements and scholarly potential to complete graduate-level coursework 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, 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 who do not meet this standard may enroll as non-degree graduate students and complete 12 consecutive units of 500-level (or higher) coursework with a grade-point average of at least 3.25, to be considered for admission to the graduate degree program of their choice. 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 with regard to standardized entrance examinations such as the Graduate Record Examination (GRE), the Graduate Management Admissions Test (GMAT), and the Miller Analogies Test. Some departments may require applicants to take the GRE Subject Test in the appropriate discipline. Refer to Chapter VIII, 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. Such scores are only one component of the credentials used to make admission decisions, and are evaluated in the context of the applicant's complete record. 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

GRE, Educational Testing Service
P.O. Box 6000
Princeton, New Jersey 08541-6000
1-800-GRE-CALL
e-mail address <gre-info@ets.org>

GMAT, Educational Testing Service
P.O. Box 6103
Princeton, New Jersey 08541-6103
1-800-200-7131
e-mail address <gmat@ets.org>

Miller Analogies Test
Psychological Corporation
P.O. Box 98213
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.

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 as 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 coursework 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 on the Test of English as a Foreign Language (TOEFL) is required for those 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.

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, Box 899-TR, Princeton, New Jersey, 08540, U.S.A., to request the mailing of your score report. The University of Arizona institution code is 4832. A student's application is not considered complete until TOEFL scores of 550 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 proficiency, can obtain English language training on campus from the Center for English as a Second Language (CESL). No college credit is awarded for such training. However, at the completion of the student's program, verification by the Director of CESL that the student has attained satisfactory English proficiency, meets the University's English proficiency requirement for admission.

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.
International students seeking graduate teaching assistantships, whose native language is not English, must obtain, in addition to a TOEFL score of 550 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 in Chapter II of this Catalog for further information.

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 of Arizona 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 Bursar's Office, The University of Arizona, P.O. Box 44390, Tucson, Arizona 85733-4390.

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. Additional information about this coverage will be sent to those international students who are accepted for admission.

Application Procedures for Admission to a Degree Program

Application for admission to the Graduate College 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

Graduate College deadlines 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 as early as January for enrollment in the Fall Semester. Consult individual program information for specific department deadlines. Applications, with fee, not received by the dates noted above, will not be considered for that term, and will be automatically reviewed 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 previously enrolled in a University of Arizona graduate degree program but who has not been officially enrolled for one or more semesters (fall/spring) or received an approved leave of absence, is required to apply for readmission. 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, or U.S. currency. It is recommended that applicants not send currency through the mail. Applications 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 must contact their department if they wish to defer enrollment to another term. 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 one of the following:

Regular Graduate Status: Students who meet all admission requirements may be admitted to Regular Graduate Status to undertake work leading to an advanced degree. This restriction does not, however, 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 graduate grade-point average of 3.0 or better, in addition to meeting any other requirements established by their major department or academic unit. Students admitted provisionally because they lack only 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 should submit a “Provisional to Regular Graduate Status Request” form available from the Graduate Degree Certification Office.

Admission with Deficiencies: 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, additional undergraduate courses may be required. 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, however, 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 graduate grade-point average of 3.0 or better, in addition to meeting any other requirements established by their major department or academic unit. Students admitted provisionally because they lack only 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 should submit a “Provisional to Regular Graduate Status Request” form available from 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 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, and release of the official transcripts and other student records.

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, taking 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 academic unit 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. Students admitted to Regular Graduate Status can receive graduate credit only for the graduate courses taken during the one semester immediately preceding the award of Regular Graduate Status. It is the responsibility of the student to initiate the paperwork requesting conversion to Regular Graduate Status, by submitting an "International Special Status Change of Status" form to the Graduate Degree Certification Office.

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, taking 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 academic unit 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. Students admitted to Regular Graduate Status can receive graduate credit only for the graduate courses taken during the one semester immediately preceding the award of Regular Graduate Status. It is the responsibility of the student to initiate the paperwork requesting conversion to Regular Graduate Status, by submitting an "International Special Status Change of Status" form to the Graduate Degree Certification Office.

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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 attend 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 the courses 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 in their previous course work may enroll in Graduate Non-Degree Status. After completing 12 consecutive units of 500 level (or higher) course work with a minimum grade-point average of 3.25, they may request to be considered for admission 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 210066
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.
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 $107.50.* 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 $9.00 for 7 or more units of credit; and a $12.50 Recreation Center fee for 3 or more units per 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.

Tuition and Fees Per Semester for the 1997-98 Academic Year

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<th>Rec. Center (^3)</th>
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\(^{1}\) Expenses and fees for 1998-99 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 non-refundable 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 Campus Radio was approved by the Arizona Board of Regents for 1997-98.
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

<table>
<thead>
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<td>$25</td>
</tr>
<tr>
<td>ARCH 502</td>
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<td>$25</td>
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<td>ART 505</td>
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<tr>
<td>ART 541</td>
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</tr>
<tr>
<td>ART 546</td>
<td>$25</td>
</tr>
<tr>
<td>ART 550</td>
<td>$40</td>
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<tr>
<td>ART 551</td>
<td>$40</td>
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<tr>
<td>ART 553</td>
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<tr>
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<td>ART 573</td>
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<td>ART 574</td>
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<tr>
<td>ART 580</td>
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<td>ART 583</td>
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<td>ART 587a</td>
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</tr>
<tr>
<td>ART 587b</td>
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<tr>
<td>ART 587c</td>
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<td>ART 587d</td>
<td>$40</td>
</tr>
<tr>
<td>ART 587e</td>
<td>$40</td>
</tr>
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<td>ART 587f</td>
<td>$40</td>
</tr>
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<td>ART 587g</td>
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<td>ART 656</td>
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<tr>
<td>ART 673</td>
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<tr>
<td>ART 687</td>
<td>$40</td>
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<tr>
<td>GEOS 536/HWR 536</td>
<td>$25</td>
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<table>
<thead>
<tr>
<th>Course Fee</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWR 514 (summer only)</td>
<td>$75</td>
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<tr>
<td>HWR 517L</td>
<td>$25</td>
</tr>
<tr>
<td>HWR 531</td>
<td>$10</td>
</tr>
<tr>
<td>HWR 536/GEOS 536</td>
<td>$25</td>
</tr>
<tr>
<td>HWR 551</td>
<td>$25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Fee</th>
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</thead>
<tbody>
<tr>
<td>MAR 506</td>
<td>$15</td>
</tr>
<tr>
<td>MAR 523</td>
<td>$40</td>
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<tr>
<td>TAR 501</td>
<td>$25</td>
</tr>
<tr>
<td>TAR 518</td>
<td>$10</td>
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<tr>
<td>TAR 520</td>
<td>$10</td>
</tr>
<tr>
<td>TAR 523</td>
<td>$40</td>
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<tr>
<td>TAR 526</td>
<td>$35</td>
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<td>TAR 527</td>
<td>$20</td>
</tr>
<tr>
<td>TAR 528</td>
<td>$25</td>
</tr>
</tbody>
</table>

General Policies Regarding Fees

All fees are payable prior to the due date for any semester or term, approximately one month in advance of the first day of class for that semester or term. Payment of registration fees and non-resident tuition entitles students to many services, including instruction in university courses, use of university libraries, use of laboratory and course equipment, and use of the Recreation Center. No reduction of fees is made for students who choose not to use university services or facilities.

All fees for the semester must be paid in full at the time of registration. The University accepts Visa, Master Card, College Card, and checks for the amount due, but cannot advance cash on checks. The University also cannot extend credit or accept installment payments. However, in the case of graduate students with teaching or research assistant contracts, arrangements can be made for the payment of registration fees in at least two installments each semester. Students with past-due debts to The University of Arizona are considered financially ineligible to register until outstanding debts are paid in full. The registration of a student whose check is returned to the bank is considered incomplete and a late fee will be assessed. Collection fees will also be assessed if payment for returned checks is not received within twelve calendar days.

Late Payments and Late Registration Fees

A student who fails to complete payment of all fees prior to the due date will be assessed a non-refundable late payment fee. Students who fail to register prior to the first day of class will be assessed an additional late registration fee. For registration and payment deadlines consult the Academic Calendar in this Catalog or the Schedule of Classes.

Refund of Tuition and Fees

The refund schedule begins with the first day of class and applies to weekdays (Monday to Friday). Sufficient time must be allowed for final clearance of registration fee payment checks before refunds will be made. Students who withdraw and who are entitled to a refund will be charged a $10 withdrawal fee. The Arizona Financial Aid Trust (AFAT) fee will not be refunded once classes begin. Students receiving financial aid will be refunded in compliance with federal regulations. All refunds and deposits that may be due a student will be first applied to encumbrances owed by the student to the University. Refunds will be forfeited unless claimed by the last day of the semester.

Refund Schedule

<table>
<thead>
<tr>
<th>Days After Classes Begin</th>
<th>Refund Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5 days</td>
<td>100%</td>
</tr>
<tr>
<td>6-15 days</td>
<td>90%</td>
</tr>
<tr>
<td>16-30 days</td>
<td>50%</td>
</tr>
<tr>
<td>Thereafter</td>
<td>25%</td>
</tr>
</tbody>
</table>

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. Each university shall allow students to register for classes, receive cash refunds, or obtain transcripts, diplomas, or a certificate of degree. The university may allow students to register for classes, obtain transcripts, diplomas, or a 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, 1997-98*

<table>
<thead>
<tr>
<th></th>
<th>Arizona Residents</th>
<th>Non-Residents**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition and fees</td>
<td>$2,060</td>
<td>$8,712</td>
</tr>
<tr>
<td>Room/Meals</td>
<td>7,230</td>
<td>7,230</td>
</tr>
<tr>
<td>Books</td>
<td>650</td>
<td>650</td>
</tr>
<tr>
<td>Travel</td>
<td>1,380</td>
<td>1,380</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>2,480</td>
<td>2,480</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$13,800</strong></td>
<td><strong>$20,452</strong></td>
</tr>
</tbody>
</table>

* Minimum estimated expenses for 1998-99 were not available at the time of publication of this Catalog.

** Out-of-state and international students.

Additional Miscellaneous Expenses

<table>
<thead>
<tr>
<th>Expense</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music fee for private lessons, per semester *</td>
<td>2 hours per week $80</td>
</tr>
<tr>
<td></td>
<td>1 hour per week $100</td>
</tr>
<tr>
<td>Late registration and payment fees</td>
<td></td>
</tr>
<tr>
<td>late registration penalty</td>
<td>$50</td>
</tr>
<tr>
<td>late payment penalty</td>
<td>25-500</td>
</tr>
<tr>
<td>late payment for registration on</td>
<td>$250</td>
</tr>
<tr>
<td>or after the 21st day of class</td>
<td></td>
</tr>
<tr>
<td>(includes weekends)</td>
<td></td>
</tr>
<tr>
<td>International student language examination fee</td>
<td>$15</td>
</tr>
<tr>
<td>Application for degree candidacy</td>
<td>$15</td>
</tr>
<tr>
<td>Processing fee (thesis or dissertation)</td>
<td>$15</td>
</tr>
<tr>
<td>Thesis microfilming fee (optional)</td>
<td>$65</td>
</tr>
<tr>
<td>Dissertation microfilming fee</td>
<td>$65</td>
</tr>
<tr>
<td>Transcript fees</td>
<td></td>
</tr>
<tr>
<td>unofficial</td>
<td>$1</td>
</tr>
<tr>
<td>official, mailed within 9 working days</td>
<td>$4</td>
</tr>
<tr>
<td>official, mailed within 5 working days or</td>
<td></td>
</tr>
<tr>
<td>for pickup at counter</td>
<td>$8</td>
</tr>
</tbody>
</table>

* 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, but the primary sources of information and assistance are the student's department, the Graduate College (Administration Building, Room 322), 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 $6,773 to $17,357 for half-time (20 hours per week) assistantships/ associateships. Each assistantship/ associateship provides a waiver of non-resident tuition. Interested students should contact the hiring department regarding application procedures.

As a condition of employment, all graduate assistants/associates must be enrolled in a graduate degree program, maintain a grade point average of 3.00 or higher 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/ associates are allowed to take is dependent upon the total number of hours they are employed by the University. Graduate assistants/associates are not required to enroll during the summer session to maintain employment status.
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>

*A pay period is equivalent to two weeks.

All graduate teaching assistants/associates who have direct instructional contact with students are required to participate in a two-day University-wide orientation offered the Friday and Monday before 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), and a score of 230 (in testing prior to 1996) or of 50 (in testing after 1996) on the Test of Spoken English (TSE/SPEAK). Students must also attend their hiring department's orientation, which covers specific information relevant to that department and to the course(s) to be taught.

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 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.

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), and a score of 230 (in testing prior to 1996) or of 50 (in testing after 1996) on the Test of Spoken English (TSE/SPEAK). Students must also attend their hiring department's orientation, which covers specific information relevant to that department and to the course(s) to be taught.

Students should contact their departments for availability and application procedures regarding the above 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 GPA of 3.5, have completed all or nearly all their course work, have an approved dissertation proposal approved by their dissertation committee.

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 Final Project Fund provides up to $2,500 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 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 6 900-level units (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.

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

Financial and Academic Support for Underrepresented 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

...
Expenses, Fees, and Financial Assistance

Offered by the Graduate College includes Graduate Minority Tuition Scholarships, Graduate Minority Registration Scholarships, and Graduate Minority Fellowships. In addition, support to students is available through 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, some Graduate Minority Fellowships require verification of financial need. 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 Minority Affairs Office, Administration Building, Room 302, (520) 621-9192, FAX (520) 621-7112, and from the Graduate College Information Counter, Administration Building, Room 322.

The Graduate College also supports the American Indian Graduate Center. Cultural and social activities, emergency financial aid, privately donated scholarships, as well as academic and support services for Native American graduate students are coordinated by the Center, located at 1610 E. Seventh St., (520) 621-7989, FAX (520) 623-3233.

Federal, State, and Institutional 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. 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. Applicants must have been admitted to a degree program before the application will be processed by the Office of Student Financial Aid. A separate application is required for the Federal Family Education Loan program. Students are encouraged to apply early because processing time can involve up to 4 months. Contact the Office of Student Financial Aid, Administration Building, Room 1858, (520) 621-1850, for more information.
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 faculty time they must enroll for 1 unit of graduate credit. If degree requirements (including the Comprehensive and the Final Oral Examinations) are completed during the summer term, the student must also be registered for a minimum of 1 unit of graduate credit during that term. If degree requirements are completed during an intersession, the student must have been registered during the preceding semester. Summer-only students will be required to continuously enroll during consecutive summers until all degree requirements are fulfilled. Students who have completed all degree course requirements but who are not yet enrolled for thesis or dissertation work, should enroll for 3 units of Supplementary Registration (930).

Leave of Absence Policy
Graduate students in degree programs may be granted a Leave of Absence for up to one academic year by the Dean of the Graduate College, upon the recommendation of the student's department. Such leaves are granted for extraordinary reasons only, such as health or medical problems, or military duty. They may not be granted for pregnancy, unless medical complications are present. Students of both genders can apply for a Leave of Absence for up to one semester following the birth or adoption of a child. Time-to-degree requirements are not suspended during a Leave of Absence. The right to use University facilities and/or faculty time is suspended during a Leave of Absence.

Leave of Absence requests must be filed no later than the last day for adding classes during the semester in which the leave is to start, and cannot be granted retroactively. Students on an approved Leave of Absence will not be required to apply for readmission. Students who are absent beyond the end of an approved Leave of Absence will be required to apply for readmission to the Graduate College and to the appropriate academic department, and to pay outstanding fees imposed by continuous registration requirements upon readmission.

Undergraduate Enrollment in Graduate Courses
To be enrolled in a 500-level course for undergraduate credit, an undergraduate student must be an official senior, have a minimum cumulative GPA of 3.00, and receive the approval of the instructor and the Dean of the Graduate College.

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 not propose a semester load to 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, with the approval of their major and minor department heads, apply 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:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Excellent</td>
</tr>
<tr>
<td>B</td>
<td>Good</td>
</tr>
<tr>
<td>C</td>
<td>Average</td>
</tr>
<tr>
<td>D</td>
<td>Poor</td>
</tr>
<tr>
<td>E</td>
<td>Failure</td>
</tr>
<tr>
<td>F</td>
<td>Failure (See Pass/Fail Option)</td>
</tr>
<tr>
<td>P</td>
<td>Passing (See “Special Grades,” “Pass-Fail”)</td>
</tr>
<tr>
<td>S</td>
<td>Superior (See “Special Grades”)</td>
</tr>
<tr>
<td>I</td>
<td>Incomplete</td>
</tr>
<tr>
<td>K</td>
<td>Course in Progress</td>
</tr>
<tr>
<td>W</td>
<td>Approved Withdrawal</td>
</tr>
<tr>
<td>O</td>
<td>Audit</td>
</tr>
<tr>
<td>CR</td>
<td>Credit</td>
</tr>
<tr>
<td>Y</td>
<td>No grade reported</td>
</tr>
</tbody>
</table>

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 no graduate credit will be earned.
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. 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, the degree will not be awarded.

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 which offers the course, 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 offering the course 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> in the Academic Manual, 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 evaluation of 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.

Grievance Procedure

A grievance procedure is available to graduate students who believe that they have been treated unfairly by a faculty member or department. A student must first exhaust other available possibilities, including appeals to the department’s graduate advisor, department head, and dean of the college. If the matter is not resolved, the Dean of the Graduate College will appoint a review committee which will review the case and provide a written report with recommendations to the Dean of the Graduate College. The Dean will make the final decision and inform the student, faculty member, department head, and the dean(s) of the college(s) involved in writing of the decision. Complaints alleging ethnic/racial discrimination or sexual harassment, however, must be addressed through the University’s Affirmative Action Office and not through the Graduate College. Separate processes for grade appeal and graduate examination appeal exist and are explained elsewhere in this chapter. A copy of the Grievance Procedure is available from the Graduate College Information Counter and from the Graduate College home page.

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 petition the Dean of the Graduate College as outlined in the Petitions section.
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 home page.

**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; however, a withdrawal may not be initiated after the last day of classes of any semester, and it must be completed before the beginning of the final examination period. Consult the Schedule of Classes for detailed instructions and deadlines.

A medical withdrawal is initiated through Campus Health. Adequate medical documentation must be supplied by the student. Students who withdraw from the University for medical reasons and who are medically encumbered, must have their readmission approved by Campus Health.

**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 after such work has been submitted to the supervising faculty member, without the approval of 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 Degrees

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, 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 its preparation. 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 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 master's degree program if the majors are sufficiently different to justify an exception with the approval of the Dean of the Graduate College. No student will be permitted to enroll in a third master's degree program without specific prior approval of the Graduate Council.

Major Professor

The department head of the student's major department 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 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

Some 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 a 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 on the Graduate College home 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 for 36 different fields of study. A minimum of 30 units of graduate work, including a 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 in Chapter VIII, Departments and Courses of Instruction, of this Catalog.

Master of Science

The Master of Science degree is offered for 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.

Master of 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 Art

Sixty units are required, of which 12 must be in art history, art criticism, or related areas, 30 in the studio area of concentration, and 18 in related electives (as approved by the major advisor). In lieu of a thesis, an original work or group of such works, must be presented in public. Review of this work will accompany the final oral examination. The exhibit may include a written document, but the document itself will not be considered a thesis. As evidence of completion of this work, a folio of slides or photographs of the exhibition must be submitted to the Department of Art graduate committee upon completion of the final examination. The candidate may be required to prepare a one-person exhibit of the work or to participate in a group exhibit during the last semester in residence. For specific admission requirements and further information, contact the Department of Art, Art Building, Room 101 D, (520) 621-7570.
Major in Theatre Arts
Sixty units are required for this program. Concentrations are available in acting-directing, design-technical production, and dramatic writing. The major in Theatre Arts 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. For specific application requirements and further information contact the Department of Theatre Arts, Drama Building, Room 239, (520) 621-7008.

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 445, (520) 621-1836.

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 Architecture
The College of Architecture offers a graduate program leading to the second professional degree, the Master of Architecture. The program is designed to accommodate graduates of accredited schools of architecture and is flexible in concept to meet the needs and interests of students who desire advanced, specialized training in architecture and related fields. The program requires a minimum of 32 graduate units including at least 16 units of architecture. The graduate study program must be planned by the student in consultation with a committee consisting of the major professor and two additional faculty members. This program must include ARCH 596a and a thesis or master's report. The thesis and the report each consist of three parts: research, written report, and graphic presentation. Candidates must pass a final oral examination over the thesis/report and related matters.

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.

For admission consideration, applicants must have completed, with a grade-point average of 3.00 or higher, an undergraduate program of either four or five years duration that is substantially equivalent to the Bachelor of Architecture program at The University of Arizona. Students without this background will be required to first apply to the undergraduate Bachelor of Architecture program to complete undergraduate course 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, corporate finance, design of database systems, entrepreneurship, financial institutions, health care administration, information systems design, international business, legal studies, management of information, operations management, marketing management, marketing research, quality management, and reliability and quality engineering. Alternatives include the Juris Doctor/MBA program, which reduces the completion of both engineering and management, and reliability and quality operations management, marketing studies, management of information, design, international business, legal administration, information systems design, international business, legal studies, management of information, operations management, marketing management, marketing research, quality management, and reliability and quality engineering. Alternatives include the Juris Doctor/MBA program, which reduces the completion of both programs from five to four years; the MBA/Master of International Management (MIM at 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. Four other joint degree programs are being proposed at the time of publication of this Catalog: The MBA/MS in Nursing program; the MBA/MA in Journalism; the 3/2 MBA/Racetrack Industry program; and the 3/2 MBA/Liberal Arts 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; Reading*; 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.

* This program is currently under review. Consult the Graduate College before applying.

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 Resources 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 including 6 to 9 units of thesis. The Second Professional Degree provides opportunity for an advanced, individualized program of study, to include a thesis of 6 to 9 units. Curriculum information, admission requirements, and application materials are available from the School of Renewable Natural Resources at (520) 621-7260.

Master of Music

The School of Music offers programs leading to the Master of Music degree with majors 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.

* At the time of publication of this Catalog, consideration is being given to possible consolidations among certain degree programs and possible name changes for certain degree programs in conjunction with consolidations. Contact the Graduate College for updated information.

Composition

Applicants submit a minimum of three reproductions of 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, instrumenal 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.

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.

Master of Teaching

Graduate programs leading to the Master of Teaching degree are intended for individuals currently engaged in teaching or in other appropriate programs of training and development. Two majors are available: Elementary Education and Secondary Education. For information regarding the status and requirements of these programs and degrees, contact the Department of Teaching and Teacher Education, College of Education, Room 802, (520) 621-1124.
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 or in non-degree graduate status 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. An oral examination may also be required by the department. A candidate who fails a final oral examination may, upon the recommendation of his or her 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.

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.
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 at least 30 units of graduate credit must be completed at The University of Arizona. Any semester during which a doctoral student in actual residence at The University of Arizona is 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 directly, without a break in enrollment, from a master's degree to a doctoral degree in the same major, he or she may be permitted 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. Graduate assistants or graduate associates and students on appointment to any teaching or research position 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 what the foreign language requirements are, if any, for the degree they seek, and how the requirements may be satisfied.

Qualifying Examination
For the purpose of demonstrating 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 of 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

The head of the student's major department will designate a major professor (who may or may not be the same faculty member as the major professor) 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, meeting with the student periodically to review the student's progress.

Plan of Study

In conjunction with his/her major professor or advisor, each student is 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 graduate 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. Deadlines for the submission of paperwork pertaining to the Oral Comprehensive Examination are available in the Graduate Degree Certification Office. 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. No student will be permitted a second attempt to pass the Oral Comprehensive Examination unless it is recommended by the examining committee, endorsed by the major department, and approved by the Dean of the Graduate College. The second examination, if approved, 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. Deadlines for the submission of paperwork pertaining to doctoral programs are available in departments, in the Graduate Degree Certification Office, and on the Graduate College homepage. “Application to Advance to Candidacy” forms are available from the Graduate Degree Certification Office.

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 homepage.

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 shall 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. A member of the Committee on Graduate Study, representing the Dean of the Graduate College, presides over the examination. The examination is closed to the public, except for an initial seminar portion during which the student presents the dissertation and entertains questions.

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 abstracts, 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 Cashier. 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, and successful candidates are urged 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 majors in the field 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 the 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 major 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 Cashier. 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 qualifying 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. The four recitals must include representative literature from all major periods. Each recital will be evaluated independently by the student's advisory committee and area faculty. 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 should more than one recital be 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 submits one bound copy of the Lecture-Recital Document to the University Music Library for placement in its permanent collection, and 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 Cashier.

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 submits 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 Cashier.

* At the time of publication of this Catalog, consideration is being given to possible consolidations among certain degree programs and possible name changes for certain degree programs in conjunction with consolidations. Contact the Graduate College for updated information.
VII. Student Services

Campus Health
Campus Health provides high-quality, primary medical and psychological care to University of Arizona students, and is 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 become 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, but 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 measles and rubella vaccines since 1980; these vaccines are available at Campus Health for a charge. 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 a Wildcat Job Line—(520) 791-6456—listing part-time and seasonal employment. Career Services is located on the Lower Level of Old Main, (520) 621-2588.

Center for Disability Related Resources
The Center for Disability Related Resources (CeDRR) 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 CeDRR 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@ccit.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 gives authorization (as appropriate) concerning 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. It 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 also 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.

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. A Self-Help Library, free of charge, is available on the premises. 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 the Holscaw Hall, the Lightsong Gallery, the Joseph Gross Gallery, 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 popular shows like Cats and STOMP. Many events offer master classes, and pre- and post-performance activities. Ticket discounts are available for students, families, and UA staff.

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 handles 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 maintains 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 aims of graduate and professional students, to establish effective communication among them, and to facilitate communication within the University and with 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 Day to recognize the contributions that graduate and professional students make to the University.

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 about Christopher City, contact Christopher City Apartments,
Minority Cultural Resource Centers

The University of Arizona supports cultural resource centers designed to provide academic, social, and cultural support to ethnic minority students.

The American Indian Graduate Center provides a home-like gathering place and support program for Native-American graduate students. The Center offers students academic counseling, advisement, emergency loans, computer assistance, and social and community activities with other graduate students and the Tucson Indian community. It is located near the campus, at 1610 E. Seventh St., Tucson, AZ 85719, (520) 621-7989, FAX (520) 623-3233.

Other centers providing resources and assistance to both undergraduate and graduate minority students are:

- The Chicano/Hispano Student Affairs and Resource Center, located in the Economics Building, Room 217, (520) 621-5627.
- The African American Cultural Resource Center, located in the Martin Luther King, Jr. Building, Room 209, (520) 621-3419, and
- The Asian Pacific American Cultural Resource Center, located in the Martin Luther King, Jr. Building, Room 320, (520) 621-3481.

Office of Child-Care Initiatives

Assistance is available to students, faculty, and staff with locating and selecting child-care arrangements, including referrals to centers and family child-care providers, and to child-care 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 child care. Students need to pre-register for both the subsidy and sick-child care programs by calling (520) 621-5844, (520) 626-7227, sending an e-mail to <mgray@cit.arizona.edu>, or by stopping by the Student Union, Room 300.

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.

Student Union

The Student Union provides many of the dining services on campus. Its food services are located in the Memorial Student Union, the Park Center, Business and Public Administration, Electrical and Computer Engineering, the Student Recreation Center, and the Arizona Stadium. The range of services available includes specialty snack bars, convenience stores, and table service restaurants. ALL ABOARD, a debit card program to pay for meals at all food services on campus (including most vending machines), can be purchased in the basement of the Student Union. For further information, call (520) 621-7038.

The Student Union also includes the Department of Student Programs which offers campus-wide leadership programs, recognizes over 300 student organizations, and houses the Center for Service Learning.

Testing Office

The Testing Office offers the GRE, LSAT, MCAT and GMAT, as well as preparation courses for these examinations for a fee. 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. In addition, 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.
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 electronic 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 his or her 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.


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, with prior approval of the responsible faculty member, may be selected by a student in any department even though the courses are not listed in the departmental course offering section.

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.

593L, Legislative Internship [493 (12), 593 (9)] 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, by graduate students. Grades Available: S/P, C, D, E, K, W.


909. Master's Report (Credit varies) Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees. Grades Available: S/P, E, K, W.

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

920. Dissertation (1 to 9)
Research for the doctoral dissertation (whether 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)

930. Supplementary Registration (1 to 9)
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. Grades Available: K, CR.

Faculty Lists
The listing of faculty which precedes the departmental course offerings identifies tenured and tenure-track faculty members appointed for the 1996-97 academic year, 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 the complete listing of faculty, consult the last section of this Catalog.

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 in the course; [Rpt./6 units] 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.

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 15 weeks). 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 requirement 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.

(Identical 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.
### 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 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 electronic catalog at [http://catalog.arizona.edu](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](http://www.bpa.arizona.edu/depts/acct)

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

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

Degrees Offered: M.Ac.

Professors:
Dan S. Dhaliwal, Head, William B. Barrett, William L. Felix, Jr., William S. Waller

Associate Professors:
Ashiq Ali, Jeffrey W. Schatzberg

Assistant Professors:
Leslie Eldenberg, Sanjay Kalapur, Lilliam Mills, Kaye Newbury, Galen R. Sevcik, Brian P. Shapiro, Mark A. Trombley, Cynthia C. Vines

The department offers a program leading to the Master of Accounting degree with a major in accounting. 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) Theory and methodology involved in contemporary accounting for assets, liabilities, stockholders' equity, net income and funds, analysis and interpretation of financial statements. P, 210. Credit allowed for this course or 400a-400b but not for both.

501.* Advanced Accounting (3) Theory and methodology involved in the preparation of consolidated financial statements and in accounting for partnerships. P, 400b. Credit allowed for this course or 401 but not for both.

510.* Principles of Profit Planning and Control (3) Examination of the value of managerial accounting in organizational decision-making and control, addressing specific managerial accounting problems and their solution. P, 310. Credit for this or 410 but not for both.

520.* Introduction to Federal Taxation (3) Principles of federal income taxation, with emphasis on how individuals are taxed; additional topics. P, 210. Credit allowed for this course or 420 but not for both.

522.* Advanced Federal Taxation (3) Introduction to advanced topics: taxation of corporations and stockholders' transactions in stocks, taxation of partnerships and fiduciaries, gift and estate taxation. P, 420. Credit allowed for this course or 422 but not for both.

525.* Issues in Accounting and Taxation (3) Professional discussion of current issues such as estate and income tax, financial planning, IRS audits, bankruptcy, accounting developments, and accounting in business formation. P, 420. Credit allowed for this course or 425 but not for both.


529.* International Corporate Taxation (3) Concepts of U.S. taxation of international transactions, including rules for sourcing income and allocating deductions and such fundamental multistate concepts as nexus, unitary taxes, and apportionment. P, 422 or permission of instructor. Credit allowed for this course or 429 but not for both.

531.* Principles of Auditing (3) The opinion formulation process of the professional auditor, the auditor's reports, professional standards, internal and operational auditing. P, 305, 400b. Credit allowed for this course or 431 but not for both.


550. Financial Accounting (3) Principles and procedures underlying basic financial accounting processes and their application in the preparation and analysis of financial statements. Open to MBA candidates only.


797. Workshop
a. Research Design (1-3) [Rpt./6 units] Open only to Ph.D. students.

#### 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](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, dynamic/computational mechanics, control systems, and thermosciences; design and manufacturing technology; reliability engineering; biomedical engineering; reactors, dynamics of nuclear systems, and energy.

Associate Professors: Ara Arabyan, Cho Lik Chan, Morris Farr (Emeritus), Rocco Fazzolari, Jeffrey W. Jacobs, Edward J. Kerschen, Erdogan Madenci, Alfonso Ortega, K.R. Sridhar
Assistant Professors: Weinong (Wayne) Chen, Ernest Fasse, Matthew R. Jones, Karl Ousterhout

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in aerospace engineering, mechanical engineering, space engineering, or nuclear engineering. Students in any of these majors may select one of the following interdisciplinary options: biomedical engineering, energy systems engineering, materials engineering, or reliability engineering. Close relation with the Applied Mathematics Program is maintained. For information concerning these options see Engineering elsewhere in this Catalog.

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: All students are required to complete 32 units of graduate work, including two units of 696. All students are required to complete 500a and 500b and core courses in one fundamental area. (These are dynamics and control systems, fluid mechanics, solid mechanics, and thermal sciences.) 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 Graduate Program booklet.

Doctor of Philosophy: All students are required to complete a minimum of 54 units of graduate course work (including 30 units, other than 696, earned for the M.S. degree), 18 units of 920 dissertation, and 3 units of 696. 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. To obtain the last unit of 696, all degree candidates are required to present a department seminar on their research during the last year in residence. Specific department Ph.D. degree requirements and examination procedures are described in the department Graduate Program booklet.

Aerospace and Mechanical Engineering (A ME)


510. Design for Manufacturing (3) Design methodology—axiomatic, algorithmic, hybrid. Concepts of design sensitivity; applications to several manufacturing processes—metal forming, metal cutting, welding. P, 461 (AI programming ability; knowledge of plasticity).

520.* Aircraft Conceptual Design (3) 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, 320, 321, 323.


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. 3ED. P, 420 or 428.

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

524.* Introduction to Space Technologies (3) 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. 1.5ED. P, 432.


528.* Space Mission Conceptual Design (3) 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, 424.


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


534. Radiative Heat Transfer (3) 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, 432.

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

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

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

540.* Energy Utilization and Management (3) 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. 2ES, 1ED. (Identical with NEE 540).

542.* HVAC System Design (3) Computer analysis and design of air conditioning systems for commercial and industrial buildings, including equipment and component selection. Energy-efficient concepts and controls will be emphasized. 1ES, 2ED. P, 230, CR, 331. (Identical with NEE 542).


545.* Renewable Energy Systems (3) Solar radiation intensity and location; basic concepts of solar thermal processes; collectors; applications for water heating, active and passive building heating and cooling, industrial processes. Wind energy fundamentals. Aerodynamic theory of propellers and windmills, optimal blade design and economics. 1.5ES, 1.5ED. P, A ME 230, 331, ECE 207. (Identical with NEE 545).

547.* Direct Energy Conversion (3) Engineering requirements for achieving direct conversion of energy to electrical power; the engineering of thermoelectric and thermionic converters, fuel cells, magnetohydrodynamic, and photovoltaic energy. 1ES, 1ED. P, 230 or PHYS 142. (Identical with ECE 547).


553. Computational Multibody Dynamics (3) Computational methods in multibody dynamics; Euler parameters; automatic generation and numerical methods in solving equations of motion; application in vehicle dynamics, spacecraft, and robotics. P, knowledge of kinematics, dynamics, and numerical methods. P, 552.

554.* Optimal Control of Parametric Systems (3) Scalar minimization, vector minimization, continuous static games, matrix games, numerical techniques, and applications. 2ES, 1ED. P, MATH 254.

555. Modern Control Theory (3) Nonlinear dynamical systems; Lyapunov stability, Lyapunov center system design, controllable and reachable sets. P, 455.

556.* Control of Manufacturing Processes (3) Modeling and control of manufacturing processes; mathematical modeling of manufacturing processes including, metal forming, turning, milling, and welding; review of classical control methods; introduction to nonlinear control systems analysis and simulation; analysis, design, and applications of digital control systems; robotics; hardware and software issues; computer simulations. 1.5ES, 1.5ED. 1R, 2L, P, 250, 300, 301, 412a-412b, 455.


561. Finite Element Analysis in Structural Mechanics (3) Advanced problems in structural analysis using the finite element method; analysis of complex systems; dynamics. Composite structures and material programs, program development. P, 461.


563. Finite Element Analysis in Nonlinear Solid Mechanics (3) Finite element methods, including material nonlinearity (elastic, plastic, viscoelastic); geometric nonlinearity (finite deformations), numerical solution methods, and nonlinear programs. P, 461.

566.* Biomechanical Engineering (3) One subject covered yearly from: biomechanical-solid mechanics (orthopedic, vascular, muscle, skin); feedback control (physiological systems); heat transfer, thermodynamics (temperature regulation exercise, hyperthermia, instrumentation). 3ES. P, 302, 330, 331, 410.

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

572.* Reliability Engineering (3) 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. 1.5ES, 1.5ED. P, CR, 474 or SIE 408 and SIE 572.

573.* Probabilistic Mechanical Design (3) Application of probability theory and statistics to mechanical and structural design; modern mechanical reliability methods; design philosophy. 1.5ES, 1.5ED. P, C E 217, CR, 410.

574.* Reliability and Quality Analysis (3) Probability and statistics with applications to reliability engineering, discrete and continuous statistical models for engineering variables, fundamentals of statistics. 1.5ES, 1.5ED. P, MATH 223.

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

576. Advanced Probabilistic Design (3) Advanced methods for mechanical and structural reliability analysis, system reliability analysis, random loading models, applications to fatigue, fracture, buckling, creep, etc. P, 473.

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


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


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

635. Hydrodynamic Stability (3) 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, 500a-500b, 536a-536b.


Nuclear and Energy Engineering (NEE)

506. * Nuclear Engineering Laboratory (4) Experimental techniques for determining various parameters in nuclear systems; experiments using the critical and subcritical reactors. 3R, 3L. 1ED. P, 380 or 483. Non-majors may substitute 586 for the prerequisites.
514a-514b. * Nuclear Engineering Design (3-3) (a) Modern engineering design methods to effectively use thermal energy and power. Covers: economic analysis and modeling of thermal equipment; optimization techniques; steady state and dynamic simulation of energy systems. Comprehensive project. 3ED. P, 381, CR, A ME 432. May be convened with 514a.
(b) A multi-disciplined design project of modern energy systems. Covers: project management tools, design techniques, proposal and project reports, written and oral presentations. Comprehensive team project based on environmental impact, cost optimization, engineering analysis, and resource allocations. 3ED. P, 414a.
540. * Energy Utilization and Management (3) (Identical with A ME 540, which is home).
543. Power Plant Engineering (3) The application of fluid dynamic heat transfer and mechanical interaction principles to the engineering design of a power plant. P, 582, 588.
545. * Renewable Energy Systems (3) (Identical with A ME 545, which is home).
556. * Engineering System Simulation (3) Dynamic modeling and simulation of engineering systems, including energy conversion systems, nuclear and chemical reactors, and control systems, using digital continuous-system simulation languages. 1ES, 1ED. P, A ME 230; MATH 254.
563. * Energy from Biomass (3) (Identical with ABE 563, which is home).
581. * Nuclear Fuel Cycles (3) The processes, methods, and strategies of the nuclear fuel cycle. 2ES, 0.5ED. P, 482. A ME 230.
582. * Contemporary Nuclear Power Systems (3) Analysis of present nuclear power plants, with emphasis on design decisions as they affect performance of individual systems; advanced design concepts; proposed standard designs; comparison of different contemporary systems. 0.5ES, 0.5ED. P, 380 or 486.
583. * Reactor Dynamics and Control (3) Nuclear reactor kinetics, integral transform methods, internal feedback effects, stability and control. 2ES, 0.5ED. P, 380. Non-majors may substitute 486 for the prerequisite.
584. * Radiation Effects (3) Radiation effects on solids and radiation chemistry of gases and liquids, with emphasis on effects encountered in nuclear reactor, detector, and dosimeter systems. 1.5ES, 1.5ED. P, 200, CR, MATH 422a.
585a. * Radiation Health Physics and Safety (3-3) (a) A study of health physics principles and safety, including instrumentation, regulations, record keeping and monitoring of facilities. 2ES, 1ED. (b) Shielding methods, normal and off-normal working practices, national and international regulations and practices. 1.5ES, 1.5ED. P, 585a.
586. * Nuclear Energy and Power (3) Fundamentals of nuclear energy and radiation; engineering applications; the basic concepts of nuclear reactors and power systems. Designed for non-majors. 2ES, 1ED.
587a-587b. * Introduction to Radioactive Waste Management (3-3) (a) Background in the technology of low level radioactive wastes from institutional, research, and fuel cycle sources. 1.5ES, 1.5ED. (b) Background in the technology of high-level wastes, including reprocessing and disposal, from the fuel cycle, both national and international approaches. 1.5ES, 1.5ED. P, 587a.
681a. Analytical Methods of Transport Theory (3) Application of the Boltzmann equation to neutron and photon transport problems; exact solutions, the method of singular eigenfunctions, spherical harmonics, expansions, the moments methods, integral transport theory, invariant embedding, variational techniques, applications to slowing down and diffusion problems. P, 689, MATH 422a.
682. Nuclear Safety (3) Possible incidents involving nuclear materials in critical reactors, chemical processing systems, fuel shipment operations or subcritical arrays, including assessments of the magnitudes and consequences of nuclear incidents, determination of criteria for evaluating nuclear system safety, including plant siting and operational procedures. P, 380.
687. Experimental Nuclear Engineering (3) Advanced experimental studies using the nuclear reactor and radiation detection systems. 2R, 3L. P, 406 or 506. 588.
689. Reactor Theory II (3) Fundamental theory of heterogeneous reactors, integral and perturbation theory, and applications; temperature coefficient, changes in reactivity due to fission product accumulation, fuel consumption, and conversion. P, 588.
author of a manuscript published or accepted for publication in a refereed professional journal.


506. * Applied Hydraulics (3) GRD 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. Not for ABE majors. P, MATH 118, 123 or 125a, PHYS 102. (Identical with WS M 506).

508. * Environmental Simulation (3) Introduction to the usage of mathematical tools and techniques to analyze physical, chemical, and biological components of the environment. P, MATH 123 or 124.


515. * Agri-biosystems Process Engineering (3) Application of the principles of heat transfer, thermodynamics, psychrometrics and fluid flow to the development and solution of simulation of (1) soil temperature and moisture distribution, (2) radiation balances of plants and ventilated greenhouses, and (3) photosynthesis and transpiration. 2R, 3L. 2ES, 1ED. P, A ME 230.

516. * Simulation of Biological Systems (3) 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 used to provide realistic simulation of cyclic conditions. P, knowledge of computer programming.

523. * Agricultural Systems Analysis and Design (3) Application of systems analysis to agricultural and biologically related problems; computer modeling and use of operations research methods. 2ES, 1ED.

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


555. * Irrigation Engineering (3) Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs. 3R, 2ES, 1ED. P, C E 321 or A ME 331. (Identical with C E 555).


557. * Irrigation Engineering Laboratory (1) Data acquisition and analysis pertinent to design and evaluation of irrigation systems. 3L. 1ES. Field trip. CR 455.

558. * Drainage of Irrigated Lands (3) Origin and nature of drainage problems in arid lands; drainage theories, investigations and design for irrigated agriculture. Field trip. 1.5ES, 1ED. P, C E 321 or A ME 331. (Identical with C E 558).


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

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

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

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

696. Seminar

a. Agricultural and Biosystems Engineering (1) [Rpt./8]

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 Aradhuya, satheesh@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.

Professors: Dennis C. Cory, Head, Robert C. Angus (Emeritus), Bruce Beattie, Bartley P. Cardon (Emeritus), Bonnie C. Colby, Robert S. Firch (Emeritus), Roger W. Fox, Jimmye S. Hillman (Emeritus), Robert D. Innes, Maurice M. Kelso (Emeritus), Robert O. Kuehl, Jeffrey T. LaFrance, William B. Lord (Emeritus), William E. Martin (Emeritus), Eric A. Monke, Richard T. Newcomb, Lester D. Taylor, Paul N. Wilson

Associate Professors: Roger A. Dahlgren, Gary D. Thompson

Assistant Professors: Satheesh V. Aradhuya, Alan P. Ker

Instructor and Assistant Research Scientist: Mark W. Langworthy
Senior Lecturer: William J. Hanekamp
Research Scientist: Edwin H. Carpenter
Extension Specialist: Harry W. Ayer
Associate Extension Specialists: George B. Frisvold, Russell E. Tronstad
Assistant Extension Specialist: Julie P. Leones

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 in 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 nonthesis 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. Students completing the nonthesis option must complete 33 units.

504. Production Economics (3) Theory of the firm and industry; single and multiple products; risk and uncertainty. P, MATH 123, ECON 300 or 361. (Identical with ECON 504).

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


514. Cost-Benefit Analysis (3) 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) Micro-economic 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 also discussed. P, ECON 300 or 361. (Identical with ECON 516).

549. Applied Econometric Analysis (3) (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 361 and 3 units of accounting. (Identical with ECON 550).

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

575. Economics of Natural Resource Policy (3) Theory and application of economic concepts needed to evaluate resource laws and policies; including welfare economics, externality, 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 361. (Identical with AR L 575, ECON 575 and RNR 575).


676. Economic Dynamics and Natural Resources (3) 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 treat 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 lto calculus are developed. The sections on natural resource apply these tools to the classical economic problems of natural resource allocation and exploitation. P, graduate student standing with one year of graduate microeconomic theory. (Identical with ECON 676).

696. Seminar

570. Interstate Conflict Resolution (3) [Rpt.] (Identical with SIE 696g, which is home).

Agricultural Education (A ED/AGTM)

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

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, Clinton O. Jacobs (Emeritus), Floyd G. McCormick (Emeritus), Kenneth S. Olson, Phillip R. Zurbrick (Emeritus)
Associate Professors: David E. Cox, Glen M. Miller
Assistant Professor: John F. Elliott

Master of Science: The program requires the completion of at least 20 units in agriculture and agricultural education. Supporting course work shall 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.

Agricultural Education (A ED)

501. Leadership Concepts and Contexts (3) Personal leadership development through experiential learning, philosophical exploration, examination of the literature, and reflective writing. P, consent of instructor or graduate standing.

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


540. International Extension Education (3) 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.


585. Teaching Psychomotor Skills in Laboratory Sciences (1-2) 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.

597. Workshop
a. Instructional Advances in Experiential Education (1-3) [Rpt./3]
b. Advances in Youth Leadership Development (1-3) [Rpt./3]
c. Instructional Advances in Applied Biological Systems (1-3) [Rpt./3]
d. Continuing Education in Agriculture (1) [Rpt./3]
e. Program Development in Vocational/Technical Education (1-3) [Rpt./3]
f. Instructional Advances in Vocational/Technical Education (1-3) [Rpt./3]


615. Investigations and Studies in Applied Research (3) 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) Principles and practices of selecting, developing, and analyzing research instruments, analyzing and interpreting both qualitative and quantitative data research in agricultural and extension education, including the use of the computer. P, 615.

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

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

Agricultural Technology Management (AGTM)


522. * Communicating Knowledge in Agriculture and the Life Sciences (3) (Identical with A ED 522).

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.), Master of Agricultural Education (M.Ag.Ed.), Master of Landscape Architecture (M.L.Arch.), and Doctor of Philosophy (Ph.D.) degrees as indicated in the following list of departments and majors:

Agricultural and Resource Economics
agricultural and resource economics

Agricultural Education
agricultural education

Agricultural and Biosystems Engineering
agricultural and biosystems engineering

Animal Sciences
animal sciences

Entomology
entomology

Family and Consumer Resources
family and consumer resources

Nutrition and Food Science
nutritional sciences

Plant Pathology
plant pathology

Plant Sciences
plant sciences

Renewable Natural Resources
landscape architecture

range management

denatural

Resource studies

wildlife and fisheries science

Soil, Water and Environmental Science
soil and water science

Veterinary Science and Microbiology
pathobiology

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 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 elsewhere in this Catalog.

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/~atsp/index.htm

Graduate Interdisciplinary Program in American Indian Studies

Application Questions:
Debi Nalwood, dnalwood@ccit.arizona.edu

Advising Questions:
Jay Stauss, jstauss@u.arizona.edu

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

Concentrations: American Indian law and policy, American Indian societies and cultures, American Indian languages and literatures, and American Indian education.

Professors: Joseph (Jay) H. Stauss (Family and Consumer Resources), Chair, Barbara A. Babcock (English), Lawrence J. Evers (English), Thomas M. Holm, N. Scott Momaday (English), J. Jefferson Reid (Anthropology), Robert Williams, Jr. (Law)

Associate Professors: Jennie R. Joe (Family and Community Medicine), Tsiamina Lomawaima, Alice S. Paul (Teaching and Teacher Education), David E. Wilkins (Political Science), Ofelia Zepeda (Linguistics)

Assistant Professors: Michelle Grijalva, Eileen M. Luna, Mary Willie (Linguistics)

Associate Research Professor: Nancy J. Parezo (Anthropology)

Adjunct Lecturers: Mary Jo Fox, Robert Hershey

Research Anthropologist: Emory Sekaquaptewa (Anthropology)

The American Indian Studies graduate interdisciplinary program offers opportunities for advanced study in the following concentrations: American Indian law and policy, American Indian societies and culture, American Indian languages and literature, and American Indian education. American Indian Studies is an academic discipline open to both Indian and non-Indian students.
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. AIS 596 Seminar (1) is required each semester a student is enrolled. Each student completes 12 units in an approved field of concentration. 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 governmental 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 course 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 coursework in the regular concentrations offered by the program. Grads 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. and Ph.D. degrees must submit a statement of purpose, 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 invited to submit vitae, published articles, or other materials relevant to admission.

502. Dynamics of Indian Societies (3) 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) (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) (Identical with ANTH 523, which is home).
524.* Studies in Southwest Literature (3) (Identical with ENGL 524, which is home).
530.* The Anthropology of Visual Art (3) (Identical with ANTH 530, which is home).
545a-545b.* Structure of a Non-Western Language (3-3) (Identical with LING 545a-545b, which is home).
577. Studies in American Indian Literature (3) (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) (Identical with ANTH 582, which is home).

584. Development of Federal Indian Policy (3) European colonial precedents through the treaty-making period; federal policy from treaty-making to the present. (Identical with POL 584, which is home).
587a-587b.* Race and Public Policy (3-3) (Identical with POL 587a-587b, which is home).
588.* Areal Survey of Native North American Language (3) (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 junctions. (Identical with RELI 590).
596. Seminar f. American Indian Studies (1-2) (Rpt./3) h. American Indian Law and Policy (3) (Rpt./2) (Identical with POL 596h, which is home).
m. Studies in the Oral Tradition (3) (Rpt./9) (Identical with ENGL 596m, which is home).

602. Interdisciplinary Research: Theory and Method (3) 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.
631. Federal Indian Law (3) (Identical with LAW 631, which is home).
646. Ancient and Contemporary Voices (3) The connections between ancient and contemporary native literature of North and South America.
660. Ecology, Demography, and Disease in the Americas (3) Linked issues of environmental change, demographic change, epidemic/endemic diseases, and health in the Americas after 1492.
670. Colonization and Native Peoples (3) 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.
677. History of American Indian Education (3) Educational philosophies, policies, and practices of native people, European missions, and federal schools. Historic overview of Indian education to early 1900s.
678. Contemporary American Indian Education and Research (3) 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.
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.

**American Indian Higher Education (3)**

American Indian Education (3)

**Energy and Natural Resources (3) GRD**

(Identical with LAW 688, which is home).

**Seminar**

a. American Indian Policy (3) [Rpt./2]
b. Languages and Literature (3) [Rpt./2]
c. Sociology and Culture (3) [Rpt./2]
d. American Indian Education (3) [Rpt./2]

**Workshop**

a. College Teaching Methods (3)

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### Anatomy

(See Cell Biology and Anatomy)

#### Animal Sciences (AN S)

Shantz Building, Room 205
Phone: (520) 621-5965
FAX: (520) 621-9435
WWW: http://ag.arizona.edu/ANS/

Application Questions:
Cheryl McCauley, Administrative Assistant, (520) 621-5965, mccauley@ag.arizona.edu

Advising Questions:
Vince Guerriero, Jr., (520) 621-7764, guerriero@cit.arizona.edu

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

Concentrations: nutrition of beef and dairy cattle, reproduction and breeding, genetics, muscle growth, development and function, meat science, and effects of heat on animal performance.


Associate Professors: Sue K. DeNise, Vincent Guerriero, William A. Schurg, Mark E. Wise

Assistant Professor: Parker Antin

Adjunct Professors: Patricia Hoyer, David Karabinus, Rita Manak, Catherine Racowsky, Bobby L. Reid

Lecturer: Thomas N. Wegner (Emeritus)

Adjunct Lecturers: Wendy Davis, F. Doug Reed

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**Extension Specialists**

- Dennis V. Armstrong, Robert M. Kattning, Albert M. Lane (Emeritus), Edward A. LeViness (Emeritus)
- 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 nutrition of beef and dairy cattle, reproduction and breeding, genetics, muscle growth, development and function, meat science, and effects of heat on animal performance.

Department faculty also participate in interdisciplinary graduate committees on genetics, nutritional sciences, and physiological sciences 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 501, 513, 585, 609, 622, 635, 636, 637, 684, 687.

**Growth and Development (2)**

Animal Growth and Development (2)

Growth and development of domestic animals, with emphasis on skeletal muscle, bone, and adipose tissue growth, from the cellular level to the whole animal. P, BIOL 460 or 462A.

**Biological Electron Microscopy (4)**

(Identical with MCB 512, which is home).
513. Quantitative Genetics (3) 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) 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 462a.

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


585. Domestic Animal Endocrinology (3) Endocrine regulation of growth, metabolism and reproduction of domestic farm animals. P, 3 units of biochemistry.

596. Seminar
   a. Animal Sciences (1) [Rpt./3 units]

609. Nutritional Biochemistry Techniques (3) (Identical with N SC 609, which is home).

615. Chemistry and Metabolism of Lipids (3) (Identical with N SC 615, which is home).

622. Mineral Metabolism (2) (Identical with N SC 622, which is home).

635. Ruminant Nutrition (3) Recent findings in ruminant nutrition; the physicochemical processes of digestion and absorption; importance and metabolism of rumen microflora; normal metabolism and abnormal metabolic disorders; modes of action of feed stimulants. P, 330, 336; CHEM 241a, 243a.


665. Analysis and Purification of Proteins (3) Principles and procedures for analyzing, purifying, and characterizing proteins and amino acids from cells or from CDNA expression systems. P, BIOC 462a preferred, BIOC 460 acceptable. (Identical with BIOC 665 and N SC 665).

684. Animal Physiology Research Techniques (2) Introduction to selected physiological and biochemical techniques used in animal research. 1R, 3L. Open to majors only. P, BIOC 460 or 462a.

687. Environmental Physiology of Domestic Animals (3) Physiological, behavioral and anatomical responses of domestic animals to their environment, with emphasis on adaptive mechanisms. P, 313, 315R, 330, 3 units of general physiology/anatomy.

696. Seminar
   a. Animal Sciences (1) [Rpt./3 units]

Anthropology (ANTH)

Emil W. Haury Anthropology Building, Room 210 Phone: (520) 621-2585 FAX: (520) 621-2088

Application Questions: (520) 621-2585, advising@anthro.arizona.edu

Advising Questions: Laura Stuckey, lstuckey@anthro.arizona.edu

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

Concentrations: medical and applied anthropology, cultural anthropology, archaeology, and linguistic anthropology.


Associate Professors: Ana Alonso, Barbara J. Mills, Thomas K. Park, Richard A. Thompson

Assistant Professors: Mamadou Baro, Willem de Reuse, David J. Killick, Steven L. Kuhn, Daniel Nugent, Mary C. Stiner

The department offers programs leading to the Master of Arts and Doctor of Philosophy degrees with a major in anthropology. The department is presently the fifth-ranked department of anthropology in the nation, according to the National Research Council. Concentrations are available in applied anthropology, archaeology, biological anthropology, cultural anthropology, or linguistic anthropology.

In addition to official transcripts, each applicant is required to submit scores on the aptitude test of the Graduate Record Examination taken within the last five years, a detailed statement of professional goals, and two letters of recommendation from instructors who are in a position to predict the applicant's potential as a graduate student.

Master of Arts: A master's thesis or master's report is required. A minimum of 12 units in anthropology core courses and 18 units in supporting work must be completed. Supporting courses may be chosen from within the department or from American Indian studies, anatomy, arid lands, comparative cultural and literary studies, ecology and evolutionary biology, epidemiology, genetics, geosciences, linguistics, secondary education, Southwestern studies, or women's studies. Specific course requirements for programs in applied anthropology, culture, science, and technology, forensic anthropology, and medical anthropology are listed in literature available from department advisors.

Doctor of Philosophy: The major consists of 36 or more units of course work plus the dissertation. The minor may be taken within the department, in which case it consists of 15 or more units. Minors in other graduate programs at the University also are available; students should consult with the appropriate program advisor. Special requirements include reading knowledge of a foreign language and a working knowledge of modern statistical methods.

Related research opportunities: The Bureau of Applied Research in Anthropology (BARA), an affiliate of the Department of Anthropology, is a unit dedicated to research and instruction in the area of applied anthropology. It carries out a wide-ranging agenda of applied research related to culture change, urban and rural living, gender, agricultural development, technological innovation, policy analysis, learning and education, cultural preservation, and environmental change. Extensive archaeological, ethnological, and osteological collections are available in the Arizona State Museum; internship opportunities in museology also are available. Field training in archaeological techniques is offered on both the graduate and undergraduate levels at the University of Arizona Archaeological Field School, which is operated jointly by the department and the Arizona State Museum. A specialization in culture and technology is offered in cooperation with the Program in Culture, Science, and Technology. The Laboratories of Tree-Ring Research, Isotope Geochemistry, and Paleoenvironmental Studies, provide
opportunities for climatic and chronological studies of special interest to advanced students in archaeology. Programs in public health, nutritional sciences, and genetics as well as the Laboratory of Molecular Systematics and Evolution provide research opportunities for advanced students in biological anthropology. A joint program in linguistic anthropology and linguistics leading to the Ph.D. is offered in collaboration with the Department of Linguistics.

The Minor in Anthropology: Students majoring in other doctoral programs at The University of Arizona who elect a minor in anthropology must complete 15 hours of course work. Students who contemplate such a minor should consult at an early date with the graduate advisor in anthropology to develop a plan of study.

502. Dynamics of Indian Societies (3) (Identical with AIS 502, which is home).
503.* Anthropology of Conflict Resolution (3) Decision making, conflict, and violence from a cross-cultural perspective, aiming to build both understanding of conflict processes and skills for managing and resolving them.
506.* Gender and Social Identity (3) An analysis of the social and cultural construction of gender across cultures. Emphasis will be on preindustrial societies, using data to test theories of gender. (Identical with W S 506).
509.* Economic Anthropology (3) Analysis of production, exchange, distribution, consumption, property, economic surplus, inheritance, and types of economic structure. P, 200, or 12 units of economics. (Identical with LA S 509).
510.* Ceramic Ethnoarchaeology (3) Using ethnoarchaeological and ethnographic case studies from diverse geographical areas, the course examines relationships between ceramics and a range of matters traditionally of interest to archaeologists.
511. Anthropology of Religion (3) Comparative approaches to the study of religion, systems of ritual and symbolization in the primitive world, shamanism and possession, religious movements, and religion in the modern world. (Identical with RELI 511).
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).
513.* Ethnology of the Southwest (3) Culture, history and economic, social, and religious institutions of the living people of the Southwest. P, 200 (Identical with AIS 513).
514. Late Quaternary Geology (3) (Identical with GEOS 514, which is home).
515. Cultural Ecology of Agrarian Societies in the Middle East (3) 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. (Identical with AIS 516).
517.* Cultures of Ancient Mexico (3) Archaeological and ethnohistoric survey of the civilizations of ancient Mexico from earliest times to the period of the Spanish Conquest. Field trips. (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, 102 or 200.
520.* Contemporary American Culture (3) Diverse perspectives on American values as expressed in organization of kinship, space, bureaucracies, media, social classes, ethnic groups, religious sects and movements.
522a-522b. Pre-Hispanic Art (3-3) (Identical with ARH 522a-522b).
523.* Anthropology of Rural Mexico (3) 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. (Identical with AIS 523 and LA S 523).
524.* Theoretical Population Genetics (3) (Identical with ECOL 524, which is home).
525.* Language Variation (3) (Identical with LING 525, which is home).
526. Archaeology of Africa (3) Survey of the prehistoric and early history of Africa, with emphasis on sub-Saharan Africa and on the last ten thousand years. P, 3 units of archaeology.
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, 101. (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. 527a is a prerequisite for 527b. P, 101; consult department before enrolling. (Identical with CHN 527b).
528. Near East Pastoral Nomads and Arid Lands Hunter-Gatherers (3) 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, 200. (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.
534.* Kinship and Social Organization (3) Principles in the comparative study of social systems, types of social structure. P, 200, or 9 units of sociology. (Identical with SOC 534).
535.* Principles of Anthropological Fieldwork (3) Introduction to the principles of archaeological fieldwork, with emphasis on method and theory of survey and excavation. 2R, 3L. P, 235.
536a. Medical Anthropology (3) 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.
536b. Ethnomedicine (3) 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 culture. Explores the medical cultures of Mexico and Latin America, Native America, Africa, and Asia. 536a is not prerequisite to 536b.
540.* Engendering the Past (3) Primatological, ethnographic, archaeological, and historical evidence are reviewed and critically evaluated to develop an empirically well-rounded view of engageder status, roles, and duties in prehistory and in selected early historic periods. Field trip. (Identical with W S 540).
541.* Organization of Museums (3) An intensive introduction to museum studies, with emphasis on the history, philosophy, structure, and function of museums.
543a-543b. The Archaeology of Neolithic and Bronze Age Greece (3-3) (Identical with CLAS 543a-543b, which is home).
544. In the Wake of the Green Revolution (3) Survey of agricultural and fisheries production, marketing, and research activities in Sonora, Mexico, locus of "Green Revolution" in wheat

547. *Anasazi Archaeology (3) Detailed review of the archaeology of the Colorado Plateau emphasizing its agriculturally-based occupants, the Anasazi, and their descendants, the Pueblo Indians.

548. *Writing Culture (3) [Rpt.] 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.

551. *Archaeology of North America (3) Intensive survey of the development of culture in North America from the time of the initial peopling of the New World to the historic period.

552R. Archaeology of the Southwest (3) Development of culture in the prehistoric Southwest from the late Pleistocene to the historic period.

552L. Archaeology of the Southwest (3) The nature of archaeological data recovered in the Southwest, with emphasis on their potential for the drawing of both cultural and chronological inferences.

553a-553b. Mesoamerican Archaeology (3-3) Development of culture in Mexico and Central America from the origins of agriculture through the Spanish Conquest. 553a: Maya culture. 553b: the culture of Mexico north of the Maya area. 553a is not prerequisite to 553b. (Identical with LA S 553a-553b and MAS 553a-553b).

554. *Andean Archaeology (3) Development of culture in the Andean countries of South America from hunters and gatherers of the terminal Pleistocene through Inca civilization. (Identical with LA S 554).


556a-556b. *Old World Prehistory (3-3) A survey and interpretation of archaeological evidence for human cultural development of the Old World prior to the appearance of anatomically modern humans. 556a: The Paleolithic, from earliest tools to the cave artists at the end of the Ice Age. 556b: From hunting and gathering to the roots of urban society following the Ice Age.

557. *Prehistoric Mesopotamia (3) Theories of the rise of civilization tested against archaeological data from Mesopotamia with comparative material from other areas. Time period: end of the Paleolithic to historic (Sumerian) civilization. (Identical with NES N557).

558. *Historical Archaeology (3) Survey of the basic data and methods of research in the material culture of modern history. The New World from first European contacts to the 20th century.

560. *History of Archaeological Theory (3) Explores the relationship between method and theory in anthropological archaeology over the past 100 years. The intimate relationship between general theory and the development of methods and research interests in archaeology will be demonstrated through case studies.

561. Paleolithic Origins (3) Chronological development of Paleolithic occupation of the New World in relation to environmental changes of the Quaternary Period; site discoveries, case studies, hypothesis on the peopling of the Americas. Field trip. (Identical with GEOS 561).

562. Archaeological Quantitative Methods (3) Intensive review of the theory and application of statistical and mathematical methods to archaeological data.

563. Evolution of Ancient States and Civilizations (3) Classical and modern theories used to explain the rise of ancient states and civilizations are evaluated as systems of anthropological logic and for their ability to elucidate the archaeological record. Major topics include the nature of growth trajectories, variability in ancient states, the collapse of states, and constraints of growth in selected areas of the world. P, consult department before enrolling.

564. *Introduction to Dendrochronology (4) (Identical with GEOS 564, which is home).


568. *Human Osteology (4) Human osteology for the anatomist, for the biologist; techniques of in situ and laboratory identification, preservation and measurement. P, consult department before enrolling.

570a-570b. *Human Adaptability (3-3) Study of the means by which humans adjust to their environments through the processes of growth and development. Focus is on physiological, nutritional, and epidemiological factors. 570a includes discussion of the biology of human aging, P, 265 or consult department before enrolling. 570a is identical to 570b. 570a is identical with GEOR 570a.

571a-571b. Applied Medical Anthropology in Western Contexts (3-3) Investigations of the illness experience; symbolic interpretations of medicines and medical procedures; doctor-patient communications and illness narratives. 571a demonstrates the applicability of major social science theories in the related study of health-related behavior. 571b focuses on methods of data collection and presents case studies illustrating the application of methods in the study of designated health problem areas, interview transference and issues of reflexivity. P, 336a.


573. *Primate Anatomy (4) Comparative primate functional anatomy from an anthropological viewpoint including extensive laboratory dissection and study of behavior, ecology, and evolution. P, 265 or consult department before enrolling.

574. *Archaeometry: Scientific Methods in Art and Archaeology (3) Critical survey of scientific methods used in archaeology and art history. Emphasis on the potential and limitations of these techniques for reconstructing human behavior. P, 304 or equivalent experience. (Identical with CLAS 574 and NES 574).


577. *Discuss and Text (3) Analysis and cross-cultural comparison of patterns of communication in discourse; modern approaches to discourse and text. P, LING 101 or ANTH 276. (Identical with LING 577).

578. *Design, Production and Performance of Ceramic and Metals (3) (Identical with MSE 578, which is home).

579. *Cultural and Materials Technology (3) Investigates the ways in which systems of technology are embedded in a cultural context and the resulting impacts on invention, innovation and conservation, technology transfer, and cultural change. (Identical with ENGR 579 and 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 cultures, and their origins in time and space. P, 276 or LING 101. (Identical with LING 580).

581. *Quaternary Palynology and Plant Macrofossils (2-4) (Identical with GEOS 581, which is home).

582. *Hopis Language in Culture (3) A conversational introduction to Hopi language and culture, with emphasis on cultural context and covering essentials of Hopi language structure. (Identical with AIS 582).

583. Sociolinguistics (3) Contributions of the ethnography of communication, language variation studies, and conversation/discourse analysis to the interdisciplinary development of sociolinguistics. (Identical with LING 583).

588. Healing Systems in the Southwest (3) (Identical with NURS 588, which is home).
589. * Areal Survey of Native North American Languages (3) 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. (Identical with LING 589 and AIS 589).

590. * Women in Middle Eastern Society (3) 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. (Identical with W S 590).

595. Colloquium f. Special Topics in Applied Anthropology (3)


b. The Dynamics of Human Subsistence (3)

c. Pre-Columbian Art (3) [Rpt./4] (Identical with ARH 596e, which is home).

d. *Ceramic Analysis (3)

e. *Experimental Archaeology (3)

f. Issues in African Art History (3) [Rpt./12 units] (Identical with ARH 596j, which is home).

g. Risk and Society (3) [Rpt./6 units] (Identical with GEOG 596k, which is home).

h. Near Eastern Archaeology (3) [Rpt.] (Identical with NES 596q, which is home).

597. Workshop a. Biological and Forensic Anthropology (2) [Rpt.] Consult department before enrolling.

b. Biological and Forensic Anthropology (2) [Rpt.] Consult department before enrolling.

c. *Dendrochronology (1-4) 3L or 6L. Field trips. (Identical with GEOS 597c, which is home).

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

605. Professional Ethics and Skills (3) Treatment of a series of ethical issues that can arise in 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) 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) 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) Survey of the foundations of contemporary theory in the field of cultural anthropology.

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

620. Linguistic Field Techniques (3) 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) The role of anthropology in interdisciplinary projects involving economic development and planned change on the national and international levels. (Identical with AR L 631 and LA S 631).

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

637. Archaeological Methodology (3) 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) Archæological methods, theory, and field techniques. 642a: Three-week field excavation and survey. Fee. 642b: Three-week laboratory processing and analysis. Fee. Registration restricted. Contact department for application which must be returned by April 1.

645. Early Civilizations (3) [Rpt./2] Comparative analysis of early civilizations from both the Old World and the New World, with emphasis on regularities in cultural development. P, 454, 457, or 456a or 456b.

665. Survey of Biological Anthropology (3) 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) Intensive study of specific theories and varieties of culture change. P, 6 units in cultural anthropology or consent of instructor.

675a-675b. Anthropology and International Health (3-3) 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 with emphasis on anthropological investigations of health within a broader development context. P, 536a.

679. Language and Ethnography (3) 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.

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

695. Colloquium a. Forensic Anthropology (2) [Rpt./6 units] 2R, 1L. P or CR, 468 and 597b.


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**Applied Mathematics**

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

**Graduate Interdisciplinary Program in Applied Mathematics**

Application Questions: Graduate Secretary, (520) 621-2016, applmath@ccit.arizona.edu

Advising Questions: Michael Tabor (520) 621-4664, applmath@ccit.arizona.edu

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

Concentrations: applied mathematics with emphasis on interdisciplinary research.

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 mathematical 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)
Architectural Building, Room 104
Phone: (520) 621-6751
FAX: (520) 621-8700
WWW: http://w3.arizona.edu/~arch/

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


Associate Professors: Harry der Boghiosian, Nader V. Chalfloun, Dennis C. Doxtater, Robert W. Dvorak, Charles Poster

Assistant Professors: Renée Cheng, Susan K. E. Moody (Acting Associate Dean), Assistant Dean)

The College 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.


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. Fee: P, 401.

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.

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. (Identical with LA 504).

512.* Publication Graphics (3) Designing compositions of text and graphics, and preparing them for publication. Class produces annual Archalendar and other publications. P, 222, 301.

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, 302.

514.* History of American Architecture (3) Developments in American architecture from the colonial to the early modern period. P, 334 or permission of instructor. Open to non-majors.

522.* Urban Open Space (3) [Rpt./6 units] 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.

524.* Modern Architecture (3) Study of recent architectural developments throughout the world, focusing on the personalities, theories and issues influencing built form since 1945. P, 334 or by permission of instructor; upper-division standing.

532.* Video and Media in Design Communications (3) [Rpt./11 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.

533.* Lightweight Construction Techniques (3) Survey of lightweight construction techniques, including pneumatics, tensile membranes, three-dimensional cable nets, grid shells, and flexure stiff plates.

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, 334 or permission of instructor. (Identical with ARH 534). Open to non-majors.

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), copywork, scale models, and simulation. Introductory hands-on exploration of large format photography with polaroid film.

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.

544.* Site Planning (3) 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 involving and applying all criteria to a realistic development project is required. P, 302. (Identical with PLAN 444).

551.* Emphasis Areas in Architecture (6) 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. Fee. P, 334, 335, 336, 402, 428.

559.* Ethics and Practice (3) Standards and values of architectural services and professional project and practice management. P, 270 and 402.

560.* Introduction to Architecture Graduate Computing (3) 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, 402.


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. P, upper division standing and permission of instructor. (Identical with ARH 564 and W S 564).


573.* Introduction to the Conservation of Cultural Resources (3) 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. Field trips.

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

580.* Computer Presentations in Architecture (3) [Rpt.] 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, 470.


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, 302, 334 and satisfaction of upper-division writing proficiency requirement. (Identical with PLAN 584).

587.* Space: A Social-Cultural View (3) [Rpt./1] Human, socio-cultural use of space including processes of symbolic expression. Investigation of the role of space through ethnocentric readings describing both ritual and architectural examples. Consult department before enrolling.

597. Workshop
a. Issues in Architecture (3-8) [Rpt.] Open to majors only. (Identical with PLAN 597a).

b. Special Projects in Architecture (1-3) [Rpt./6 units] Consult college before enrolling.

c. Community Design for Non-Designers (3-6) Field trips. Open to non-majors only. (Identical with LAR 597i and PLAN 597i).

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

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/alrsgp/contents.html

Graduate Interdisciplinary Program in Arid Lands Resource Sciences

Application Questions:
Sonia Economou, (520) 626-9111,
economou@ag.arizona.edu

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

Degrees Offered: Ph.D.

Professors: Steven P. McLaughlin, Chair,
Paul G. Bartels (Plant Sciences),
Robert B. Bechtel (Psychology),
Michael E. Bonine (Near Eastern Studies),
Herbert E. Carter (Emeritus),
Wayne E. Coates (Arid Lands Studies),
Dennis C. Cory (Agricultural and Resource Economics),
Owen K. Davis (Geosciences),
Stanley N. Davis (Emeritus),
Peter F. Follott (Renewable Natural Resources),
Martin M. Fogel (Emeritus),
Kenneth E. Foster (Arid Lands Studies),
Roger W. Fox (Agricultural and Resource Economists),
Lay J. Gibson (Geography and Regional Development),
C. Vance Haynes (Anthropology and Geosciences),
Joseph J. Hoffmann (Arid Lands Studies),
Charles F. Hutchinson (Arid Lands Studies),
Fred S. Matter (Architecture),
Eric A. Monke (Agricultural and Resource Economists),
James W. O'Leary (Plant Sciences),
John W. Olsen (Anthropology),
Stanley J. 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: Steven P.
McLaughlin (Arid Lands Studies),
Chair, D. Robert Altschul (Geography and Regional Development),
Bonnie G. Colby (Agricultural and Resource
Economics), Lisa J. Graumlich (Laboratory of Tree-Ring Research), Phillip D. Guertin (Renewable Natural Resources), Katherine K. Hirschboeck (Laboratory of Tree-Ring Research), Vicente L. Lopes (Renewable Natural Resources), Mitchel 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 semiarid 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, soil science, and watershed management.

Economic Botany studies focus on the development of speciality and industrial cash crops with low water use for sustainable agriculture in arid and semiarid 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) (Identical with AREC 512, which is home).
521. Physical Climatology (3) (Identical with AMO 521, which is home).
523. Hydrology (3) (Identical with CE 523, which is home).
530. The Climate System (3) (Identical with GEOG 530, which is home).
535. Water Management in Dryland Ecosystems (3) (Identical with WS M 535, which is home).
541. Economic Botany of Arid Lands (3) (Identical with PL S 541, which is home).
550. Geomorphology (4) (Identical with GEOS 550, which is home).
564. The Arid and Semiarid Lands (3) (Identical with GEOG 564).
565. Physical Aspects of Arid Lands (3) (Identical with GEOG 565).
575. Economics of Natural Resource Policy (3) (Identical with AREC 575, which is home).
590. Remote Sensing for the Study of Planet Earth (3) (Identical with REM 590, which is home).
595. Colloquium a. Current Research (1) [Rpt./8 units]
631. Anthropology and Development (3) (Identical with ANTH 631, which is home).
641. Natural and Human Impacts on Arid Lands (3) The influence of nature and humans on arid lands sustainability and the role of locally-adaptable technologies. Various aspects of measuring, monitoring, and describing natural and human impacts on arid lands. Focuses on occurrences such as El Niño, population growth, and utilization of limited resources in relation to their economic and environmental significance.
642. Use and Management of Arid Lands (3) Major issues surrounding land uses in the world's arid and semi-arid zones. Examination of issues which will determine the future of land management in much of the arid and semi-arid lands of the western United States. The debate over the management of lands in relation to ownership, tenure, and access, intergenerational transfers, and the economic, environmental, and social consequences of proposed changes in current arrangements.
643. Cultures and Institutions of Arid Lands (3) Social-science aspects of arid lands studies through exposure to approaches and analyses rooted in various disciplines. Examines arid lands cultures, societies, and institutions, and highlights distinctive adaptations to prevailing climatic and physical conditions. Objectives are to develop skills that will improve students' ability to understand, critique, and synthesize oral presentations; review and analyze written materials; discuss and debate interpretations of scholarly work; and prepare critical essays.
644. Biodiversity and Sustainability in Arid Lands (3) Feasibility of these concepts are studied thoroughly with the aim to explore the changing global community. Multi-media presentations, videos, selected readings, and textbook material will be used to explore the political, economic, and ecological impacts on the environment and health of our entire ecosystem.
696. Seminar b. Cultural Anthropology (1-3) [Rpt./3] (Identical with ANTH 696b, which is home).

Art

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 Boelts, Robert Colescott (Emeritus), Michael F. Croft, Douglas Dennison (Emeritus), Margaret B. Doogan, Moira Geoffrion, Judith Golden (Emerita), Dwaine Greer, Maurice K. Grossman (Emeritus), Harmony Hammond, Charles V. Hitner, Harold Jones, Dennis Jones, Vincent Lanier (Emeritus), Bruce E.
McGrew, Ellwood C. Parry, III, Robert M. Quinn (Emeritus), Sheldon Reich (Emeritus), Barbara Rogers, Jean Rush (Emeritus), Lynn Schroeder (Emeritus), Gayle Wimmer

Associate Professors: Andrew Polk, Head, Rosemarie T. Bernardi, Jerold Bishop, Aurore Chabot, David Christiana, John F. Heric, D. Keith McElroy, Lynn Galbraith, Bart J. Morse, Mikelle Omari, Alfred Quiroz, Joyan Saunders, Kenneth Shorr, Robert P. Tobias (Emeritus), Stacie Widdifield, Jane Welch Williams

Assistant Professors: Pia Cuneo, Paul Ivey, Ellen McMahon, Barbara Penn, Sheila Pitt, Julie Plax

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 Retablo of Ciudad Rodrigo by Fernando Gallego; the Charles Leonard Pfeiffer 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 requires 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] Special problems in drawing, using the classroom model and outside sources as references for personal expression. 65. Fee.

509. Graduate Drawing Critique (3) [Rpt./5] Individual exploration in drawing media and visual concepts. Classroom and individual critiques.


523. * New Genre Concept Development (3) [Rpt./1] 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.

537. Art Therapy Techniques I (3)


546. * Experimental Color Photography (3) [Rpt./1] 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. 2R, 2S. Fee. P, 241, 341a, 341b or 341c, 346, acceptance by portfolio.

547. * Mixed Media Book (3) [Rpt./1] Investigation of the book as a format for presenting visual material; the process of making simple books. Contemporary bookmakers will be presented. 2R, 2S. Field trips. P, 12 units of upper-division studio art courses.

548. * Video for Artists (3) Seniors and graduate students utilize small format video camera and editing to extend/ amplify concepts that have developed in their artistic inquiry. 2R, 2S. Field trips. P, admission by portfolio.

549. * Advanced Artists' Video (3) [Rpt./1] 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, portfolio review and ART 349 or M AR 314. (Identical with M AR 549).

550. Graduate Relief Printmaking (3) Relief printmaking with emphasis on individual research, personal direction, and professional standards. 65. Fee.

551. Graduate Intaglio (3) Intaglio printmaking with emphasis on individual research, personal direction, and professional standards. 65. Fee.

553. Graduate Alternative Methods in Printmaking (3) Nontraditional approaches to printmaking with emphasis on individual research, personal direction, and professional standards. 65. Fee.

555. Graduate Lithography (3) Lithography with emphasis on individual research, personal aesthetic, and professional standards. 65. Fee.

556. Graduate Graphic Design Problems (3) [Rpt./1] Two- and three-dimensional design considerations with emphasis on conceptualization and presentation. 65. Field trips. Fee. P, acceptance of portfolio.


567. Graduate Illustration (3) [Rpt./1] Exploration of any optical material or phenomenon as a possible solution to illustration problems. 65. Fee. P, 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. 65. Fee. P, 9 units of graphic design courses and approval of portfolio.

572.* Advanced Jewelry and Metalsmithing II (3) [Rpt./1] Advanced problems in design and execution of jewelry and metalsmithing projects. Preparation of professional credentials including portfolio, photographing, rendering, exhibitions, and resumes. Fee. P, 471.

573.* Advanced Practices in Ceramics (3) [Rpt./5] Individual studio research and instruction with emphasis on personal creative development. 1R, 4S. Fee. P, 373, acceptance of portfolio by ceramic faculty.

574.* Ceramic Surface and Color (3) [Rpt./6 units] Higher sophistication and complex investigation of surface possibilities and color interactions specific to ceramic fired techniques by making glaze, casting, tiles, relief pieces, and simple and complex forms on which to conduct experiments with slips, engobes, stains, and glazes. Emphasis on experimentation and creative explanation of ceramic materials; commercial ceramic pigments, metallic oxides, fluxes, clays and organic additives, and diverse firing methods. Students will be required to write a paper on surface and color related to the use of ceramics. Sketchbook required. 65. Fee. Field trips, P, 373 and portfolio or consent of instructor.

575.* Ceramics Within a Public Art Context (3) [Rpt.] 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. 65. Fee. Field trips, P, ART 373a-373b and consent of instructor/portfolio review.

599.* Portfolio Preparation (3) [Rpt./1] For a description of course topics see 469. Graduate-level requirements include an in-depth research project on a single aspect of a current scholarly interest. Fee. P, 9 units of graphic design courses and approval of portfolio by Portfolio Committee.

580. Graduate Painting (3) [Rpt./5] Graduate study in painting with an emphasis on the development of a personal imagery and body of work. Fee. 65.

583.* Combining Media (3) [Rpt.] Individual and group projects, including collages, constructions, image sequences, and elements from other art forms (sound, language, movement, etc.). Fee.

585. Graduate Watercolor Painting (3) [Rpt./5] High-level experimentation in personal expression with watercolor and related media. Demonstration and critique.

587a. Sculpture/Casting Materials (3) [Rpt.] An in-depth exploration of the techniques and concepts of casting. Advanced process of mold making as applied to individual directions. 65. Fee.

587b. Sculpture Materials/Metal and Wood Fabrication (3) [Rpt./3] An in-depth exploration of advanced processes and concepts of sculpture through metal and wood fabrication. 65. Fee.

587c. Sculpture Materials/Carving (3) [Rpt.] Advanced processes of subtractive thinking through direct carving versus specific imagery. 65. Fee.

587d. Sculpture Materials/Glass Casting and Slumping (3) [Rpt./3] Advanced research and studio work in materials and processing of glass casting and slumping. 65. Fee.

587e. Sculpture Materials/Experimental and Combined Media (3) [Rpt./3] In-depth advanced-level exploration of concepts, processes, and personal direction through combining media and experimental sculpture processes. 65. Fee.

587f. Sculpture Materials/Site Specific Concepts (3) [Rpt./3] The development and research of specific sites and the ramifications of sculptural placements within these sites. Students will develop plans and models that reflect individual concepts. 65. Fee.

587g. Sculpture/Kinetic Materials (3) [Rpt./3] An in-depth exploration of the techniques and concepts of kinetic sculpture as applied to individual directions. 65. Fee.

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. Fee. P, 101, 102, 104, 287, 289, and 389.

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

j. *Writing Art Criticism (3) [Rpt./6 units] Field trips.

597. Workshop a. *Gallery Management (1-3) P, 12 units of studio or art history.

598. 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.

530. Introduction to Research in Art Education (3) 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.


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).

539. Art, Symbolism, and Psychopathology (3) (Identical with FCM 539, which is home).

558. theories of Curriculum and Instruction in Art (3) 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, 338.

596. Seminar h. *Current Issues in Art Education Theory and Practice (3) [Rpt./12 units]

630. History and Philosophy in Art Education (3) [ Rpt./9 units with consent of instructor] 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./9 units with consent of instructor] The identification of problems in art education at various curricular levels; examination of related research with possible implications for practice.

**Art History (ARH)**

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

512a-512b-512c. *Medieval Art (3-3-3) The history of art and architecture in Western Europe and Byzantium between ca. 300 and ca. 1300. 512a: Early Christian and Byzantine Art. 512b: Early Medieval Art. 512c: Romanesque Art. 512d: Gothic Art. 512a is not prerequisite to 512b, etc.

513b-513c.* Renaissance Art in Italy (3-3) Painting, sculpture and architecture in Italy. 513b: 15th century. 513c: 16th century. 513b is not prerequisite to 513c.

514a-514b.* Northern Renaissance Art (3-3)

514a: German, French, and Netherlandish painting during the late 14th through the 15th centuries. 514b: 16th century art production in Germany, France, England, and the Netherlands. P, 6 units of history or art history. 514a is not prerequisite to 514b.

515.* Southern Baroque Art (3) The painting, sculpture, and architecture of the 17th century Italy and Spain.

516a.* 18th Century Art (3) Survey of art and architecture of 18th century England and Italy within the context of the grand tour.

516b.* 18th Century Art II: France and Germany (3) Course will examine the art and architecture of 18th century France and Germany.

517.* 19th-Century European Art (3) Painting and sculpture from the French Revolution through Impressionism. P, 6 units of history or art history.

518a-518b.* 20th-Century Art (3-3) Painting and sculpture in Europe. 518a: 1886 to World War I. 518b: Between the World Wars. P, 6 units of history or art history. 518a is not prerequisite to 518b.

522a-522b-522c.* Pre-Hispanic Art (3-3-3) 522a: Art of the high cultures of Mesoamerica, with the focus on architecture, sculpture, painting, and crafts prior to European contact. 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. 522a is not prerequisite to 522b, etc. (Identical with ANTH 522a-522b-522c and LA S 522a-522b-522c).

523a-523b.* The Art of Mexico (3-3) 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. Painting, sculpture, architecture, graphic, and minor arts. 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. 523a is not prerequisite to 523b.

524a-524b.* History of Photography (3-3) 524a: From its invention to 1895; impact of photography on the art and culture of the 19th century. 524b: As an art medium from 1895 to 1965. P, 6 units of art history. 524a is not prerequisite to 524b.

529a-529b-529c-529d.* American Art (3-3-3-3) The history of art and architecture 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. May be taken in any order. P, 6 units of history or art history.

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. Lecture with discussion.

534.* History of the American House (3) (Identical with ARCH 534, which is home).

535.* History of Prints (3) The technique and functions of the printmaking media from their inception in the 15th century to the 19th century. P, 117 or 118.


539b.* African Art (3) African art in context through chronological, interdisciplinary focus; the main traditions of the Southern Savannah, Equatorial Africa, and the Eastern Sudan. Field trip. 539a is not prerequisite to 439b/539b. P, 339.

552.* Etruscan Art and Archaeology (3) (Identical with CLAS 552, which is home).

554.* Greek and Roman Sculpture (3) (Identical with CLAS 554, which is home).

556.* Greek and Roman Painting (3) (Identical with CLAS 556, which is home).

557.* Greek Architecture (3) (Identical with CLAS 557, which is home).

561.* Greek Pottery 1200-400 B.C. (3) (Identical with CLAS 561, which is home).

564.* Women in American Architecture (3) (Identical with ARCH 564, which is home).

566.* Art and Architecture of LeCorbusier(3) (Identical with ARCH 566, which is home).

581.* Contemporary Theory and Criticism (3) Discussion of the theory and criticism of contemporary art since 1960 based on assigned readings and slide presentations. Field trips.

584.* Roman Art and Architecture (3) (Identical with CLAS 584, which is home).

596. Seminar b. Problems in Renaissance-Baroque (3) [Rpt./2]

a. Art Museum Training (1-6) [Rpt./12 units] Open to students concentrating in museum studies only. P, 12 units of graduate art history courses.

b. Curatorial Training for Archives of Photography (1-6) [Rpt./12 units] Open to students concentrating in museum studies only. P, 511, 12 units of graduate art history courses.

c. Archivist Training for Collection of Photography (1-6) [Rpt./12 units] Open to students concentrating in museum studies only. P, 12 units of graduate art history courses.

d. Archives of Photography: Preservation/Cataloging (1-6) [Rpt./12 units] Open to students concentrating in museum studies only. P, 511, 12 units graduate art history courses.

**Astronomy (ASTR)**

933 N. Cherry Ave. Phone: (520) 621-2288 FAX: (520) 621-1532 WWW: http://www.as.arizona.edu

Application Questions: Willy Benz, wbennz@as.arizona.edu Advising Questions: C. Impey, (520) 621-6522, cimpey@as.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: Peter A. Strittmatter, Head, J. Roger Angel, W. David Arnett (Physics), Willy Benz, Adam Burrows (Physics), Li-Zhi Fang, Thomas Gehrels (LPL), William F. Hoffmann, Christopher Impey, J. R. Jokipii (LPL).
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 Observing Station, 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. The 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.

502. Astronomical Instrumentation Project (3) 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) (Identical with PTYS 503, which is home).

515. Interstellar Medium and Star Formation (3) 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. (Identical with PTYS 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.

523. Statistical Mechanical Problems in the Space Sciences (3) (Identical with PTYS 523).

535. Stellar Structure (3) 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) 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) 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. 540.

545. Stellar Atmospheres (3) Radiative transfer, gray atmosphere, opacity, line formation, non-LTE, curves of growth, stellar hydrodynamics, planetary applications. (Identical with PTYS 545).

553. Solar System Dynamics (3) (Identical with PTYS 553).


556. Electrodynamics of Conducting Fluids and Plasmas (3) (Identical with PTYS 556).

575. General Relativity and Cosmology (3) General relativity with application to celestial mechanics, stellar structure, gravitational radiation, black holes, gravitational lensing, and cosmology.

582. High Energy Astrophysics (3) 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 PHYS 582 and PTYS 582).

589. Topics in Theoretical Astrophysics (3) [Rpt.] (Identical with PHYS 589, which is home).

596. Seminar
b. Methods in Computational Astrophysics (3)

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, asdept@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, 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, Roger Davies, 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.

Formal undergraduate coursework in atmospheric sciences or meteorology is not required for admission, but some knowledge of the field is desirable. 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.

Doctor 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.

510. * Statistical Methods in the Atmospheric Sciences (3) Review of basic statistical procedures; time series analysis; analysis of multivariate data sets; statistical weather forecasting and forecast verification. P, MATH 125b, knowledge of FORTRAN or a similar programming language.

521. * Physical Climatology (3) The global and surface energy balance; the hydrologic cycle; the influence on climate of the atmospheric and oceanic circulation; climate history, sensitivity, modeling, and natural and anthropogenic change. P, 171, MATH 125b. (Identical with GEOG 521).

524. Hydroclimatology (3) (Identical with HWR 524, which is home).

530. Micrometeorology (3) Theoretical aspects of atmospheric turbulence, including discussions of laminar flow, turbulent flow, the mechanical energy equations, and the shear stress and the wind profile. P, 541b.

555. Air/Sea Interactions (3) Physical characteristics of the oceans; the dynamics of ocean currents and their interactions with the atmosphere; El Niño and other teleconnections between the oceans and the atmosphere. P, 300b.

540. * Air Pollution Meteorology (3) Theoretical description and experimental practice relating to the dispersion and chemistry of gases and particulate matter in the atmosphere. Attention given to the scales of dispersion and the scales of atmospheric turbulence as related to local, regional, and global pollution. P, 300a, PHYS 142, MATH 254, CHEM 103a, or consult department before enrolling.

541a-541b. * Dynamic Meteorology (3-3) Thermodynamics and its application to planetary atmospheres, hydrostatics, fundamental concepts, and laws of dynamic
meteorology. P, 300a-300b or consent of instructor; PHYS 142; MATH 254. (Identical with PTYS 541a-541b).

544. Physics of High Atmospheres (3) (Identical with PTYS 544).


551a-551b.* Introduction to Physical Meteorology (3-3) Introduction to atmospheric physics that includes the composition and chemistry of the atmosphere, kinetic theory, the mechanics of ideal and real fluids, aerosol mechanics, atmospheric acoustic, atmospheric radiation, scattering, radiative transfer, atmospheric optics, cloud physics, and atmospheric electricity. P, 300a-300b or consent of instructor; PHYS 142; MATH 254.

560.* Aerosol Science and Engineering (3) (Identical with CHEE 560, which is home).

565.* Mesoscale Analysis (3) Description, analysis, and dynamics of weather systems of the mesoscale. Topics may include fronts, thunderstorms, gravity waves, lake effect storms, and sea breezes. P, CR, 441b; 471.

567. Inverse Problems in Geophysics (3) (Identical with GEOS 567, which is home).

571.* Synoptic Meteorology (3) Principles of meteorological analysis; fundamental concepts of dynamic meteorology; Structure and dynamics of midlatitude cyclones and fronts. Use of computer driven graphical displays. 1R, 6L P, knowledge of FORTRAN or a similar programming language. P, 350, SIE 305 or ATMO 410; CR, 441a.


583. Remote Sensing Instrumentation and Techniques (3) (Identical with ECE 583, which is home).

589. Atmospheric Electricity (3) An introduction to the sources and chemistry of atmospheric ions, fair weather electricity, the global circuit, electrical structure of clouds, thunderstorm electrification, lightning, lightning electromagnetic fields, mechanisms of lightning damage, and lightning protection. P, MATH 322, PHYS 241. (Identical with ECE 589).

590.* Remote Sensing for the Study of Planet Earth (3) (Identical with REM 590, which is home).

595. Colloquium
   a. Atmospheric Measurement Techniques (1-3) P, strong quantitative background in HWR, ATMO, GEOS or RNR. (Identical with GEOS 595b and HWR 595b).
   b. Global Climate Change (1-3) [Rpt/1] P, 541a, 551a, ENGR 170 (FORTRAN). (Identical with GEOS 595c and HWR 595c).

641. Theoretical Meteorology (3) Methods of solution of the hydrodynamic equations; identification and analysis of acoustic, gravity, Kelvin-Helmholtz, inertial, Kelvin, barotropic and baroclinic waves. P, 541b.


656b. Atmospheric Radiation and Remote Sensing (3-3) Theory of atmospheric radiative transfer processes; specific methods for solving the relevant equations; applications to problems in radiative transfer; theoretical basis for remote sensing from the ground and from space; solutions to the "inverse" problem. P, MATH 254. (Identical with OPTI 656a-656b).

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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://worm.biosci.arizona.edu/bmbc/gradprog.html

Application Questions:
Eva Wilson (520) 621-3868, eva#worm.biosci.arizona.edu
Advising Questions:
Elizabeth Vierling (520) 621-1601, eliz@biosci.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), Herbert E. Carter (Emeritus), Michael A. Cusanovich, Carol Dieckmann, Rene Fryereisen (Entomology), Leslie S. Forster (Emeritus), Eugene W. Gerner (Radiation Oncology), Robert J. Gillies, Darrel E. Goll (Animal Sciences), William J. Grimes, Richard B. Hallock, David J. Hartshorne (Animal Sciences), Mark R. Haussler, John G. Hildebrand (Molecular and Cellular Biology, Division of Neurobiology/ARL), Victor J. Hruby (Chemistry), Richard G. Jensen, Henry Koffler (Microbiology and Immunology, Molecular and Cellular Biology), John H. Law, John W. Little, David W. Mount (Molecular and Cellular Biology), David F. O'Brien (Chemistry), Jose M.C. Ribeiro (Entomology), John A. Rupley, Eugene G. Sander, Gordon Tolin, Elizabeth Vierling, F. Ann Walker (Chemistry), Michael Wells, Henry I. Yamamura (Pharmacology; ARL)

Associate Professors: Louise M. Canfield, Jennifer D. Hall (Molecular and Cellular Biology), Martinez J. Hewlett (Molecular and Cellular Biology), Neil E. MacKenzie (Pharmaceutical Sciences), Roger L. Miesfeld

Assistant Professors: Mark S. Dodson, William R. Montfort, David B. Morton (Neurobiology), Martha L. Narro, Roy R. Parker (Molecular and Cellular Biology)

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 in the Colleges of Agriculture, Science, and Medicine.

The Department of Biochemistry offers the Master of Science and Doctor of Philosophy degrees. Except in unusual circumstances, however, the department will only admit graduate students whose stated objective is the Doctor of Philosophy degree. The department also offers undergraduate instruction in programs of the Colleges of Agriculture, Sciences, and undergraduate Bachelor of Science and Bachelor of Arts degrees in biochemistry.

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 over 60 faculty members in the BMCB Graduate program, which, through joint appointments in Biochemistry and Molecular and Cellular Biology, represent an additional 13 departments or interdisciplinary 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 an individual or joint degree program.
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) P, formal admission to the Ph.D./M.D. program, and consent of the course instructor.


505. Eukaryotic DNA Replication (3) [Rpt./1] (Identical with CBIO 505, which is home).

510. Plant Molecular Biology (3) (Identical with PL S 510).

511. Molecular Biology (3) (Identical with MCB 511).

512. Biological Electron Microscopy (4) (Identical with MCB 512, which is home).

516. Bioinformatics and Genomic Analysis (3) (Identical with MCB 516, which is home).

518. Laboratory Methods in Insect Physiology (3) (Identical with INSC 518, which is home).


543. Research Animal Methods (3) (Identical with SC 543, which is home).

545. Concepts in Genetic Analysis (3) (Identical with MCB 545, which is home).

555. Molecular Mechanisms of Development (3) (Identical with MCB 555, which is home).

561. Introduction to Biochemical Literature (1) 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 462a-462b. (Identical with CHEM 561).


568. Nucleic Acids (4) Chemistry, structure, and function of nucleic acids; replication, transcription translation, gene organization, regulation of gene expression and organelle nucleic acids. Both procaryotic and eucaryotic systems will be considered. P, BIOC 411/511, MCB 411/511, or an equivalent introductory molecular biology course, or consent of the instructor. (Identical with GENE 568, INSC 568, and MCB 568)

569. Topics in Gene Regulation (2) 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, 568 or consent of instructor. (Identical with MCB 569).

572. Cell Regulation (3) (Identical with MCB 572, which is home).

574. Advances in Mammalian Genetics (2) [Rpt./1] 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 and MCB 574).

577. Biological Structure II (3) Advanced study of macromolecular structure; theory, methods, and results of x-ray crystallography and NMR. P, 585 or consent of instructor.


586. Intracellular Messengers (2) (Identical with NRSC 586, which is home).

588. Principles of Cellular and Molecular Neurobiology (4) (Identical with NRSC 588, which is home).

595. Colloquium a. Oncogenes and Signal Transduction (1) [Rpt./1] Open to graduate students in biological discipline, exceptionally qualified undergraduates (Identical with CBIO 595a).

597. Workshop a. Recombinant DNA Techniques (2) Open to high school biology teachers only. 1R, 3L. (Identical with MCB 597a).

b. Current Topics for Biology Teaching (1) [Rpt./29] Designed to inform in-service and pre-service biology teachers of new developments in the biologically sciences. Topics vary with each offering. Open to in-service and pre-service teachers only. P, 18 units of biological sciences.

621. Molecular, Plant, Microbe Interaction (3) (Identical with PL P 621, which is home).

623a-623b. Biology Update (2-2) Focuses on recent advances in the understanding of basic biology and new applications. Open to middle and high school biology teachers only. 623a is not a prerequisite to 623b. (Identical with ECOL 623a-623b and MCB 623a-623b).

633. Secondary Biology Lab Curricula (3) Contemporary secondary science curriculum materials and teaching approaches. Course taught jointly by science and education faculty. The use of laboratories in teaching is discussed in the broad context of the national recommendations for science education. Open to middle and high school biology teachers only. 2R, 3L. P, 18 units of biological sciences.

643. Biology Lesson Development (3) Focuses on translating material learned in the biology research experience into laboratory or field experiments to be used in middle school and high school classrooms. Open to middle and high school biology teachers only.

665. Analysis & Purification of Proteins (3) (Identical with AN S 665, which is home).

681. Introduction to Biochemical Research (1-3) [Rpt./1] Supervised research experiences in the laboratories of individual faculty members. 3 or 6L. Open only to first-year majors. P, CR 561.


696. Seminar a. Biochemistry I (1-3) [Rpt./9 units] b. Biochemistry II (1-3) [Rpt./9 units]

800. Research (1-16) Yr.


891. Preceptorship a. Biochemistry (3-12) [Rpt./12 units]

Biology (See General Biology)

Biomedical Engineering (BME)

Arizona Health Sciences Center,
Room 5334
Phone: (520)626-9134
FAX: (520)626-2890
WWW: http://www.ahsc.arizona.edu/bmeidp/

Graduate Interdisciplinary Program in Biomedical Engineering

Application Questions: Charlotte Todd, (520) 626-9134, toddc@ccit.arizona.edu
Advising Questions: Stuart K. Williams (520) 626-4707, skwill@aruba.ccit.arizona.edu

Degrees Offered: M.S., Ph.D. The unit also offers a minor for Ph.D. students in related disciplines.

Professors: Stuart K. Williams, Chair, (Surgery/Physiology/Materials Science & Engineering), William J. Dallas
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, research projects, and clinical internships and industrial externships 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.

510. Biology for Biomedical Engineering (3) I Basic biological principles governing cellular processes and link these to applications in medicine, engineering, and applied sciences.

511. Physiology for Biomedical Engineering (3) II Fundamental concepts and principles in physiology relevant to the field of bioengineering and includes a survey of material necessary for an understanding of physiological principles.

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 application in biomedical engineering.

517. Measurement and Data Analysis in Biomedical Engineering (3) II Topics in biomedical instrumentation, sensors, physiological measurements, analog signal processing, digital signal processing, data acquisition, data reduction, statistical treatment of data, and safety issues. P. 516.

597. Research Methods in Biomedical Engineering (3) I, II, S 2D, 3L Offered in six 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 curriculum must complete three out of these six:

a. Biomechanics and Biomaterials
b. Cardiovascular and Respiratory Mechanics
c. Signal Processing and Imaging
d. Neural Systems and Neural Network Modeling
e. Health Informatics
f. Modeling and Simulation of Biological Systems

Business Administration (B A D)
McClelland Hall, Room 210
Phone: (520) 621-2169
FAX: (520) 621-2606
WWW: http://www.bpa.arizona.edu
Application Questions: wlnernet@bpa.arizona.edu
Advising Questions:
Susan K. Wong, (520) 621-4528
Degrees Offered: M.B.A.
Professors: 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)
Assistant Professors: Chris C. Demchak (Public Administration and Policy), Mark A. Trombley (Accounting)

The committee offers programs leading to the Master of Business Administration degree with a major in business administration and specialized concentrations in functional areas, as well as specialized masters' degrees in functional areas. The committee also participates in a program leading to a Doctor of Philosophy degree with a major in management and specialized concentrations in functional areas.

These degree programs are designed to educate students in modern scientific research methods as applied to general and specialized management problems and to prepare students for careers in education, management, and government.

All prospective students should check with the academic department of their specialization with respect to matters of program focus and requirements.

Master of Business Administration and specialized masters' degrees in functional areas: For information concerning this degree see Requirements for Masters' Degrees/Master of Business Administration elsewhere in this Catalog.
Doctor of Philosophy: The degree program is interdisciplinary and draws heavily on the fields of mathematics, statistics, economics, and the behavioral sciences, as well as knowledge of specific functional areas of management.

Candidates must have a bachelor's degree and proficiency in mathematics at the level of MATH 125a-125b. Individual functional areas will vary to allow for differing backgrounds and to accommodate different special interests. The program requires a concentration in one of the functional areas available in the college: accounting, finance, management information systems, management and policy, and marketing. Minor fields are selected to complement the major area of emphasis. Courses are chosen with the approval of the major and minor advisors to provide a strong theoretical and methodological background for research in the candidate's chosen discipline.

500. Managerial Economics (3) Microeconomic theory and applications. P, MIS 400 or MATH 119 or 123. Advanced degree credit available for non-majors only. Open only to students admitted to a BPA graduate program.


507. Studies in Microeconomics (3) Studies in microeconomics, such as the economics of imperfect information and uncertainty, externalities and public goods, and imperfect competition. P, 361, MATH 125b.


511. Microeconomic Theory and Behavior (3) Microeconomic theory with an emphasis on the use of experimental laboratory and field methods for testing the behavioral implications of the theory. P, 300 or 361, MATH 125b.

512. Economic Policy in Developing Countries (3) (Identical with AREC 512, which is home).

513. Consumption Economics and Price Analysis (3) (Identical with AREC 513, which is home).

514. Cost-Benefit Analysis (3) (Identical with AREC 514, which is home).

515. Operations Research in Applied Economics (3) (Identical with AREC 515, which is home).

516. Agricultural Development (3) [Rpt/1] (Identical with AREC 516, which is home).

518. Introduction to Econometrics (3) 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, 339 or 376.

519. Mathematical Economics (3) Introduction to the theory and methods of mathematical economics and its applications. Designed primarily for entering graduate students majoring in economics. P, CR, 520; consult with department before enrolling.

520. Theory of Quantitative Methods in Economics (3) 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, CR, 519; consult with department before enrolling.

521. Introduction to Mathematical Economics (3) 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, CR, 519; consult with department before enrolling.


525. Topics in the Economic History of the United States (3) 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, 300 or 361.

526. Health Economics (3) (Identical with PA 526, which is home).

530. Macroeconomic Aspects of Finance (3) The effects of changing economic conditions upon a firm's operation, including capital decisions as well as production decisions. P, 500.

531. Games and Decisions (3) Introduction to decision theory and game theory and their application to various economic situations under conditions of complete and incomplete information. P, 300 or 361.


536. Innovation and Economic Growth (3) (Identical with MKTG 536, which is home).


543. International Trade Theory (3) General equilibrium analysis of product and input markets of international trade, tariffs, commercial policy, and growth and the welfare aspects of each. P, 300 or 361.


553. Business and Economic Forecasting (3) 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. P, 300 or 361; 418.

560. Industrial Organization (3) Structure, conduct, and performance of American industry; governmental institutions and policies affecting business. P, 300 or 361; 339 or 376.

561. Economics of Regulated Industries (3) Economic analysis of the regulated sector of the American economy, including communications, transportation and energy industries; impact of existing and alternative public policies. P, 300 or 361.


568. Environmental Scanning and Business Strategy (3) (Identical with MKTG 568, which is home).

575. Economics of Natural Resource Policy (3) (Identical with AREC 575, which is home).

576. Advanced Natural Resource Economics (3) (Identical with AREC 576, which is home).

577. Advanced Topics in the Economics of Environmental Regulation (3) (Identical with AREC 577, which is home).

580. Mathematics for Economists (2) (Identical with AREC 580, which is home).
584.* Economics of Fuels and Energy (3) 
Analysis of demand/supply, pricing, competitive behavior, transportation, interfuel competition, technical change, and externalities for markets for coal, oil, natural gas, and nuclear power. P, 300 or 361.

585.* Economics of Non-Fuel Mineral Industries (3) 
Analysis of national and international minerals markets; reserves/deposits, production technologies, market structure and pricing, recycling, and international trade. P, 300 or 361.

586.* Economics of Minerals, Residuals, Effluents, and the Environment (3) 
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. P, 300 or 361.

589.* Public Choice (3) 
The study of voting theory, government expenditures, government structures, behavior of voters and bureaucracy. P, 361 or consent of instructor. (Identical with POL 589.)

597. Workshop
b. Computational Methods in Laboratory Economics (1-3) [Rpt./3 units] P, MATH 125a-125b; consult department before enrolling.
c. Teaching Methods in Economics (1-3) 
Consult instructor before enrolling.
d. Summer Institute on the American Economy (3) 
Consult instructor before enrolling.
e. Economics Education Workshop (2) 
Consult instructor before enrolling.
f. Economic Development for Educators (2) 
Open to non-majors only. Consult with department before enrolling.

676. Economic Dynamics and Natural Resource Use (3) 
Graduate student standing with one year of graduate microeconomic theory. (Identical with AREC 676, which is home).

696. Seminar
a. Experimental Economics I (3) [Rpt./3] 
b. Experimental Economics II (3) [Rpt./3] 
c. Applied Economic Analysis I (3) [Rpt./3] 
d. Applied Economic Analysis II (3) [Rpt./3] 
e. Econometric Modeling I (3) [Rpt./3] 
f. Econometric Modeling II (3) [Rpt./3] 
g. Monetary Economics (3) [Rpt./3] 
h. Labor Economics I (3) [Rpt./3] 
i. Labor Economics II (3) [Rpt./3] 
j. Public Policy Analysis I (3) [Rpt./3] 
k. Public Policy Analysis II (3) [Rpt./3] 
l. International Economics I (3) [Rpt./3] 
m. International Economics II (3) [Rpt./3] 
n. Advanced Macroeconomic Theory I (3) [Rpt.] 
o. Advanced Macroeconomic Theory II (3) [Rpt.] 
p. Industrial Organization and Regulation I (3) 
q. Industrial Organization and Regulation II (3) 
r. Advanced Microeconomic Theory I (3) [Rpt./3] 
s. Advanced Microeconomic Theory II (3) [Rpt./3] 
t. Mathematical Economics (3) 
u. Game Theory (3) 
v. Public Choice I (3) 
w. Public Choice II (3) (Identical with POL 696w). 
x. Economic History I (3) [Rpt./3] 
y. Economic History II (3) [Rpt./3] 

697. Workshop
d. Labor Economics (3) [Rpt./4] P, 696h, 696i. 
g. Advanced Macroeconomic Theory (3) [Rpt./4] P, 696n, 696o. 
i. Advanced Microeconomic Theory (3) [Rpt./4] P, 696r, 696s. 

Cancer Biology (CBIO)
Arizona Cancer Center, Room 0914 
Phone: (520) 626-7479 
FAX: (520) 626-4480 
WWW: http://grad.admin.arizona.edu/IDPs/cbio/cbio.html

Graduate Interdisciplinary Program in Cancer Biology

Application Questions:
Anne Cione, acione@azcc.arizona.edu

Advising Questions:
G. Tim Bowden, (520) 626-6006, bowden@azcc.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.)

Concentrations: Research interests span cellular and molecular biology, biochemistry, genetics, and immunology. Specific research projects focus on the regulation of gene expression, mechanisms of chemical and physical mutagenesis, and carcinogenesis.

Professors: G. Tim Bowden, Chair (Radiation Oncology), David S. Alberts (Internal Medicine), Harris Bernstein (Microbiology and Immunology), Danny L. Brower (Molecular and Cellular Biology), Anne E. Cress (Radiation Oncology), Carol Dieckmann (Biochemistry), Harlinder S. Garewal (Medicine), Eugene W. Gerner (Radiation Oncology), Robert Gillies (Biochemistry), William J. Grimes (Biochemistry), Evan M. Hersh (Internal Medicine), Junetsu Ito (Microbiology and Immunology), John W. Little (Biochemistry), Neil Mendelson (Molecular and Cellular Biology), David W. Mount (Molecular and Cellular Biology), Raymond B. Nagle (Pathology), Garth Powis (Cancer Center), Sydney E. Salmon (Internal Medicine), I. Glenn Sipes (Pharmacology and Toxicology), Raymond Taettle (Internal Medicine), Elizabeth Vierling (Biochemistry), Samuel Ward (Molecular and Cellular Biology), Ronald Weinstein (Pathology)

Associate Professors: Alison E. Adams (Molecular and Cellular Biology), Emmanuel Akporiaye (Microbiology and Immunology), Louise M. Canfield (Biochemistry), Jennifer D. Hall (Molecular and Cellular Biology), Kit S. Lam (Internal Medicine), Daniel C. Liebler (Pharmacology and Toxicology), Alan F. List (Medicine), Charlene McQueen (Pharmacology and Toxicology), Roger L. Miesfeld (Biochemistry), Roy Parker (Molecular and Cellular Biology), Charles W. Taylor (Internal Medicine), Ted Weinert (Molecular and Cellular Biology)

Assistant Professors: William T. Bellamy (Pathology), Margaret Briehl (Pathology), Douglas Lake (Microbiology and Immunology), Lynne Manseau (Molecular and Cellular Biology), Jesse D. Martinez (Radiation Oncology), Kathy McGovern (Radiation Oncology), William Monfort (Biochemistry), Mark Nelson (Pathology), Scott Selleck (Molecular and Cellular Biology), Luke Whitesell (Pediatrics)

Research Associate Professor: Marianne Broome Powell

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 cell, 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 January 1.

As part of the minimum 18 hours of course work in the major field, the graduate student is required to take Cancer Therapeutics (CBIO 555, 3 units), Molecular Mechanisms of Carcinogenesis (CBIO 555, 3 units), Cancer Genetics (CBIO 589, 3 units), Cancer Epidemiology and Prevention (CBIO 515h, 3 units), Science, Society and Ethics (CBIO 596e, 1 unit), and the Cancer Biology Seminar Series (CBIO 569h, twice for credit, 2 units total, although all students in the program are strongly encouraged to participate throughout their graduate careers).

505. Eukaryotic DNA Replication (3) [Rpt./1] Molecular and biochemical aspects of DNA replication in mammalian cells will be described in conjunction with discussions of recent journal articles on selected topics. Includes the regulation of S phase within the eukaryotic cell cycle; nuclear organization during DNA synthesis; DNA replication enzymes; viral, yeast and embryo models of DNA replication; the initiation of DNA replication; DNA replication origins and the reconstitution of DNA replication complexes. P, BIOL 462b. (Identical with BIOL 505, MCB 505, and MBIM 505).

515. Basic Human Pathology (4) Identical with PATH 515, which is home.

550. Drug Disposition and Metabolism (2) (Identical with PHCL 550, which is home).

551. Molecular Mechanisms of Carcinogenesis (3) 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 biology techniques used in the study of carcinogenesis will also be covered. P, consult program before enrolling. (Identical with MBIM 551 and RONC 551).

555. Cancer Therapeutics (3) Fundamental biological aspects of physical, chemical, and biological therapies for cancer. (Identical with CBA 555, MEDI 555, MBIM 555 and RONC 555)

560. Clinical Cancer Biology (1) 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 the students with practicing physician specialists in selected areas of oncology. A minimum of 16 hours of experience will be provided. Enrollment is limited to three students. P, consent of instructor. (Identical with CBA 560).

562. Tumor Immunology (3) (Identical with MBIM 562, which is home).


595. Colloquium
   a. Oncogenes and Signal Transduction (1) [Rpt./2] Open to graduate students in biological discipline, exceptionally qualified undergraduates. (Identical with BIOL 595a, which is home).
   i. Principles in Cellular and Molecular Cardiovascular Biology (3) [Rpt./6 units] (Identical with SURG 596d)
   602a. Biotoxicology (3) (Identical with PCOL 602a, which is home).
   618. Introduction to Cancer Biology Research (2) Supervised research experience in the laboratories of individual faculty members.


Cell Biology and Anatomy (CBA)
Arizona Health Sciences Center, Room 4205
Phone: (520) 626-6084
FAX: (520) 626-2097
WWW: http://www.cba.arizona.edu

Application Questions:
Audrey Pallette (520) 626-6084, audrey@ccit.arizona.edu

Advising Questions:
Paul St. John, (520) 626-2553, stjohn@u.arizona.edu

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

Concentrations: Cell biology, developmental biology, endocrinology, molecular biology, neurobiology, reproductive biology, systems biology, and biological anthropology.

Professors: Robert S. McCuskey, Head, Jay B. Angevine, Jr., Joseph T. Bagnara (Emeritus), Bryant Benson, Robert W. Gore (Physiology), Mac E. Hadley, Mary I. Johnson (Pediatrics), Philip H. Krutzsch (Emeritus), Raymond B. Nagle (Pathology), John Neote, Donald P. Speer (Surgery), Nicholas J. Strausfeld (Arizona Research Laboratories, Neurobiology), Leslie Tolbert (Arizona Research Laboratories, Neurobiology)

Associate Professors: Gail D. Burd (Molecular and Cellular Biology), C.Ward Kischer (Emeritus), R. Clark Lantz, Associate Head, Christopher A. Leadem, Albert V. LeBouton, Nathaniel McMullen, Mary E. Morbeck (Anthropology), Naomi Rance (Pathology), Raymond Runyan, Paul A. St. John

Assistant Professors: Parker Antin (Animal Sciences), Herman Gordon, Carol C. Gregorio, Mary Rykowski, Jean M. Wilson

Lecturer: Norman E. Koelling

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
investigating the problems of clinical cancer prevention, diagnosis, treatment, and medical management. One on one interaction of the students with practicing physician specialists in selected areas of oncology. A minimum of 16 hours of experience will be provided. Enrollment is limited to three students. P, consent of instructor. (Identical with CB10 560).

567r. Endocrinology (3) (Identical with MCB 567R).

575. Special Topics in Biological Imaging (2) Designed for graduate students in the biological and biomedical sciences to provide an understanding of biological imaging techniques. Lecture and laboratory demonstrations/exercises. Student participation in discussion will be expected. (Identical with PSIO 575 and MCB 575).


582. Topics in Neural Development (2) (Identical with NRSC 582, which is home).

583. Topics in Neural Plasticity (2) (Identical with MCB 583, which is home).

584. Cellular Neurobiology (2) Readings and discussions of primary literature on the cell biology of the synapse. P, consent of instructor and prior course in neurobiology or cell biology. (Identical with MCB 584 and NRSC 584).

588. Principles of Cellular and Molecular Neurobiology (4) (Identical with NRSC 588, which is home).

589. Principles of Systems Neurobiology (4) (Identical with NRSC 589, which is home).


596. Seminar c. Concepts in Cellular Differentiation (2) P, 577 or equivalent (Identical with MCB 596c).

a. Principles in Cellular and Molecular Cardiovascular Biology (3) [Rpt./6 units] (Identical with SURG 596i, which is home).

601. Human Gross Anatomy (8) Comprehensive survey of the development and gross structure of the human body. No grade is given until the full 8 units are completed.


825. Human Neuroscience (6) Morphological organization of the human central nervous system. (Identical with MED 825, which is home).

Chemical and Environmental Engineering (CHEE)

Harssharger Building, Room 120
Phone: (520) 621-6044
FAX: (520) 621-6048
WWW: http://www.che.arizona.edu

Application Questions:
Wendy Haley, (520) 621-6045, haley@bigdog.engr.arizona.edu

Advising Questions:
Jost Wendl, (520) 621-6044, wendl@bigdog.engr.arizona.edu

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

Professors: Thomas W. Peterson, Head, Milan Bier (Emeritus), Alan D. Randolph (Emeritus), Thomas R. Rehm (Emeritus), Farhang Shadman, Raymond A. Sierka, Jost O. L. Wendl, Donald H. White (Emeritus)

Associate Professors: Robert Arnold, William P. Cosart, Roberto Z. Guzman, Bruce E. Logan, Jennifer Sinclair

Assistant Professors: James Baygents, James Farrell, Kimberly L. Ogden
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 work 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 interdisciplinarity 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.

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) Advanced applications of First and Second Laws, nonideal gases and liquids and their mixtures, principles of chemical equilibrium, and molecular theory. P, 326.

514. Particulate Processes (3) Dispersed-phase dynamics, population balances, particle growth kinetics, birth-death functions, phase space particle distributions, suspended-phase reactors, crystallization, and comminution. 520. *Chemical Reaction Engineering (3) Application of thermodynamic and kinetic fundamentals to the analysis and design of chemical reactors. 1.5ES, 1.5ED. P, 201, 326.

521. *Topics in Real-Time Computing (3) 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. 1.5ES, 1.5ED.


532. Solid-Fluid Reactions (3) Characterization of solid structural properties; principles of heterogeneous reactions involving a fluid and a reacting solid. P, 326 and 420, or MSE 450R and 412. (Identical with MSE 532).

535. *Corrosion and Degradation (3) (Identical with MSE 435, which is home).

548. Combustion Generated Air Pollution (3) (Identical with A ME 548, which is home).

551. *Chemical and Physical Fundamentals of Air Pollution (3) Study of the kinetics, transport phenomena, and phase equilibria of urban air pollution problems. 3ES. P, 305, 420, or consult with department.

552.* Space Manufacturing (3) Basics of producing high value added materials in microgravity, as well as commodities for use in space from extraterrestrial resources.

554. *Law for Engineers/Scientists (3) 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. (Identical with ENGR 554).

560. *Aerosol Science and Engineering (3) 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. (Identical with ATMO 560 and ECE 560).

573. Biodegradation of Hazardous Organic Compounds (2-3) Chemical and microbiological considerations which affect the thermodynamics and kinetics of transformations of hazardous organic compounds in treatment facilities and in natural settings. 1 or 2R, 3L. P, 577, or consult with department. (Identical with C E 573).

574. Environmental Transport Processes (3) 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) Principles of bacterial physiology including morphology, metabolism, and genetics. Applications of importance to waste treatment and environmental quality. P, 370, or consult with department. (Identical with C E 577).

578. *Introduction to Hazardous Wastes (3) Management, planning, legal, and engineering aspects of liquid and solid hazardous waste treatment and disposal. 2ES, 1ED. P, 370 or consult department before enrolling. (Identical with C E 578).


581. *Bioreactor Engineering (3) 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. 3ES. P, MATH 254, CHEM 241a, CHEM 480a.

583. Remote Sensing Instrumentation and Techniques (3) (Identical with ECE 583, which is home).


675. Wastewater Treatment (3) Theoretical and applied principles of aerobic and anaerobic wastewater treatment systems. P, 370. (Identical with C E 675).

676. Advanced Water Treatment System Design (3) 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]
b. Combustion (1) [Rpt./6]
c. Kinetics (1) [Rpt./6]
d. Pollution Control (1) [Rpt./6]
e. Crystallization (1 to 3) [Rpt./6]
Chemistry (CHEM)

Old Chemistry Building, Room 221
Phone: (520) 621-6354
FAX: (520) 621-8407
WWW: http://www.chem.arizona.edu/

Application Questions:
(520) 621-4362, chemistry@arizona.edu

Advising Questions:
Debbie Boberg, (520) 621-2737

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


Associate Professors: Ludwik Adamowicz, Michael F. Burke, Eugene A. Mash, Jr., Robin L. Polt, John V. Rund, G. Krishna Vemulapalli, Lucy M. Ziurys (Astronomy)

Assistant Professors: Jacqueyn Gervay, S. Scott Saavedra, Jon Rainier

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, bioorganic science and several other interdisciplinary fields.

Prospective students should contact the department for information and brochure about the variety of research programs, the faculty involved, the 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 adviser. 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 concise review of modern chemical analysis. P, 424, 460b or consent of instructor.

523. Advanced Topics in Equilibrium Chemistry (2-3) [Rpt./6 units]
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, 521b or consent of instructor.

526a-526b. Analytical Spectroscopy (2-3/2-3)
(a) Principles of atomic absorption and emission spectroscopies and x-ray methods for chemical analysis. (b) 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, 424 or consent of instructor.

527. Analytical Separations (2-3) 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, 424 or consent of instructor.


529. Methods of Surface and Materials Analysis (2-3) Fundamentals of electron, atomic, and molecular spectroscopies for surface and materials analysis. This course is suitable for enrollment by advanced undergraduates. Students enrolled for 3 units are required to complete an additional research project with paper and oral presentation. P, 424 or consent of instructor.

533. Chemistry Demonstrations (3) Preparation 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. 1R, 6L. P, 241b; 243b or 245b; or consent of instructor.

540. Organic Syntheses (3) Organic reactions and the methods by which they are applied to synthetic problems in organic chemistry. P, 241b, 480b.


544. Introduction to Biochemical Literature (1) (Identical with BIOC 561, which is home).

545. Enzymes (3) (Identical with BIOC 565, which is home).

580. Introduction to Quantum Chemistry (3) An introduction to quantum mechanics, with applications to atomic structure and spectra, the nature of chemical bonding, and molecular structure. P, 480b.

582. Statistical Thermodynamics (3)
Introduction to classical and quantum statistical thermodynamics with application to ideal gases and simple solids; equations of state and elementary solution theory. P, 480b.


584. Practical NMR Spectroscopy (3) 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, 480b.

584L. Practical NMR Spectroscopy Laboratory (1) Laboratory designed to accompany 584. Students work in the NMR lab and report their findings in papers. P, 480b. CR, 584.

585. Biological Structure I (4) (Identical with BIOC 585, which is home).

587. Introduction to Molecular Spectroscopy (3) Modern molecular spectroscopy including rotational, vibrational, and electronic spectroscopy and their various combinations. P, 480a-480b or consult department before enrolling.

591. Preceptorship
a. *College Teaching (1) [Rpt./2 units]
b. *Chemistry Course Development (1) [Rpt./2 units]
c. *Professional Service (1) [Rpt./2 units]

Note: A combination of 591a, 591b, or 591c may be taken up to a total of 6 units.

595. Colloquium
a. Current Topics in Chemical Research (3) [Rpt./6 units]

613. Current Topics in Inorganic Chemistry (4) [Rpt./10 units] In-depth treatment of advanced topics in inorganic chemistry. Examples include kinetics and mechanisms of inorganic reactions, bioinorganic chemistry, EPR spectroscopy, main group chemistry, solid state materials chemistry, and other topics characterized by faculty expertise. Topics will vary each semester. P, 510 or consent of instructor.

614. Organometallic Compounds (3) Compounds containing carbon-to-metal bonds, with emphasis on those of the transition elements and the determination of their structures. P, 410.

615. Physical Methods in Inorganic Chemistry (3) 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, 510b.


642a-642b. Polymer Chemistry (3-3) Synthesis, stereochemistry, and mechanisms of formation of high polymers. 642a: Condensation and ring-opening polymers. 642b: Vinyl polymers. P, 540. 642a is not prerequisite to 642b.

644. Heterocyclic Compounds (3) The behavior of the more important heterocyclic systems. P, 540.


646. Advanced Organic Chemistry (3) [Rpt.]
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.


684. Magnetic Resonance Spectroscopy (3)
The use of nuclear magnetic resonance and electron spin resonance in studies of molecular systems. P, 580.


685. Colloquium
a. Chemical Research Opportunities (1)
b. Exchange of Chemical Information (1 to 3) [Rpt./7 units]

696. Seminar
a. Analytical Chemistry (1-3) [Rpt./8 units]
b. Inorganic Chemistry (1-3) [Rpt./8 units]
c. Organic Chemistry (1-3) [Rpt./8 units]
d. Physical Chemistry and Chemical Physics (1-3) [Rpt./8 units]

697. Workshop
a. Chemical Instruments (1-3) [Rpt./8 units]

Chinese (See East Asian Studies)
Ehsani, Achintya Haldar, David J. Hall (Emeritus), Simon Ince (Hydrology and Water Resources), Rudolf A. Jimenez (Emeritus), James D. Kriegh (Emeritus), Tribikram Kundu, Emmett M. Laursen (Emeritus), Allan J. Malvick (Emeritus), Haaren A. Miklofsky (Emeritus), Richmond C. Neff (Emeritus), Philip B. Newlin (Emeritus), Ralph M. Richard (Emeritus)  
Associate Professors: Donald J. Baumgartner, George N. Frantziskonis, Donald B. Hawes (Emeritus), Panos D. Kiousis, Kevin E. Lansey, Margaret S. Petersen (Emerita), Hamid Saadatmanesh, Robert H. Wortman  
Assistant Professors: Sonia H. Armaleh, William M. Isenhour  
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, regional development and urban planning, highway engineering, hydraulics and fluid mechanics, environmental engineering, geomechanics, geo-technical engineering, water resources, structural engineering, and transportation. Certain interdisciplinary options are available by combining various areas of the program. For further information concerning these options see Engineering and Mines 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. Still other fields are available as minors with the approval of the head of the department.  
Civil Engineering (CE)  
503. Subsurface Fluid Dynamics (3) (Identical with HWR 503, which is home).  
504. Numerical Methods in Subsurface Hydrology (4) (Identical with HWR 504, which is home).  
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.  
523. * Hydrology (3) Discussion and analysis of major topics of the hydrologic cycle and their interrelationship, such as rainfall, infiltration, evaporation, and runoff. Statistical and probabilistic methods in water supply and flood hydrology.  
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.  
525. Water Quality Modeling (3) Deterministic and stochastic modeling of surface water systems with particular emphasis on water quality management functions. Applications and modifications of Streeter-Phelps technique for predicting oxygen levels in streams.  
526. Water Quality Management (3) (Identical with HWR 526).  
528. * Introduction to Coastal Engineering (3) Hydrodynamics of the coastal zone; coastal sediment processes and their interaction with structures; diffusion in coastal waters and marine offshore design; coastal zone management.  
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.  
533. Plastic Analysis and Design (3) Material and member behavior to full plasticization; redistribution of forces; plastic design of continuous beams and frames; influence of axial and shear forces; deflections and rotations; alternating plasticity; shakedown analysis. P, 432 or consult department before enrolling.  
535. Prestressed Concrete Structures (3) Behavior, analysis, and design of statically determinate and 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.  
540. * Foundation Engineering (3) 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.  
541. * Earth Structures in Geotechnical Engineering (3) Stability analysis for earth slopes, including planar, circular piece-wise 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.  
544. * Special Topics in Geomechanics (3) Introduction to geoenvironmental engineering; physiochemical and microstructural behavior of geomaterials, effect of pollutants, design of waste disposal systems; advanced laboratory testing, geotextiles, space geomechanics, etc.  
547. Seepage and Earth Dams (3) 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.  
548. Numerical Methods in Geotechnical Engineering (3) 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.  


552. Engineering Surveys (3) CDT Solar and Polaris observations; mineral, public, and private land surveys; route surveying, curves, and earthwork; triangulation, photogrammetry, and modern engineering surveys. 2R, 3L. 1.5ES, 1.5ED. P. 251.

555. Irrigation Engineering (3) (Identical with ABE 555, which is home).

556. Drainage of Irrigated Lands (3) (Identical with ABE 558, which is home).

562. Bituminous Materials (3) Manufacture and evaluation tests for the control of bituminous materials used in highway construction and maintenance. 2R, 3L. 0.5ES, 2.5ED. P. 340 or consult department before enrolling.

563. Traffic Engineering (3) Methods for the efficient and safe operation of transport facilities through analysis of capacity, safety, speed, parking, and volume data. 3ED. P. 360.

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. Field trips. 3ED. P. 360.

565. Project Planning and Modeling (3) Use of systems analysis in contemporary planning, including consideration of social, environmental and physical constraints; study of general and special purpose manual and computer-based simulation and gaming as an engineering and planning tool. 0.5ES, 2.5ED. P. senior standing in civil engineering or consult with department.

566. Urban Transportation Planning (3) CDT Transportation planning in relation to urban development; techniques and procedures for developing long-range regional plans. 3ED. P. 360 or consult department before enrolling. (Identical with PLAN 568).

573. Biodegradation of Hazardous Organic Compounds (2-3) (Identical with CHEE 573, which is home).

574. Environmental Transport Processes (3) (Identical with CHEE 574, which is home).

577. The Physiological Bases of Microbial Treatment Processes (3) (Identical with CHEE 577, which is home).

578. Introduction to Hazardous Wastes (3) (Identical with CHEE 578, which is home).

584. Fundamentals of Industrial and Environmental Health (3) (Identical with OSH 584, which is home).

587. Advanced Industrial and Environmental Health (3) (Identical with OSH 587, which is home).

596. Seminar 
a. Research Topics (1) [Rpt./2] (Identical with E M 596a).

597. Seminar 
w. *Advanced Cadastral Survey (1-4) (Identical with RNR 597w).

621. Sediment Transportation (3) Erosion, transportation, and deposition of sediments by flowing water; sediment properties and their measurement; bed load and suspended load oevent; river behavior and control. P. 321.


623. Flow through Hydraulic Structures (3) Subcritical and supercritical flow through culverts, bridges, spillways, stilling basins, transitions, bends; hydrologic effects on inflow; pumps and turbines. P. 322.

624. Planning and Design of Multipurpose Water Resources Projects (3) 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. 321, 423 or 523.

632. Infrastructure Rehabilitation (3) 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. 331, 336, 337.

633. Reinforced Concrete Members (3) 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. 437 or departmental approval.

637. Soil-Structure Interaction (3) Definition of soil-structure interaction, static and dynamic loading, analytic and computer solutions, two and three dimensional structure foundation combinations. P. 340, 548 or consent of instructor.

640. Advanced Soil Mechanics (3) Site investigation and in situ testing; shear strength of sands and clays; interpretation of laboratory test results; consolidation theory: one-dimensional infinitesimal and finite strain; slope stability. P. 340.


645. Geoenvironmental Engineering (3) Interaction of environmental and geotechnical; 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. 340, 544 or consent of instructor.

646. Soil Dynamics and Machine Foundations (3) 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. 640.

648. Constitutive Laws for Engineering Materials (3) Statement of axioms of continuum mechanics. Strain, stress, and nonlinear behavior. Laboratory testing including hyperelasticity, hypoelasticity, rate type models, plasticity review, hardening, volume change and dilatancy, softening, inherent and induced anisotropy; laboratory testing and implementation. P. E M 505, 603, or consult department before enrolling. (Identical with E M 648).

661. Structural Design of Flexible Pavements (3) Analysis of loads, stresses, material characteristics, and environmental factors for the theoretical and practical design, construction, and maintenance of pavements. P. 340, 361.

662. Structural Design of Rigid Pavements (3) Analysis of loads, stresses, material characteristics, and environmental factors for the theoretical and practical design, construction, and maintenance of these pavements. P. 340, 361.

664. Transportation Economics (3) Economic analysis of transport projects, including rural and urban roadways, control systems, and mass transit; discussion of environmental and financial factors. P. 463 or 563.

665. Quick Response Transportation Planning Methods (3) Quick response transportation tools for subarea, problem and policy analysis, and strategic planning in the urban setting. (Identical with PLAN 665).

666. Highway Geometric Design (3) Study of geometric elements of streets and highways, with emphasis on analysis and design for safety. P. 463 or 563.

667. Traffic Operations and Safety (3) Application of traffic control devices for streets and highways, design of traffic control systems, analysis and management of highway traffic, evaluation of safety. P. 463 or 563.


673. Advances in Water and Waste Reclamation and Reuse (2) (Identical with CHEE 673, which is home).

675. Wastewater Treatment (3) (Identical with CHEE 675, which is home).

676. Advanced Water Treatment System Design (3) (Identical with CHEE 676, which is home).
Engineering Mechanics (E M)

502. Introduction to Finite Element Methods (3) (Identical with C E 502, which is home).

505. Continuum Mechanics (4) 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) 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, 505, or consult with department.

511. Advanced Finite Element Analysis (3) 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.

596. Seminar

- a. Research Topics (1) (Identical with C E 596a, which is home).

603. Elasticity Theory and Application (3) 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, 302.

604. Plasticity Theory and Application (3) 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.


635. Matrix Methods in Structural Mechanics (3) 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) 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 or A ME 324.


648. Constitutive Laws for Engineering Materials (3) (Identical with C E 648, which is home).

Classics (CLAS/GRK/LAT)

Modern Languages Building, Room, 371 Phone: (520) 621-1689
FAX: (520) 621-3678
WWW: http://www.coh.arizona.edu/classics

Application Questions: Patty Ward, (520) 621-1689, paward@ccit.arizona.edu
Advising Questions: Frank E. Romer, (520) 621-1689, feromer@ccit.arizona.edu

Degrees Offered: M.A.

Concentrations: Classical archaeology, and classical philology are options.


Associate Professors: Robert A. Burns, Richard Jensen (Emeritus), Frank E. Romer, Mary E. Voyatzis, Thomas D. Worthen

Assistant Professors: David Christensen, Janet Jakobsen, Cynthia White

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 CLASS 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 500a-500b is a prerequisite. The classical archaeology concentration also requires 12 units of 500-level CLAS courses, including 6 units of CLASS 596 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 Archeology (CLAS)

543a-543b. * Archaeology of Neolithic and Bronze Age Greece (3-3) History, art, and culture of prehistoric Greece through the study of archaeological excavation and artifacts. 543a: emphasizes the "Minoan" culture of Crete. 543b: emphasizes the Mycenaean culture of the Greek mainland. 543a is not prerequisite to 543b. (Identical with ANTH 543a-543b).

552. * Etruscan Art and Archaeology (3) Surveys the art and archaeology of the Etruscans between the 7th and 1st centuries B.C. P, 340b or consent of instructor. (Identical with ARH 552).

553. * Research Methods in Classical Archaeology (3) [Rpt/1] 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, 340a or 340b.


556. * Greek and Roman Painting (3) Greek vase painting from the Dipylon 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, 340a-340b. (Identical with ARH 556).


558. * Greek and Roman Provincial Archaeology (3) Survey of classical archaeology in ancient Tunisia, Cyprus, Portugal and Turkey. P, 340a or 340b.

561. * Greek Pottery 1200-400 B.C. (3) The development of Greek pottery from the collapse of the Mycenaean empire to the close of the classical period. Special attention to shapes, decoration, function, and artistic and technical skills. (Identical with ARH 561).

563. * Classical Field Archaeology (6) [Rpt/1] 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. (Identical with ANTH 563).

564. Topics in Ancient Mediterranean Archaeology (3) [Rpt/1] Research papers and oral presentations on different aspects of Greek and Roman archaeology; preparation in writing scholarly articles for refereed journals. P, 340a or 340b.
574.* Archaeometry: Scientific Methods in Art and Archaeology (3) (Identical with ANTH 574, which is home).

581.* Archaic Greek Sanctuaries (3) 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.

584.* Roman Art and Architecture (3) The origin and development of Italian art and architecture from Etruscan beginnings through the Republic to the late Empire. P, ARH 117, 118, or 6 units of ancient history. (Identical with ARH 584).

587. Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587, which is home).

596. Seminar
a. Ancient Art and Archaeology (3) [Rpt./30 units] (Identical with ARH 596a)

Classical Literature and Civilization (CLAS)
510a-510b. Classical Philology (1-1) Introduction to the various disciplines of classical scholarship: philology, textual criticism, paleography, papyrology, archeology.

570.* Greek Philosophy (3) [Rpt./1] (Identical with PHIL 570, which is home).

572a-572b.* Ancient Philosophy (3) [Rpt.] (Identical with PHIL 572a-572b, which is home).

585.* Linguistic and Computer-Assisted Approaches to Literature (3) [Rpt./6 units] (Identical with GER 585, which is home).

586.* History of Byzantium (3) (Identical with HIST 586, which is home).

596. Seminar
a. Topics in Greek or Roman Literature, History or Philosophy (3) [Rpt./30 units]

695. Colloquium
f. Advanced Studies in Ancient History (3) [Rpt./5] (Identical with HIST 695f, which is home).

Greek (GRK)
502.* Greek Reading Course (3) [Rpt.] Readings in major Greek authors including Homer, Plato, and the historians and dramatists. P, 202.

512.* Readings in Greek Philosophy (3) [Rpt./1] Extensive readings in Greek in one of the following areas of Greek philosophy: the pre-Socratics, Plato's ethics and epistemology, Aristotle's Nicomachean Ethics. P, 202. (Identical with PHIL 512)

521.* Greek Lyric Poetry (3) [Rpt.] Study in Greek of the early Greek lyric writers from Archilochus to Bacchylides, including Pindar. P, 202.

522.* Readings in Greek Drama (3) [Rpt.] 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. P, 202.

524.* Homer (3) [Rpt.] Close reading of selections from the Iliad and Odyssey in Greek and an introduction to the critical secondary literature. P, 202.


531.* Greek Orators (3) [Rpt.] Readings in Greek from Lysias, Isocrates and Demosthenes as sources for ancient rhetoric, politics, and private life. P, 202.


596. Seminar
a. Topics in Ancient Greek Literature (3) [Rpt./30 units]

Latin (LAT)
501.* Latin Reading Course (3) [Rpt./1] Readings in one of the following: epic, lyric, drama, history, oratory, satire, epistles, novel, philosophical, technical or medieval literature. P, 400.

503.* Late Antique Literature (3) [Rpt./1] Selections from genres and/or authors, both Christian and non-Christian, from the late antique period. P, 400.


513.* Augustan Literature (3) [Rpt./1] Readings from a major writer or writers of the Augustan age. P, 400.


525.* Cicero (3) [Rpt.] The life of Cicero illustrated by means of close reading of selected works in Latin. P, 400.

526.* Roman Historians (3) [Rpt.] Readings in Latin from the Roman historians and biographers. May be repeated without duplication of readings. P, 400.

528.* Silver Age Latin (3) [Rpt.] Readings from Latin writers of the early Empire. Readings will be in Latin. P, 400.

566.* Issues in Latin Teaching Methodology (3) Introduction to methodologies, pedagogical skills and teaching strategies, texts and resources essential to Latin language instruction. Readings selected from modern educational theorists as well as ancient authors. Open to majors only. P, 400.

596. Seminar
a. Topics in Latin Literature (3) [Rpt./30 units]

Cognitive Science
Communication Building, Room 302
Phone: (520) 621-2065
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 Pollock (Philosophy), Amnon Rapoport (Management and Policy), Susan M. Steele (Linguistics), Miklos Szilagyi (Electrical and Computer Engineering)

Associate Professors: Diana B. Archangel (Linguistics), Andrew Bars (Linguistics), Felice L. Bedford (Psychology), Paul Bloom (Psychology), Louann Gerken (Speech and Hearing Sciences), Elizabeth Glisky (Psychology), Kerry P. Green (Psychology), Michael Hammond (Linguistics), Simin Karimi (Linguistics), Laura A. McCloskey (Psychology), Richard T. Oehrle (Linguistics), Mary A. Peterson (Psychology), Linda Swisher (Speech and Hearing Sciences), Joseph Tolliver (Philosophy), Margaret K. Wynn (Psychology)

Assistant Professors: John J. Allen (Psychology), Cecilie McKee (Linguistics), Janet L. Nicol (Linguistics), Toni Pitassi (Computer Science), Cytm Van Petten (Psychology), Richard Zemel (Psychology)

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 #25, Room 209
Phone: (520) 621-1366
Fax: (520) 621-5504
WWW: http://www.comm.arizona.edu/commitee.html

Application Questions:
(520) 621-1366
Advising Questions:
Judee Burgoon, (520) 621-1366

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

Professors: William D. Crano, Head,
David B. Buller, Judee K. Burgoon,
Michael Burgoon (Family and
Community Medicine), Henry L.
Ewbank (Emeritus), Klonda Lynn
(Emerita)

Associate Professors: Sally A. Jackson,
Curtis S. Jacobs, Henry C. Kenski
(Political Science), Robert W. Sankey,
David A. Williams

Assistant Professor: Ron Wright
Lecturer: William E. Bailey (Emeritus)

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. Additional requirements for both programs are that 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).

509. * Theories of Mass Communication (3)
An in-depth analysis of theories of the social effects of various mass media sources on society. P or CR, 300, 318 and 325, or consent of instructor.

510. * Struggle for the Presidency (3)
Examination of the campaign strategies and tactics of those seeking the nation's most powerful office from 1960 to the present. P or CR, 300, 318 and 325, or consent of instructor. (Identical with POL 510).

511. * Communication and Conflict Management (3)
Consideration of theory and research pertaining to the handling of conflict across diverse contexts. P or CR, 300, 318 and 325, or consent of instructor.

514. * Verbal Communication (3)
Theory and research on verbal messages. Topics include patterns of conversational interaction, processes of message construction and interpretation, functions and contexts of messages. P, 300.

515. * Nonverbal Communication (3)
Theory and research on nonverbal communication codes (kinetics, 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 or CR, 300, 318 and 325, or consent of instructor.

517. * Relational Communication (3)
The relational communication process and messages people use to define interpersonal relationships, including dominance-submissiveness, affection, involvement and similarity. P or CR, 300, 318 and 325, or consent of instructor.

520. * Communication and the Legal Process (3)
Prepares 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 processes. P or CR, 300, 318 and 325, or consent of instructor. (Identical with SOC 520).

521. * Political Campaign Communication (3)
Investigation and analysis of communication principles and practices in contemporary campaigns for elective office. P or CR, 300, 318 and 325, or consent of instructor.

522. * Presidential Leadership and Communication (3)
Examination of presidential leadership and communication strategies of the modern presidents from Kennedy to the present. P, upper-division standing. P or CR, 300, 318 and 325, or consent of instructor.

523. * Topics in Rhetorical Theory and Criticism (3) [Rpt/1]
Intensive reading and analysis of the works of major rhetorical theorists. Each semester will focus on a specific era or perspective. P or CR, 300, 318 and 325, or consent of instructor.

524. * Media and Politics in America (3)
Survey of field; media in political campaigns; media coverage of leaders, issues and institutions; leadership strategies to influence media.
Comparative Cultural and Literary Studies (CCLS)

1239 N. Highland Ave.
Phone: (520) 626-8693
FAX: (520) 626-8694
WWW: http://www.coh.arizona.edu/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: Adele Barker (Russian and Slavic Languages), Malcolm Compitello (Spanish and Portuguese), Jay Stauss (American Indian Studies), Melanie R. Wallendorf (Marketing)

Associate Professors: Marvin Waterstone (Geography and Regional Development), Kamakshi P. Murti (German), Eileen R. Meehan (Media Arts)

Assistant Professors: Elizabeth G. Harrison (East Asian Studies), 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 taught through practical activities.

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 another 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; (3) an example of the student's writing on a literary or cultural topic. For students applying for the doctoral program, this 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 discourses; no more than 9 units may be taken in any one discourse; 3 units of 503; 3 units of 549a or 549b; 3 units of 509 (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 596; and an additional 3 units of 596 or 596.

503. Introduction to Comparative Cultural and Literary Studies (3) Strategies of interpretation taught through practical critique.
549a-549b. Folklore (3-3) (Identical with ENGL 549a-549b, which is home).
550. Modern Theories of Cultural Studies (3) Focuses on key topics, issues, and theorists in cultural studies. Subject varies. (Identical with ENGL 550).
562. Linguistics and the Study of Literature (3) (Identical with ENGL 562, which is home).
Computational Science and Engineering

Gould-Simpson Building, Room 705
Phone: (520) 621-6613
FAX: (520) 621-4246
email: greg@cs.arizona.edu

Graduate Interdisciplinary Program in Computational Science and Engineering

Degrees Offered: Ph.D. minor only
Professors: Gregory Andrews, Chair
(Computer Science), David W. Arnett (Steward Observatory), Robert Dickinson (Atmospheric Sciences), Herman Fasal (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)

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) 621-6613
FAX: (520) 621-4246
WWW: http://www.cs.arizona.edu

Application Questions:
Wendy Swartz, (520) 621-4049, gradadmissions@cs.arizona.edu

Advising Questions:
Larry Peterson, (520) 621-4231

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

Concentrations: programming languages, compilers, networks and operating systems, parallel programming, algorithms, and computational molecular biology.

Professors: Larry Peterson, Head, Gregory R. Andrews, Ralph E. Griswold (Emeritus), Udi Manber, Eugene W. Myers, Jr., Richard D. Schlichting, Richard T. Snodgrass

Associate Professors: Saumya K. Debray, Peter J. Downey

Assistant Professors: Will Evans, John H. Hartman, Tonioni Pitassi, Todd A. Proebsting

Lecturer: Stuart Reges

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, applicants must submit to the department scores from both the general and subject test of the Graduate Record Examination. The department requires that two letters of recommendation be submitted.

A brochure describing admissions requirements and degree programs in detail is available from the department.

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.

Doctor of Philosophy: Doctoral students must complete 36 units of graduate credit in the major including the M.S. core, 520, 543, and 576, and at least two advanced topics. Course work in a related minor field is required. There is no foreign language requirement.

Doctoral candidates majoring in other disciplines may minor in computer science by completing a sequence of courses and examinations set by the department.

502.* Mathematical Logic (3) (Identical with MATH 502, which is home).

509a-509b.* Advanced Symbolic Logic (3) (Identical with PHIL 509a-509b, which is home).

520. Principles of Programming Languages (3) Important programming language concepts, including types, control and data abstraction, denotational semantics, declarative and object-oriented languages, implementation issues. P, 453.

521a-521b. Systems Modeling and Simulation (3-3) (Identical with MIS 521a-521b, which is home).

525.* Principles of Computer Networking (3) 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, 452.


538.* Computational Linguistics (3) (Identical with LING 538, which is home).

541a-541b. Computer-Aided Information Systems Analysis and Design (3-3) (Identical with MIS 541a-541b, which is home).

543.* Theory of Graphs and Networks (3) (Identical with MATH 543, which is home).

652. Advanced Topics in Operating Systems (3) [Rpt./12 units] Operating system design, development, analysis, and performance; specific topics to be determined by current literature and faculty and student interest.

674. Test Generation for Automata (3) (Identical with ECE 674).

969. Seminar
a. Current Computing Research (1-3) [Rpt./8]

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.
Professors: Jory Hancock, Chair, John M. Wilson
Associate Professors: Nina Janik, Melissa Lowe
Assistant Professors: Suzanne Knosp, Michael L. Williams

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.

501. Advanced Floor Barre (1) [Rpt./4 units] 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. 25. P, 201.

539a-539b. * Advanced Pointe Technique (1-1) [Rpt./4 units] 539a: Barre work; continuing development of strength, speed, and stamina. Introduction of advanced barre combinations. Center work; allegro en pointe, also adagio, and pirouettes and consecutive turns. 539b: Continuation of 539a with increasing difficulty and complexity in the enchaînements. 25. P, audition.


541a-541b. * Modern Dance Technique III (2-2) [Rpt./3] By audition only.

543. Dance Ensemble (1-3) [Rpt./5] Rehearsal methods, repertorial development, and performance of dance with particular emphasis on ensemble. 45. P, repertory audition; intermediate level in modern and ballet (340a-b, 341a-b).

544a-544b. * Jazz Dance Technique III (2-2) [Rpt./3] Continued development of jazz dance technique emphasizing stylistic diversity and technical proficiency including contemporary, lyrical, funky, and classical jazz styles. P, 244a-244b, 344a-344b or by audition.

545a-545b. * Advanced Choreography (2-2) 445a: Movement, motif development for solo and group composition. 445b: Balancing the intuitive and intellectual components of the creative process to create meaningful and well-crafted dances. 45. P, 245b.

546. Careers in Dance (3) Knowledge and skills to manage and pursue professional careers in dance. (Identical with T AR 546).

548. Dynamics of Movement (3) [Rpt./1] Experiential approach to movement training and analysis based on anatomical and psychological principles, including movement, voice, guided imagery, lecture and hands-on practice.

550. Literary Resources for Choreography (3) [Rpt./1] Studies in primary world literature, in drama, and in psychology of personages as sources for choreographic themes; presentation of motifs and scenario. 65. P, 445. (Identical with T AR 550).

551b. * Ballet Repertoire (2) [Rpt./12 units] Repertoire from romantic, classical and contemporary ballets including works by Bourcenville, Petipa, Ashton, Balanchine, Christensen and others. 1R, 35. P, 340 or by audition.

595. Colloquium

b. *Teaching Methods in Dance-Grades K-12 (3) P, at least 11 units of dance technique; 100 or 370, 143, 259.

596. Seminar
a. Critical Issues in Dance (2-3) [Rpt./6 units] P, graduate standing.

b. *Critical Issues (2) [Rpt./1] P, junior standing.

694. Workshop
a. Concert Production and Choreography (3) [Rpt./12 units]

East Asian Studies (EAS/CHN/JPN)

Franklin Building, Room 404
Phone: (520) 621-7509
FAX: (520) 621-1149
WWW: http://dizzy.library.arizona.edu/branches/eas/eahome.html

Application Questions:
Sylvia Gourdin, (520) 621-7760, sgourdin@arizvm1.ccit.arizona.edu

Advising Questions:
Chinese Studies: Donald Harper (520) 621-5480 dharper@ccit.arizona.edu
Japanese Studies: J. Philip Gabriel (520) 621-5460 pgabriel@ccit.arizona.edu
Degrees Offered: M.A., Ph.D.
Concentrations: East Asian history, literature, linguistics, thought, religion, and women's studies.

Professors: Brian E. McKnight, Head, Gail L. Bernstein (History), Marie Chan, Anoop Chandola, Robert M. Gimello, Donald J. Harper, Kimberly A. Jones, John W. Olsen (Anthropology), William R. Schultz (Emeritus), Jing-shen Tao, Allen S. Whiting (Political Science)

Associate Professors: Charles H. Hedikke (Emeritus), Ronald C. Miao, Barbara N. Sands (Economics), Chia-Iin Pao-Tao (Media Arts), Feng-hsi Liu, Tsuyoshi Ono

Lecturer: Edward D. Putzar (Emeritus)

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 on 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, the applicant's statement of purpose, 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)
Issues in second language acquisition and teaching, with emphasis on teaching Asian languages as foreign/secondary language.

527a. The Prehistory of East Asia (3)
(Identical with ANTH 527a, which is home).

545. *Hindu Mysticism (3) Introduction to the major concepts and practices of Hindu mysticism, including yoga techniques, rites, symbols, and myths. (Identical with RELI 545).

551. *The United States and East Asia: 1840 to the Present (3) (Identical with HIST 551, which is home).

552. *Hindu Literature (3) Introduces major literary works with ancient Sanskrit genres. Selections from the Vedas, epics, Puranas, and other classics in English translation.

564. *International Relations of East Asia (3)
(Identical with POL 564, which is home).

587. *Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587, which is home).

589. *Women in East Asia (3) (Identical with HIST 589, which is home).

595. Colloquium
a. Masters Colloquium (1)

596. Seminar
a. Topics in East Asian Buddhism (3) P, reading knowledge of Chinese and/or Japanese; EAS 487a-487b/587a-587b or the equivalent.

b. Special Topics in Asian Studies (3) [Rpt./4]

695. Colloquium
a. Advanced Studies in Asian History (3) [Rpt./3] (Identical with HIST 695g, which is home).

Chinese Studies (CHN)

515-516-517-518. *Advanced Modern Chinese (3-3-3-3) Study of advanced modern (Mandarin) Chinese through (515) readings in social science texts, (516) composition, (517) readings in modern literature, and (518) conversation. P, 402 or consent of instructor.

519. *Linguistic Structure of Modern Chinese (3) Linguistic study of the phonological, morphological, and syntactic systems of modern Chinese, with particular attention to linguistic analysis. (Identical with LING 519).


527b. *The Archaeology of Pre-Han China (3)
(Identical with ANTH 527b, which is home).

529. Chinese-American Literature 1960 - Present (3) Studies of the significant literary works by Americans of Chinese descent between 1960 and the present. (Identical with ENGL 529).

530. *Law in Traditional China (3) 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).

540. *Chinese Calligraphy (2) [Rpt.] Theory, practice, and aesthetics of Chinese brush writing, with emphasis on individual training and development.

541. Chinese Historical Linguistics (3) Historical survey of the development of the Chinese language, with particular attention to linguistic changes in phonology, morphology, and syntax. P, 402 and a course in general linguistics.


547. *Readings in Classical Chinese Prose (3) [Rpt./2] 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, 422/522.


576. *Modern China* (3) (Identical with HIST 576, which is home).

582. *Social History of China* (3) 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. (Identical with HIST 582).


595. Colloquium


596. Seminar

b. *Ancient Chinese Philosophy* (3) [Rpt./2] P, 423/523
f. *Classical Chinese Literature* (3) [Rpt.]
g. *Modern Chinese Literature* (3) [Rpt.]
h. *Premodern Chinese History and Politics* (3) [Rpt.]
i. *Modern Chinese History and Politics* (3) [Rpt.]

Japanese Studies (JPN)


505. *Classical Japanese* (3) 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 416/516 or consent of instructor.


521.* Advanced Readings in Japanese* (3) [Rpt.] Reading and discussion in Japanese of a variety of advanced-level materials, including newspaper articles, short stories, and poetry. P, 416 and consent of instructor.

522.* Advanced Readings in Japanese* (3) [Rpt.] Reading and discussion in Japanese of a variety of advanced-level materials, including newspaper articles, short stories, and poetry. P, 421 and consent of instructor.

536.* Japanese Sociolinguistics* (3) Introduction to Japanese sociolinguistics; pragmatics, conversation analysis, discourse analysis, variation theory, ethnography of speaking and ethnemethodology. P, 202 or consent of instructor. (Identical with ANTH 536 and LING 536).


547a-547b.* Modern Japanese Literature* (3-3) Survey of modern Japanese literature with readings in English translation. 547a: Meiji to World War Two. 547b: Postwar and Contemporary Literature.

574a.* History of Japan* (3-3-3) (Identical with HIST 574a-574b-574c, which is home).

595. Colloquium

a. *Japanese Literature* (3) [Rpt./3]

596. Seminar


696. Seminar

r. *Japanese History* (3) [Rpt.] (Identical with HIST 696r, which is home).

Ecology and Evolutionary Biology (ECOL)

Biological Sciences West, Room 310
Phone: (520) 621-1165
FAX: (520) 621-9190
WWW: http://ectweb.arizona.edu

Application Questions: Joan Zokvick, (520) 621-1165, zokvick@biosci.arizona.edu

Advising Questions: Lucinda McCade, (520) 621-8220, lam@ccit.arizona.edu

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


Associate Professors: Judith L. Bronstein, Russell Davis (Emeritus), Wayne P. Maddison, Robert S. Mellor (Emeritus), Daniel R. Papaj, Irene M. Pepperberg, Robert H. Robichaux, Stephen M. Russell (Emeritus), J. Bruce Walsh, Oscar G. Ward (Emeritus)

Assistant Professors: Leticia Aviles, Lucinda McCade, Michael Nachman Lecturer: C. William Gaddis, Donald B. Sayner (Emeritus)

Associate Research Scientists: Michael F. Hammer, Phillip A. Hastings

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in ecology and evolutionary biology and, in botany. 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,
Schools. 1R, 3L. P, 12 units of biology.


501.* Biological Materials (2) Study of new biological materials. (Identical with INSC 500a-500b).

503R.* Biology of Animal Parasites (3) (Identical with V SC 503R, which is home).

503L.* Parasitology Laboratory (1) (Identical with V SC 503L, which is home).

505.* Aquatic Entomology (3) (Identical with ENTO 505, which is home).


511.* Insect Behavior (3) (Identical with ENTO 511, which is home).

512.* Plants Useful to Man (2) 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 manufactures.

514.* Plants of the Desert (2) Designed for teachers and others wishing to become familiar with common native and cultivated plants; identification, ecology, and uses.

515R.* Insect Biology (3) (Identical with ENTO 515R, which is home).

515L.* Insect Biology Laboratory (1) (Identical with ENTO 515L, which is home).

516.* Bioinformatics and Genomic Analysis (3) (Identical with MCB 516, which is home).

517.* Insect Systematics (4) (Identical with ENTO 517, which is home).

518. Laboratory Methods in Insect Physiology (3) (Identical with INSC 518, which is home).

520.* Evolutionary Quantitative Genetics (4) Rigorous coverage of the inheritance and evolution of quantitative characters. Theory, estimation and design issues, and experimental results given equal coverage. P, calculus.

521.* Philosophy of the Biological Sciences (3) (Identical with PHIL 521, which is home).

523.* Cytogenetics (3) Investigation into the structure and function of chromosomes and their role in heredity and evolution. 2R, 3L. P, 320. (Identical with GENE 523).

524.* Theoretical Population Genetics (3) Mathematical theory of modern population genetics developed from first principles with emphasis on evolutionary implications and the historical development of ideas. P, 320, MATH 223. (Identical with ANTH 524, INSC 524, and GENE 524).


533.* Human Genetics (3) (Identical with GENE 533, which is home).

534.* Population Interactions (4) [Rpt.] Empirical and theoretical treatment of competition, exploitation, and mutualism within and between species, with emphasis on application of modern dynamics to ecological problems. Computer lab. 3R, 3L. P, 302, two semesters of calculus.

535.* Evolution II (4) 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 (mathematical), experimental, and analytical logic necessary to understand processes of evolutionary change at molecular-biological, population, life history, species, and phylogenetic levels. The course is most appropriate for undergraduate and graduate students intending to pursue advanced study and research involving evolutionary questions in biology. P, 320, MATH 125a, P or CR 125b. (Identical with GENE 535).

538.* Biogeography (3) The role of historical events and ecological processes in determining the past and present geographic distribution of plants and animals. P, 182. (Identical with GEO 538).

539.* Animal-Human Communication (3) Survey of animal-human communication studies. Critical discussion of papers describing the rationale, design, and success of projects involving nonhuman primates, marine mammals, and a parrot, 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, 487 or equivalent, or instructor's consent. (Identical with PSYC 539).

540R.* Oceanography (2) Introduction to the physical, chemical, geological, and biological dimensions of the oceans, with emphasis on their importance as biological environments.

541.* Limnology (4) (Identical with W FSC 541, which is home).

542.* Marine Ecology (6) 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. Optional travel fee. Consult instructor before enrolling.

544.* Insect Ecology (3) (Identical with ENTO 544, which is home).

545. Concepts in Genetic Analysis (3) (Identical with MCB 545, which is home).


559.* Comparative Vertebrate Histology (4) (Identical with V SC 559, which is home).

560. Current Advances in Plant Physiology (3) (Identical with PL S 560, which is home).

566. *Physiology Laboratory (3) Emphasis on data acquisition, analysis and interpretation. Laboratory techniques and investigation of physiological mechanisms. 2R, 4L, P, either 437, 468; V SC 400a-400b; or PSIO 480. (Identical with MCB 566, PSIO 566, PCOL 566 and V SC 566).

568. *Comparative Physiology (3) The responses of physiological systems to the environment; energy exchanges, respiration, thermal and osmotic regulation, locomotion, behavioral regulation, and integration of responses. P, either 437, V SC 400a-400b, or PSIO 480. (Identical with PSIO 568 and V SC 568).

570. *Plant Diversity and Evolution (4) 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.


574. *Aquatic Plants and the Environment (4) (Identical with SWES 574, which is home).

575. *Freshwater and Marine Algae (4) Systematics, ecology, and evolution of planktonic and benthic species; field techniques and laboratory culture. 2R, 6L. Field trips. P, 4 units of biology or plant sciences. (Identical with SWES 575 and WFSC 575).

576a-576b. *Analysis of Biological Diversification (3-3) [Rpt/1] 576a: Patterns of biological diversity and the history of diversification and extinction. Phylogenetic analysis will be introduced to address issues in ecology, paleobiology, development, and genetics. One Saturday field trip. P, 181 and 182 and either an evolution or paleobiology course or consent of instructor. 576b: Explores approaches to studying biological diversification, integrating phylogenetic biology, ecology, population genetics, developmental biology and molecular biology. P, 335 or consent of instructor. (Identical with GEOS 576a-576b and MCB 576a-576b).

578. *Global Change (3) (Identical with GEOS 578, which is home).

579. *Art of Scientific Discovery (3) [Rpt.] Techniques of posing questions and solving puzzles encountered in scientific research, with emphasis on life sciences and mathematics. P, consult with department before enrolling.


583. *Herpetology (4) Systematics, ecology, and evolution of the amphibians and reptiles. 2R, 6L or field work. P, 304. (Identical with WFSC 583).


587.* Animal Behavior (3) Concepts and principles of the mechanism, development, function, and evolution of behavior, with emphasis on its adaptiveness. P, 8 units of biology.

587L.* Animal Behavior Laboratory (1) Exposure to current topics in behavior and process of behavioral research through video presentations, demonstrations of live animals and readings.


589.* Selected Studies of Birds (2) [Rpt.] Recent advances in ornithology. 1R, 3L or field trip. P, 484. (Identical with WFSC 589).


597. Workshop b. Phylogenetic Inference (2) (Identical with ENTO 597b, which is home).

610a-610b. Research in Ecology and Evolution (1-1) [Rpt.] Introduction to the research currently being pursued by faculty and staff in the department. Open to majors only. 623a-623b. Biology Update (2-2) (Identical with BIOC 623a-623b, which is home).

670. Recent Advances in Genetics (2) [Rpt/10] (Identical with GENE 670, which is home).

Economics (ECON) McClelland Hall, Room 401 Phone: (520) 621-6224 FAX: (520) 621-8450 WWW: http://www.bpa.arizona.edu

Application Questions: Pamela L. Schloss, (520) 621-2455, psslloss@bpa.arizona.edu

Avisding Questions: Price V. Fishback, (520) 621-4421, fishback@bpa.arizona.edu

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


Associate Professors: John Z. Drabicki, Donald G. Hecker, Sawun E. Kantor, James C. McBrearty, Kevin A. Wells, Barbara N. Sands, Gerald J. Swanson

Assistant Professors: Bruno Brosota, Devajyoti Ghose, William Horrace, James D. Ratliff, John C. Woooders

The department offers programs leading to the Master of Arts and Doctor of Philosophy degrees with a major in economics. The department also offers supporting work for the Master of Public Administration degree, the Master of Business Administration degree and Doctor of Philosophy degree with a major in management. For information concerning these degrees see chapter IV, Requirements for Master's Degrees/Master of Public Administration and Master of Business Administration, as well as the Business Administration headnotes elsewhere in this chapter.
Applicants must have completed an undergraduate major or minor in economics and must submit scores on the aptitude test of the Graduate Record Examination.

Master of Arts: The Department offers two program options for the Masters of Arts degree: the Applied Economic option and the Economic Theory option. The M.A. Program in Applied Economics trains students in the methods of applied economics commonly used in the government and private industry. The objective is to prepare students for positions of responsibility in the public and private sectors through broad training in economics and quantitative methods and focused attention to a chosen area of specialization. The M.A. Program in Economic Theory emphasizes training in economic theory and quantitative methods. It is intended for those graduate students who desire a less applied focus in master's level training and also, in large measure, serves to provide a means through which Ph.D. students may receive an M.A. degree upon completion of a substantial portion of their work toward the Ph.D. degree. All students must complete the core program consisting of 501a, 502a, 508, 519, 520 and 522a, a 9-unit field of specialization, and a thesis. (A minimum of 30 total units is required.) The field of specialization may be in economics or a related area and must be approved by an advisor. The student will be given a comprehensive examination over the core program and field.

Doctor of Philosophy: The Ph.D. in Economics prepares students for faculty positions in colleges and universities and senior level research positions in government and private industry. All Ph.D. students must complete a set of core courses in economic theory and quantitative methods. Beyond the core, each student selects seminar courses and participates in workshops in two areas of specialization. Given the nature of the Ph.D. degree, it is an overreaching program objective that graduates will influence the progression of knowledge in their respective fields. Accordingly, in addition to rigorous up-to-date training, the program places strong emphasis on providing students with ample opportunity to become familiar with and participate in all stages of research. A minimum of 18 dissertation credits comprise the curriculum. The course work consists of 501a-501b-501c, 502a-502b, 506, 508, 519, 520, 522a-522b, 597c and 18 units of 696-697 economics seminar and workshop courses. The successful completion of all coursework and written and oral comprehensive examinations, and written presentation and final oral defense of the dissertation, are required for the doctoral degree. There is no foreign language requirement. Students may expect to complete the degree in four years; those who have completed previous graduate work at other institutions may in some cases transfer up to 12 credit hours of coursework.

500. Managerial Economics (3) I Microeconomic theory and applications. P, MIS 400 or MATH 119 or 123. Advanced degree credit available for nonmajors only. Open only to students admitted to a BPA graduate program.


504. Production Economics (3) I (Identical with AREC 504)


506. * Introduction to Experimental Economics (3) II Lab. experimental studies of economic behavior; applications to monopoly, bilateral bargaining, and competitive markets under various exchange rules; speculation, voting processes, public goods. 2R, 3L. P, 300 or 361.

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, 361, MATH 125b.

508. Applied Economic Analysis (3) II Uses economic history to show how research methods in economics are used to analyze data collected through empirical observation. P, 501a, 520.


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, 300 or 361, MATH 125b.

512. Economic Policy in Developing Countries (3) II (Identical with AREC 512)

513. Consumption Economics and Price Analysis (3) II (Identical with AREC 513)

514. Cost-Benefit Analysis (3) II (Identical with AREC 514)

515. Operations Research in Applied Economics (3) II (Identical with AREC 515)

516. Agricultural Development (3) [Rpt./1] I (Identical with AREC 516)

518. * Introduction to Econometrics (3) 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, 339 or 376.

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, CR, 520; consult with 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, CR, 519; consult with 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, 6 upper-division units in economics; MATH 125b.


524. * International Historical Development (3) I The process of international economic development with special emphasis on the historical economic development of Europe, China, or Japan. P, 300 or 361.

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, 300 or 361.

526. Health Economics (3) I (Identical with PA 526)

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, 500.


536. Innovation and Economic Growth (3) I (Identical with MKTG 536)
537. International Public Finance (3) II

542. International Macroeconomics (3) I S
Analysis of exchange rates, balance of payments, and macroeconomic/financial interdependencies among nations. P. 330 or 332.

543. International Trade Theory (3) II S
General equilibrium analysis of product and input markets of international trade, tariffs, commercial policy, and growth and the welfare aspects of each. P. 300 or 361.

549. Applied Econometric Analysis (3) II
Econometric model-building, estimation, forecasting, and simulation for problems in agricultural and resource economics. Applications with actual data and models emphasized. P. 518 (Identical with AREC 549).

553. Business and Economic Forecasting (3) II
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. P. 300 or 361; 418.

560. Industrial Organization (3) II S
Structure, conduct, and performance of American industry; governmental institutions and policies affecting business. P. 300 or 361; 339 or 376.

561. Economics of Regulated Industries (3) I II
Economic analysis of the regulated sector of the American economy, including communications, transportation and energy industries; impact of existing and alternative public policies. P. 300 or 361.

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. 500.

568. Environmental Scanning and Business Strategy (3) II (Identical with MKTG 568)

575. Economics of Natural Resource Policy (3) II (Identical with AREC 575)

576. Advanced Natural Resource Economics (3) I (Identical with AREC 576)

577. Advanced Topics in the Economics of Environmental Regulation (3) II (Identical with AREC 577)

580. Mathematics for Economists (2) I (Identical with AREC 580)

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. P. 300 or 361.

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. P. 300 or 361.

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. P. 300 or 361.

589. Public Choice (3) II
The study of voting theory, government expenditures, government structures, behavior of voters and bureaucracy. P. 361 or consent of instructor. (Identical with POL 589).

597. Workshop
a. Practical Applications of Economic Theory (3) I, 501a, 502a, 521, 549.
b. Computational Methods in Laboratory Economics (1-3) [Rpt./3 units] II P, MATH 125a-125b; consult department before enrolling.
c. Economic Issues for Teachers (3) S
Consult instructor before enrolling.
d. Summer Institute on the American Economy (3) S
Consult instructor before enrolling.
e. Economics Education Workshop (2) S
Consult instructor before enrolling.
f. Economic Development for Educators (2) S
Open to nonmajors only. Consult with department before enrolling.

676. Environmental Dynamics and Natural Resource Use (3) I 1995-96 P, graduate student standing with one year of graduate microeconomic theory. (Identical with AREC 676)

696. Seminar
a. Experimental Economics I (3) [Rpt./3] II
b. Experimental Economics II (3) [Rpt./3] I
c. Applied Economic Analysis I (3) [Rpt./3] II
d. Applied Economic Analysis II (3) [Rpt./3] I
e. Econometric Modeling I (3) [Rpt./3] II
f. Econometric Modeling II (3) [Rpt./3] I
g. Monetary Economics I (3) [Rpt./3] I
h. Labor Economics I (3) [Rpt./3] II
i. Labor Economics II (3) [Rpt./3] I
j. Public Policy Analysis I (3) [Rpt./3] II
k. Public Policy Analysis II (3) [Rpt./3] I
l. International Economics I (3) [Rpt./3] II
m. International Economics II (3) [Rpt./3] I
n. Advanced Macroeconomic Theory I (3) [Rpt./3] II
o. Advanced Macroeconomic Theory II (3) [Rpt./3] I
p. Industrial Organization and Regulation I (3) [Rpt./3] II
q. Industrial Organization and Regulation II (3) [Rpt./3] I
r. Advanced Microeconomic Theory I (3) [Rpt./3] II
s. Advanced Microeconomic Theory II (3) [Rpt./3] I
t. Mathematical Economics I (3) II
u. Game Theory (3) I II
v. Public Choice I (3) II (Identical with POL 696v)
w. Public Choice II (3) I (Identical with POL 696v)
x. Economic History I (3) [Rpt./3] II
y. Economic History II (3) [Rpt./3] I

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 Administration and Higher Education
educational administration/ leadership .................................. Ed.S./Ed.D
higher education .............................................. M.A./Ph.D.

Department of Educational Psychology
educational psychology .... M.A./Ed.S./Ed.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
elementary education .......... M.Ed.
secondary education .......... M.T.
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, 500 and PSYC 230 or SOC 274 or equivalent.

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, 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, 600, 601.

604. Leadership for Educational Change (3) Investigations of the characteristics of leadership as they apply to changing 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, 500.

606. Policy Analysis in Education (3) Understanding of and necessary skills to provide leadership in the area of educational policy development and analysis.

611. Comparative Education (3) Emphasis on comparative education methodology; analysis of selected national education systems, with focus on sociocultural foundations; curriculum and instruction; administration; teacher education; contemporary trends and issues; implications for education in the United States; economics and principles; sources and distribution of funds for education in the United States; mandates federal and state funded educational programs, and effective community participation.


613. History of Western Education (3) The historical development of western educational thought from its origins to the present.

614. History of Education in the United States (3) The development of American educational thought from its colonial origin to the present.

615. Educational Sociology (3) The school as a social institution; social functions of the school; social processes, socialization, and stratification in education; informal and formal systems and the bureaucratic structure of the school.

See: Educational Administration and Higher Education Educational Psychology Language, Reading and Culture Special Education and Rehabilitation Teaching and Teacher Education

Educational Administration and Higher Education (ED A/ED)

Education Building 321
Phone: (520) 621-7951
FAX: (520) 621-1875

Application Questions:
Educational Administration/Leadership: Charles Prickett, (520) 626-9048, cprickett@email.arizona.edu
Higher Education: Marcie DeWeese, (520) 621-7951

Advising Questions:
Educational Administration/Leadership: Charles Prickett, (520) 626-9048, cprickett@email.arizona.edu
Higher Education: Gary Rhoades, (520) 621-7951

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

Professors: Gary Rhoades, Head, Larry L. Leslie, Program Head (Higher Education), Donald C. Clark, Program Head (Educational Administration), Waldo K. Anderson (Emeritus), Robert G. Grant (Emeritus), Fred Harcleroad (Emeritus), Lawrence O. Nelson (Emeritus), F. Robert Paulsen (Emeritus), Macario Saldate, IV, T. Frank Saunders (Emeritus), Sheila Slaughter, Marsden B. Stokes (Emeritus), Dudley B. Woodard, Jr.

Associate Professors: J. Robert Hendricks, John S. Levin

Assistant Professor: Stephanie Parker

Educational Administration/Leadership (ED A)

The Educational Administration/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 persons for leadership positions in schools and meets the administrative certification requirements of the State of Arizona. The Executive Doctorate offers an opportunity for persons 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 Executive Doctorate programs. Standardized test scores are also required (e.g., Graduate Record Examination or the Miller Analogies Test). Beyond these minimal requirements, applicants must also 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 Administration/Leadership Program is organized around the concept of cohort groups. As a result, new students are accepted only once a year and they must begin their study in the fall semester.

597. Workshop
a. *Trends in Educational Leadership (3) [Rpt./12 units].

b. School Evaluation/Accreditation: Problems and Procedures (3)

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. Administrative of Bilingual Education Programs (3) Dynamics of the administration of educational programs for the bilingual learner including sociopolitical realities, mandated federal and state funded educational programs, and effective community participation.


663. Computer Applications in School Administration (3) Techniques for using computers to make school administration more efficient; using computers to enhance the management of information. P, 660 or CR.


668. Curriculum and Instructional Leadership (5) 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, 660 or CR.

671. School Finance (3) 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, 660, 661 or CR.
672. School Business Management (3) The general management of school business; administration and accounting of school funds; administration of equipment and supplies; other business operations. P, 660 or CR.

675. Leadership and Organizational Theory and Behavior (3) Perspectives on the nature of the individual in the school organization; nature of schools as organizations; development of individual-organizational relationships. P, 660.

681. The Principalship (3) Functions and activities of building-level administrators, with emphasis on instruction, staff development, student services evaluation, and operational services. P, 693a and 15 units of educational administration, CR, 693b.

682. The Superintendency (3) Functions and responsibilities of the chief school executive and central office staff, with emphasis on external and internal system relationships in policy formation and decision making. P, 693a, 693b or CR.

693. Internship a. Educational Leadership (2-3) [Rpt./4 units] P, 660, 661, 662 or CR. b. Advanced Educational Leadership (3-4) [Rpt./8 units] P, 693a and 15 units of educational administration. CR, 681 or 682.


Higher Education (H ED) Education Building, Room 321 (520) 621-7951

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 concentration 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, or those practitioners pursuing advanced degree to better understand, analyze, and act within higher education organizations and systems. The Center also offers services as staff development, planning, and financial management 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, retrenchment, and supply and demand of scientists and engineers. Potential careers for the graduate include work at two and four year institutions, faculty positions, research, and state and federal policy research positions.

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, Millers 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) The scope, objectives, and educational functions of the community college, patterns of community college programs.

601. Higher Education in the United States (3) 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) 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) 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) Student personnel services, philosophy, history, administrative procedures, representative programs, current trends.

622. Teaching in Higher Education (3) Planning, organizing, presenting, and evaluating learning experiences for mature students.

641. Institutional Research and Planning (3) Development of institutional research programs for short-term/long-term planning; input/output measures.

650. Higher Education Finance (3) 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) Budget planning and execution; systems of resource allocation; personnel management; physical plant planning and construction; information systems and use in management.

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, and educational technologies. Professors: Darrell Sabers, Head, Robert E. Calmes, Emeritus, Sarah M. Dinham, Thomas L. Good, Kenneth J. Smith Associate Professors: Mary McCaslin, Janice Streitmatter Assistant Professor: M. Virginia Gonzalez The Department of Educational Psychology offers programs leading to the M.A., Ed.S., and Ph.D. degrees. Concentrations on the doctoral level include: teaching, learning, and development—early childhood through adulthood; measurement and methodology. Currently students are not being admitted to the Ed.S. program.

500. Life Span Development (3) Overview of major findings of theories of development from infancy throughout late adulthood. Special emphasis on cognitive, linguistic, and sociocultural development with concentration on applications to instruction and assessment. (Identical with FS 500).

501. Advanced Child Development (3) Aspects of growth and development which influence behavior of the school-age child; emphasis on current research findings. P, 301.

502. Motivation and Development in Classroom Learning (3) 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 or 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) Essentials of computer operations; presentations software; software evaluations; telecommunications; computer-based diagnosis; application to instruction.


517. Classroom Application of Behavior Modification Techniques (3) Application of behavior principles and techniques to promote learning and social development of school-related behavior. P, 510 or CR.

523. * Socio-Cultural Context of Human Development (3) (Identical with FS 523, which is home).

541. Statistical Methods in Education (3) Descriptive, correlation, and inferential procedures for presenting and analyzing school and research data. For students in all fields. 3R, 1L.

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, 541 or equivalent.

557. Design of Questionnaires and Scales (3) Emphasis on theoretical and methodological issues related to the development of survey and rating scales, sampling procedures, and response bias.

558. Educational Tests and Measurements (3) Theoretical and practical application of psychometric techniques to test construction, analysis, and interpretation of test results. P, 541.

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.

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, 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 P, 511, EDUC 500, or LRC 530.

615a-615b. Developmental Issues in Schooling (3-3) Policy, theory, research for understanding and assessing student's development and socialization in instructional settings. 615a: Affecting development. Theory and research needed for exploring how students develop and learn the informal curriculum in educational settings. 615b: Foundations, policy, theoretical, methodological, and education applied issues related to contemporary measures for young children across different developmental areas; practice in applying assessment models is provided.


646. Multidimensional Methods in Educational Research (3) Provides an understanding of and facility with research application of multivariate correlational techniques, such as multiple regression, discriminant function, canonical correlation, and factor analysis. P, 640.


673. Theories of Intellectual Assessment (3) Various theories and models of human ability and their implications for intellectual assessment. P, 558 or CR.

679. Psychoeducational Assessment in the Schools (3) Psychoeducational assessment techniques; practice in prescribing remedial programs.

682. Evaluation of Educational Technologies (3) Evaluation for use in educational settings of instructional, measurement, and tool software; hardware; local and wide area network systems. P, 511 or consent of instructor.

693. Internship a. Research/Evaluation (1-3) [Rpt./12 units] b. College Teaching (1-3) [Rpt./12 units]

695. Colloquium b. Issues in Educational Psychology (1-3) [Rpt./12 units]

696. Seminar b. Issues in Educational Psychology (1-5) [Rpt./12 units]

**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.

Professors: Glen C. Gerhard, Acting Head, John R. Brews, Robert N. Carlile (Emeritus), Thomas C. Cetas (Radiation Oncology), William J. Dallas (Radiology), Eustace Dereniak (Optical Sciences), Donald G. Dudley (Emeritus), Walter H. Evans (Emeritus), Walter J. Fahey (Emeritus), Jack D. Gaskell (Optical Sciences), Douglas J. Hamilton (Emeritus), Charles R. Hausenbauer (Emeritus), Robert A. Hessemer, Jr. (Emeritus), Fredrick J. Hill, Stuart A. Hoenig (Emeritus), Lawrence P. Huelsmans (Emeritus), Bobby R. Hunt, Roger C. Jones (Emeritus), William J. Kerwin (Emeritus), Granino A. Korn (Emeritus), H. Angus Macleod (Optical Sciences), Roy H. Mattson (Emeritus), Piru B. Mirchandani (Systems and Industrial Engineering), Kenneth C. Mylrea, Olgiierd A. Palusinski, John L. Prince, John A. Reagan, Harry E. Stewart (Emeritus), Malur K. Sundaresnan, Miklos Szilagyi, James R. Wait (Emeritus), John V. Wait, James C. Wyant (Optical Sciences), Bernard Zeigler

The student 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 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 300 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) 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) Probability, random variables, stochastic processes, correlation functions, and spectra with applications to communications, control, and computers. P, SIE 305.

515. * Instrumentation and Measurement (3) Basic concepts of instrumentation and measurement; principles of transducers, operational amplifiers, and instrument systems, with emphasis on biomedical applications; laboratory, experiments with transducers, amplifiers, computers, and medical equipment. 2R, 3L. 1 ES, 2 ED.

522. Analog Signal Processing and Filtering (3) Approximation of magnitude, phase, and delay characteristics; design of passive, active, and switched capacitor filters; effects of op amp parasitics; sensitivity and gain bandwidth; optimization of designs. 0.5 ES, 2.5 ED. P, 320.

525. * Image Science and Engineering (3) Properties of optical images and image forming systems; acquisition and manipulation of digital images; two-dimensional Fourier representation; image quality criteria; introduction to image processing. 2 ES, 1 ED. P, 340.

527. Holography (3) (Identical with OPTI 527, which is home).


529. * Digital Signal Processing (3) Discrete-time signals and systems, z-transforms, discrete Fourier transform, fast Fourier transform, digital filter design. 1.5 ES, 1.5 ED. P, 340, MATH 322.

530. * Optical Communication Systems (3) Physics of optical communication components and applications to communication systems. Topics include fiber attenuation and dispersion, laser modulation, photo detection and noise, receiver design, bit error rate calculations, and coherent communications. 1 ES, 2 ED. P, SIE 305, ECE 340, 352, 381, CR, 431.

531. Image Processing Laboratory for Remote Sensing (3) 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. 3R, 1L. (Identical with OPTI 531). Not applicable to the ECE major. OPTI 531 may be applied by ECE majors to an optical sciences or remote sensing minor.

532. Computer Vision (3) Digital image analysis, including feature extraction, boundary detection, segmentation, region analysis, mathematical morphology, stereoscopy and optical flow. P, 340. (Identical with OPTI 532).


534. Advanced Topics in Electronic Materials (3) [Rpt./2] (Identical with MSE 534).

537. Digital Transmission and Telephony (3) Spectrum control, synchronization, and multiplexing in digital transmission systems. Topics include line coding, scrambling, spread spectrum, time-division multiplexing, frequency division multiplexing, timing recovery, frame synchronization, jitter, and echo cancellation. P, 431 and SIE 305.


539. Algebraic Coding Theory (3) 1993-94 (Identical with MATH 539, which is home).

541. Synthesis of Control Systems (3) 
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, CR 501.

542. Digital Control Systems (3) 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. 1.5 ES, 1.5 ED. P, 441.


545. Decentralized Control and Large-Scale Systems (3) 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, 501.

547. Direct Energy Conversion (3) (Identical with ME 547, which is home).


552. Solid-State Devices (3) Basic semiconductor physics and materials, PN junctions, metal-semiconductor junctions/contacts, BJTs and MOSFETs, device operation, terminal behavior and frequency response, device models. P, 352, 451.

553. Design-Oriented Analysis of Electronic Circuits (3) 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. 1.5 ES, 1.5 ED. P, 351a-351b, 352.

554. Electronic Packaging Principles (3) Introduction to problems encountered at all levels of packaging: thermal, mechanical, electrical, reliability, materials and system integration. Future trends in packaging. (Identical with MSE 554).

556. Optoelectronics (3) Properties and applications of optoelectronic devices and systems. Topics include radiation sources, detectors and detector circuits, fiber optics, and electro-optical components. 1.5 ES, 1.5 ED. P, 352, 381.

557. Integrated Circuit Laboratory (3) Experiments in diffusion, oxidation, processing, etc. Fabrication of an integrated circuit. P, 458 or equivalent (Identical with MSE 557).

558. Vacuum System Engineering (3) 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, 557 or consult department before enrolling.

559. Fundamentals of Optics for Electrical Engineers (3) 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 nets, associative memory optical interconnects. 1.5 ES, 1.5 ED. P, 381, 352.

560. Aerosol Science and Engineering (3) (Identical with CHEE 560, which is home).


563. Engineering Applications of Graphic Theory (3) 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.


568. Modern Computer Architecture (3) Overview of uniprocessor architectures, introduction to parallel processing, pipelining, vector processing, multi-processing, multicomputing, memory design for parallel computers, cache design, communication networks for parallel processing, algorithms for parallel processing. P, 369.


571a. Digital Systems Design (3) Computer organization and architecture; control unit design, microprogramming, input-output. (Identical with CS 571a).


573. Software Engineering Concepts (3) 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. 2R, 3L. 1 ES, 2 ED. P, 275.

574a-574b. Computer-Aided Logic Design (3-3) Tabular minimization of single and multiple output Boolean functions, NMOS and CMOS realizations, synthesis of sequential circuits, RTL description, laboratory exercises. 1.5 ES, 1.5 ED. P, 274. 574b: Standard cell layout, gate and switch level simulation, level mode sequential circuits. VLSI testing, CAD tools, laboratory projects. 1 ES, 2 ED. (Identical with CS 574a-574b).


576. Engineering of Computer-Based Systems (3) 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, 471, 479, or consent of instructor.
636. Information Theory (3) 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, 503. (Identical with MATH 636).


650. Advanced Analog Circuits (3) 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-modem power supply regulators. P, 550.

652. Advanced Solid-State Devices (3) Analysis and design of devices including BJTs, MOSFETs, MESFETs, MODFETs, microwave devices, and photonic devices. P, 552.


659. Advanced Topics in Microelectronics and Solid-State Devices (3) 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) Introduction to VLSI design, combinational and sequential logic synthesis, layout generation and optimization, logic and timing simulation, design styles. P, 474/574.


678. Integrated Telecommunication Networks (3) Analysis and design of integrated voice, data, and image networks for integrated telecommunications applications. Protocols for LANs, ISDNs, WANS, MANs and interoperable networks. ISO-based network software design for applications. P, 566, 673.


696. Seminar (1) Advanced Topics in Electrical Engineering (3) [Rpt. /Units] P, consult instructor before enrolling.
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 Committee on Biomedical Engineering.

**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: Problem Solving and Proposal Preparation (3) (Identical with MSE 501, which is home).

502. Research Proposal Preparation (3) (Identical with MSE 502, which is home).

**554.** *Law for Engineers/Scientists (3) (Identical with CHEE 554, which is home).*

**696. Seminar**

a. Science and Social Theory (3) (Identical with SOC 696a, which is home).

**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:**

g Graduate Secretary, 621-1358,
english@ccit.arizona.edu

**Advising Questions:**

Meg Lota Brown, Director of Graduate Studies, (520) 621-3266

**Degrees Offered:** M.A., M.F.A., Ph.D.


**Assistant Professors:** Laura Berry, Daniel Cooper Alarcón, Jeremy Green, Suzanne Hagedorn, Naomi Miller, Alison Moore, Roxanne Mountford

The department offers programs leading to the Master of Arts degree with a major in English (with a concentration in Literature or 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 the 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 Aptitude test, 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 arrange to have the department receive three letters of recommendation. These materials should be addressed to the Director of Graduate Study of the Department of English. Thirty units are required for the M.A. degree; 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 admission 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 units (11 courses) of the 45 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 Nonfiction Writing (3) [Rpt./24 units] F, 301 or 306, and consult department before enrolling.*
502. Professionalizing Presentation Skills (1) (Identical with BI0C 502, which is home).

505. * History of the English Language (3) The evolution of English sounds, inflections, and vocabulary from earliest times to the present, with attention to historical conditions. (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. P, 405.


513. * Poetry in Forms (3) Explores prosody through discussing and writing of forms and types, research paper. P, 309.

514. * Advanced Scientific Writing (3) Preparation of professional literature for publication.

515. History of Criticism and Theory (3) [Rpt./1] A systematic introduction to the history of criticism and/or modern and contemporary critical theory.

516. Theories of Linguistic Structure (3) In-depth examination of at least two recent theoretical models of linguistic structure, including Chomsky's, with attention to English and cross-linguistic differences. P, 506 or an introductory linguistics course.

518a-518b. Psychoanalytic Literary Theory (3-3) 518a: Introduction to Psychoanalytic Theory. 518b: Psychoanalysis and Literature. P, consult department before enrolling. 518a is not prerequisite to 518b.

520. History of the German Language (3) (Identical with GER 520, which is home).

521. * American English (3) 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, 405 or introduction to linguistics.


526. * Medieval English Literature (3) Survey of Old and Medieval English literature (exclusive of Chaucer), with some use of modernized or glossed versions.

527. * Chaucer (3) The Canterbury Tales and other poems, read in Middle English.

529. * Chinese-American Literature 1960-Present (3) (Identical with CHN 529, which is home).

531. Advanced Studies in Shakespeare (3).

533. Studies in the Renaissance (3) [Rpt./1].

534. Advanced Studies in Milton (3).

541. Studies in the Restoration and Eighteenth Century (3) [Rpt./1].

543. * Mexican-American Literature in English (3) Study of the literature, in English or English translation, by Mexican-American authors, or important to the development of Mexican-American literature. P, upper-division standing.

545. * Introduction to TESL: An 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.

548. * The Theory and Practice of Writing (3) (Identical with FREN 548, which is home). 549a-549b. Folklore (3-3) 549a: Forms of verbal folklore; 549b: non-verbal folklore and material culture (Identical with AIS 549a-549b, ANTH 549a-449b and CCLS 549a-549b).

550. Modern Theories of Cultural Studies (3) (Identical with CCLS 550, which is home).

554. Contemporary Feminist Theories (3) (Identical with W S 554, which is home).


565. Studies in American Literature to 1900 (3) [Rpt./3] Reading course in American literatures before 1900.


577. Studies in American Indian Literature (3) In-depth study of works by and/or about American Indian writers. (Identical with AIS 577).

585. Linguistics and Computer-Assisted Approaches to Literature (3) [Rpt./6 units] (Identical with GER 585, which is home).

587. Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587, which is home).

595. Colloquium
a. Professional Studies (1-6) [Rpt./A]
   Designed for teaching assistants in English. May also be used, at discretion of graduate program directors in English, for other professional training.

596. Seminar
a. British Literature (3) [Rpt./B]
b. Studies in Colonial and Post-colonial Literature and Theory (3) [Rpt./3]
c. American Literature (3) [Rpt./B]
d. Comparative Literature (3) [Rpt./A] (Identical with CCLS 596g)
h. Modern Literature (3) [Rpt./24 units] Open to creative writing majors only.
k. Methods and Materials of Literary Research (3) [Rpt./4]
l. Theories of Criticism (3) [Rpt./4]
m. Studies in the Oral Tradition (3) [Rpt./9 units] (Identical with AIS 596m).

597. Workshop
a. Southern Arizona Writing Project (3-6) [Rpt./12 units] (Identical with LRC 597a).
b. The Teaching of English (3) [Rpt./3] (Identical with LRC 597o).
c. Contrastive Rhetoric (3) [Rpt./2] P, graduate standing.
d. Women's Studies (3) [Rpt./2] (Identical with W S 599w).

604. Writing Project in Fiction (1-6) [Rpt./24 units] For M.F.A. candidates working toward book-length writing project in fiction.

609. Writing Project in Poetry (1-6) [Rpt./24 units] For M.F.A. candidates working toward book-length writing project in poetry.


613. Methods of Teaching English to Speakers of Other Languages (3) Foundations, theory, and methodology in English as a second language. (Identical with LRC 613).


615. Second Language Acquisition Theory (3) Survey of major perspectives on second language acquisition processes, including interlanguage theory, the Monitor Model, acculturation/gidization theory, cognitive/connectionist theory, and linguistic universals. Analysis of research from the different
for field studies include University Agricultural Centers in Maricopa and Yuma counties and a farm with an entomology lab 3 miles from campus. Natural habitats can be studied on University land in the Sonoran Desert and in the rangelands 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. The undergraduate program 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 ETO 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 ETO 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 ETO 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) (Identical with AGTM 502, which is home).

503R. * Biology of Animal Parasites (3) (Identical with V SC 503R, which is home).

503L. * Parasitology Laboratory (1) (Identical with V SC 503L, which is home).

504. * Physiological Systems (3) (Identical with ECOL 504, which is home).


508. * Insect Toxicology (3) Introduction to the interactions of insect 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 58).

511. * Insect Behavior (3) The evolution of arthropod behavior in ecological context. (Identical with ECOL 511).

512. Biological Electron Microscopy (4) (Identical with MCB 512, which is home).


515R. * Insect Biology (3) Insects and other land arthropods, their functional anatomy, perception of the environment, relationships to other animals and plants. Insect classification and taxonomy to order and major families. P, ECOL 182. (Identical with ECOL 515R).


518. Laboratory Methods in Insect Physiology (3) (Identical with INSC 518, which is home).

527. * Insect Chemical Ecology (4) 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, 507 or equivalent, and 3 units of organic or biochemistry. (Identical with V SC 527).

533. * Teaching Biology Labs (2) (Identical with BIOL 533, which is home).

544. * Insect Ecology (3) 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. Field trips and project. (Identical with ECOL 544).

552. * Medical-Veterinary Entomology (4) (Rpt./3) Survey of arthropods of public health and veterinary importance with emphasis on transmission dynamics and pathogens, biomicroscopy.
of vector populations, and current control
care. 3R, 3L. P, parasitology recom-
Methods of collection/pollination/social
insects and forensic entomology, insects in
agriculture, using insects to learn biological
principles. Field trips. P, previous biology course (by approval).

576. Environmental Toxicology (3) (Identical with PCol 576, which is home).

596. Seminar
a. *Entomology (1) [Rpt./6]
b. *Medical-Veterinary Entomology (1-3) P, 452.
c. *Topics in Insect Diversity (2) [Rpt./5]
d. *Plant-Insect Interactions (1) [Rpt./5] (Identical with PL S 596d).
e. *Insect Physiology, Biochemistry, Toxicology (1) [Rpt./5].
f. *Topics in Pest Management (1) [Rpt./5].
g. *Ecology, Epidemiology, and Control of Vector-borne Diseases (1-3) [Rpt./5].

597. Workshop
b. Phylogenetic Inference (2) 2D. P, 465/565, equivalent, or consent of instructor.
(Identical with GEOS 597b and ECOL 597b).

600. Infectious Disease Epidemiology (3) [Rpt./1] (Identical with EPI 660, which is home).

696. Seminar
a. Entomology (1) [Rpt./6]

Epidemiology (EPI)
Arizona Prevention Center, Room 4441
Phone: (520) 626-6379
FAX: (520) 626-6093
WWW. http://www.grad admin.
arizona.edu/IDPs/EPI/EPI.html

Graduate Interdisciplinary Program in Epidemiology

Application Questions: epiadmit@resp-sci.arizona.edu
or
College of Medicine/
Arizona Prevention Center
Epidemiology Interdisciplinary Program
P.O. Box 245163
Tucson, Arizona 85726

Advising Questions:
Michael Lebowitz, (520) 626-6379
lebowitz@resp-sci.arizona.edu

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

Concentrations: Infectious disease, cancer, respiratory, cardiovascular, and environmental epidemiology.

Professors: Michael D. Lebowitz, Chair (Internal Medicine), Carlos C. "Kent" Campbell (Arizona Prevention Center), Charles Gerba (Soil, Water and Environmental Science), C. John Mare (Veterinary Science, Microbiology and Immunology), James Marshall (Arizona Prevention Center), E. Petersen (Medicine), 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: Robin B. Harris (Arizona Prevention Center)

Research Associate Professor: D.J. Roe (Family and Community Medicine)

Research Assistant Professors: Milcent Fleming-Moran (Arizona Prevention Center), Anna R. Guliano (Arizona Prevention Center), M. Elena Martinez (Arizona Prevention Center), Mary Kay O'Rourke (Arizona Prevention Center), Mark A. Veazie (Arizona Prevention Center)

Lecturer: Theodore M. Dembroski (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 and state and national health institutions provide classroom and community training opportunities. To accomplish this goal, faculty program members with overlapping expertise from several health science departments 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).

515. Subspecialty
h. Cancer Epidemiology and Prevention (3) P, none; statistics helpful. (Identical with RONC 515h).
i. Cancer Prevention and Control (3-15) (Identical with RONC 515i).

596. Seminar
a. Basic Principles of Epidemiology (3) [Rpt./1] (Identical with PHL 596a).
b. Epidemiologic Methods (3)
c. Psychosocial Epidemiology (3)

610. Biostatistics for Research (3) 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, MATH 509

650. Quantitative Epidemiology (3) study of computer intensive multivariate epidemiologic methods including evaluation of potential etiologic environmental exposures in human populations to the rise of disease. 2R, 1L. P, 596a, 596b.

660. Infectious Disease Epidemiology (3) [Rpt./1] Introduction to epidemiologic methods used in infectious disease investigations. An emphasis will be placed on understanding the relationships between the host, the parasite, and the environment as they relate to disease causation. P, 596a, 596b. (Identical with ENTO 660, PHL 660, and VSC 660).

670. Chronic Disease Epidemiology (3-4) Nutritional epidemiology, pharmacoepidemiology, occupational epidemiology, and environmental epidemiology. P, 596a, 596b.

680. Respiratory and Environmental Epidemiology (3) Epidemiological methods and research in respiratory diseases and environmentally related diseases, with emphasis on adult and childhood chronic lung diseases, effects of air pollution and occupational exposures. P 596a, 596b, PHL 576.

696. Seminar
1. Epidemiology (3) [Rpt./8 units]

896. Seminar
a. Basic Principles of Epidemiology (3) [Rpt./1]
b. Epidemiologic Methods (3)
c. Psychosocial Epidemiology (3)
Applicants are required to submit scores in retailing or consumer studies. All retailing and consumer studies emphasize management; or a concentration in family economics/consumer resource relationships, human development, or studies emphasizing interpersonal resources and a concentration in family consumer studies; and Doctor of Philosophy sciences education, retailing and consumer studies, family and consumer resources with concentrations in sciences with a major in family and consumer studies. Retaining and Consumer Studies: Barbara Golden, (520) 621-3346, bgolden@ag.arizona.edu

Advising Questions:
Family Studies: Bonnie Barber, (520) 621-7127, bbbarber@ag.arizona.edu

Retailing and Consumer Studies: Kenneth Gehrt, (520) 621-1295, gehrt@ag.arizona.edu

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

Professors: Rodney M. Cate, Director, Victor A. Christopherson (Emeritus), Oscar C. Christensen (Emeritus), Roger J. Daldrup (Emeritus), Kathryn L. Hatch, Jean Ruley Kears (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, Soyeen Shim

Associate Professors: Bonnie Barber, Wendy Gamble, Kenneth C. Gehrt, Ellen Goldsberry, Donna R. Iams, Maureen E. Kelly, Roger M. Kramer, Philip J. Lauver (Emeritus), Mary H. Martin (Emerita), Betty J. Newlon (Emerita), Angela Taylor, Mari S. Wilhelm

Assistant Professors: David Almeida, Donna H. Christensen, Mary Ann Eastlick, Sherry Liotz, Jennifer Maggs, Susan B. Silverberg

Extension Specialists: Sherry L. Betts, Shirley Jo Taylor, Frank R. Williams

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)
R. Cate, Division Chair

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.

500. Life Span Development (3) (Identical with ED P 500, which is home).

503. Advanced Adolescent Development (3) (Identical with ED P 503, which is home).

507a-507b. Research Methods in Family Studies (3-3) 507a: Design issues of general relevance to behavioral research. 507b: Design issues of particular relevance to family and developmental research. Both 507a and 507b are offered in the fall semester only.

509. Occupational Family and Consumer Sciences Programs (3) Purposes and methods of teaching family and consumer science-related occupations, with emphasis on cooperative vocational education. P, CR, 338g.

515. The Design of the Mind: Genes, Adaptation, and Behavior (3) (Identical with PSYC 515, which is home).

528. Professional Presentations and Techniques (3) Theory and practice of educational techniques in non-formal settings in positions in business, government, and human services. 2R, 3L.

537. Analysis of Family Studies (3) An analysis of major research topics; critical resources relevant to graduate training; and ethical/professional issues related to the conduct of research.

539. Non-Formal Education (3) (Identical with A ED 539, which is home).

546. Foundations of Family and Interpersonal Theory (3) 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 the theories. P, 6 units in family studies, psychology or sociology.

547. * Problems in Human Development and Family Relations (3) In-depth examination of various dimensions of human growth and development. P, 223; 6 units of PSYC.

550. Counseling and Human Sexuality (3) Sexual function, dysfunction, and disorders in context of individual and couple; interview techniques and intervention strategies. P, 6 units of counseling or related area.

553. Addictions Counseling (3) An analysis of issues in addictions counseling ranging from various theoretical positions, information regarding diagnosis of addictive personality, treatment programs, and research. P, 6 units of counseling or related area.

557. Methods in Marital Therapy (3) Theories and principles of counseling for premarital, marital, and group counseling situations.

566. * Family Economics (3) Analysis of the family as an economic-decision-making unit within the larger economic system. P, ECON 201b.

567. Theories of Human Development (3) Analysis of major paradigms and world views influencing the study of human development. Overview of key issues and controversies arising in the field as well as evaluations of specific theories and specific theorists.

570. Counseling the Adult (3) Adult crisis, midlife changes, and developmental patterns; counseling techniques and intervention strategies. P, 6 units of counseling or related area.

571. Counseling Women (3) Examination of the counseling needs of contemporary women and current types of intervention designed to meet these needs. P, 6 units of counseling or related area. (Identical with WS 571).

573. Application of Family and Interpersonal Theory (3) 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 family studies, psychology, or sociology.

577. * Genetic Basis of Normal and Deviant Traits (3) Explores methods of studying genetic influences on human traits and summarizes research findings on normal traits, such as sociability and IQ, and on deviant traits such as criminality. Implications for the field of family studies, sociology, and psychology are considered.

587. * Advanced Family Relations (3) Critical analysis of selected studies and current research in family relations. P, 337, or SOC 321.

597. Workshop
d. Counseling Children and Adolescents (3)
f. Professional Relationships: Building Cooperation and Mediating Conflict (3)
g. Computer Application in Agricultural and Non-Formal Education (1) [Rpt./3] (Identical with A ED 597g, which is home).

h. Family Development through Family and Consumer Sciences Programs (1-2).

i. Anger, Depression, and Guilt (3) P, 6 units of counseling or related area.

k. Psychodrama (3) P, 6 units of counseling or related area.

m. Counseling Mexican Americans (3) (Identical with SER 597m).

t. Instructional Advances in Non-Formal Education (1-3) [Rpt./3] (Identical with A ED 597i, which is home).

601. Foundations of Counseling (3) Relationship and contributions of various fields to the work of the counselor at all levels, in current and historical perspective; derivation of principles and objectives; integrated laboratory experience in selected settings.

607. Topics in Family Studies (1-3) [Rpt./3] Variable content: cognitive development, biological theories of development, role theory, middle childhood, and others.

610. Studies in Family and Consumer Sciences Education (3) Study and analysis of research literature, methods, techniques, and procedures for conducting investigations, selecting and developing plans for research problems.


622. Appraisal of the Individual (3) Methods of appraising and reporting individual behavior, with emphasis on nonpsychometric data.

623. Testing in Counseling (3) Evaluation and selection of psychological tests for guidance; use of psychometric data in counseling. Open to majors only.

631. Career Counseling (3) Theories of vocational development; types, sources, and use of occupational and educational information in career counseling and decision making. P, 601 or CR.

636. Economics of Aging (3) Analysis of economic issues and policies as they affect the aging individual, family, and society. (Identical with GER 636).

637. Trends in Human Relations (3) Philosophy, content, and resources for understanding, teaching, and working in the field of human relations.

644. The Counseling Process (3) Introduction to theories of counseling; collation and interpretation of counseling data; the counseling process; study of cases. P, 601, 622.

645. Theories of Counseling (3) Rationale, development, and research underlying major counseling theories. P, 631, 644.

647. Premarriage and Marriage Counseling (3) Contemporary issues, concepts, and procedures in premarriage and marriage counseling. P, 622.


672. Cross-Cultural Counseling (3) Issues, research and procedures involved in counseling with culturally different persons. P, 601, 622.

683. Group Counseling (3) Theory and process in group counseling; applications in community and mental health settings; laboratory experience. P, 644.


655. Visual Merchandising and Display (3) 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, 115 or ART 101.

656. * Store Planning and Design (3) Study of the retail environment, the physical and psychological effects that initiate and motivate customer activity. P, 115 or ART 101.

606. Advanced International Consumption and Retailing (3) Analysis of major retailers' strategies; retailing environments in specific regions of the world. Implementation of international strategies utilizing the case methods. P, 446 or equivalent.

607. Topics in Merchandising and Retailing (3) [Rpt./6 units] Analysis of current major topics or issues facing merchandising and retailing industries. P, 606.

614. Non-Store Retailing (3) 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, 400 or CR, MKTG 361.

624. Advanced Services Retailing (3) 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 service-oriented research and case studies related to retail management and service issues. P, 400 or CR, MKTG 361.

634. Retail Merchandising Analysis (3) 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, 400 or CR, MKTG 361.

656. Consumer Socialization (3) An 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) Analysis of theoretical applications in retail management focusing on particular issues in retail management and consumer studies.

695. Colloquium a. Advanced Professional Teaching Development (1)

b. Advanced Professional Research Development (1)

c. Advanced Professional Leadership Development (1)
Finance (FIN)  
McClelland Hall, Room 315L  
Phone: (520) 621-7554  
FAX: (520) 621-1261  
WWW: http://www.bpa.arizona.edu/bpa_departments/fin/index.html

Application Questions:  
Graduate Secretary, (520) 621-7554, lmagloire@bpa.arizona.edu

Advising Questions:  
Mike Weisbach, (520) 621-1908

Degrees Offered: M.S., Ph.D. (major in Management)

Professors: Edward A. Dyl, Head, Willard T. Carleton, Nestor R. Roos (Emeritus)

Associate Professors: Erich K. Bleck (Emeritus), Joseph S. Gerber (Emeritus), Chris Lamoureaux, Michael Weisbach

Assistant Professors: Allen B. Atkins, Walid Busaba, Charles Schnitzlein, Jose Suay

The department offers programs leading to the Master of Science degree with a major in finance. The department also 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.

The program for the Master of Science degree with a major in finance includes a minimum of 16 units at the 500 level and either a thesis or a research report.

511. Managerial Finance (3) Integration of the basic principles and underlying theory of finance, with emphasis on analytical financial management of business firms and other organizations. Open only to students admitted to a BPA graduate program. P, ACCT 550.

512. Advanced Corporation Finance (3) Financial theory applied to capital structure; investment decisions; corporate valuation; and corporate financial policies. P, 412 or 511.


518. Investment Banking (3) 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, 511.


528. Topics in Public and Nonprofit Financial Management (3) (Identical with PA 528, which is home). P, 511.


537. Finance for New Ventures (3) Value maximimization; 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, 511, MKTG 500. (Identical with MAP 537).

539. Planning of New Ventures (3) (Identical with MAP 539, which is home).


601. Financial Decision Making Under Uncertainty (3) Theoretical and applied financial economics relating to uncertainty in markets, information, and choice.


695. Colloquium  
 a. Research and Finance (1-3) [Rpt./4]

696. Seminar  
 a. Investments (3) [Rpt./1]  
 b. Financial Markets (3) [Rpt./1]  
 c. Corporation Finance (3) [Rpt./1]  
 d. Financial Institutions (3)  
 e. Financial Theory (3) [Rpt./1]  
 f. Research Methods (3) [Rpt.]

697. Workshop  
 a. Research Issues (1-3) [Rpt./5] P, Admission to a graduate program in BPA.

French and Italian (FREN/ITAL)  
Modern Languages Building, Room 549  
Phone: (520) 621-7349  
FAX: (520) 621-6104  
WWW: http://www.coh.arizona.edu/frenchfrench/html

Application Questions:  
Lise Leibacher, (520) 621-5345, lleibacher@ccit.arizona.edu

Advising Questions:  
Lise Leibacher, (520) 621-5345, lleibacher@ccit.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 A. Ariew, Head, Jonathan Beck, Frank M. Chambers (Emeritus), Monique Wittig

Associate Professors: Edward G. Brown (Emeritus), Irene A. d'Almeida, Ingeborg M. Kohn (Emerita), Lise Leibacher, Henri Servin (Emeritus)

Assistant Professors: Dalila Ayoun, Reginald McGinnis, S. Prosper Sanou

Lecturers: Gerard AgnieraY, John L. Gesell, Jean Goetinck, Annamaria Kelly (Emerita)

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 cooperates with the 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 the literature of France, Francophone literature, and literature/pedagogy. Candidates must pass a final written and oral examination.
French (FREN)

510. Introduction to Graduate Study in French Language and Literature (3) 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.

511. Topics in Literary History, Criticism, and Theory (3) [Rpt./3] 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) Taught in English.


518. Literature of the 18th Century (3) [Rpt.] Studies in the French Enlightenment, including theater, fiction, essays. Analysis of the main literary, artistic, and socio-cultural movements in France and in Europe during the 18th century-the French Enlightenment. P, graduate standing.

519. Literature of the 19th Century (3) [Rpt.] Examines various aspects of literary works ranging from poetry, the theater, the novel, and critical essays. Studies in French Romanticism and Realism. P, graduate standing.

520. Literature of the 20th Century (3) [Rpt.] 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 standing.

548. * The Theory and Practice of Writing (3) An experiment in writing, concerning the means, the raw maerial 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. (Identical with ENGL 548).


552. * French Literature of Quebec (3) Comprehensive study of the most significant literary expression in Quebec. P, 350.


556. * Literature of Belgium (3) Historical and the cultural background followed by the literary background in the broader context of French literature. Examines the novel and its different themes, the theater (symbolist, metaphysical, political), and poetry, including the works of Simenon, the world renowned author of detective and psychological novels. Taught in French. P, 350.

579. Problems in Teaching College French (1-3) Methodology course in lower-division college pedagogy. Discussion of broader issues of anguage, pedagogy, academe, the history of foreign language education, college teaching as a career.

581. Technology and Foreign Language Learning (3) [Rpt./1] Use of technology to teach foreign languages or a second language. Topics include how computers fit within Second Language Acquisition theories, how to integrate computers in the curriculum, and how to design and implement computer assisted instruction materials.

585. * Linguistic and Computer-Assisted Approaches to Literature (3) [Rpt./6 units] (Identical with GER 585, which is home).

587. Testing and Evaluation in Foreign/ Second Language Programs (3) (Identical with GER 587, which is home).

696. Seminar a. *French Language and Literature (3) [Rpt./3] Italian (ITAL)

500a-500b. * Main Currents of Italian Literature (3-3) 500a: The Middle Ages and Renaissance, 900-14th. 17th through 20th. 500b: The 17th through 20th. Graduate-level requirements include more demanding readings and other assignments. P, 202.
Applications are required to submit a completed program application (available in the General Program Office located in the Department of Biochemistry) and official transcripts of all college work. Call the program office at (520) 621-5903 for an application due date. 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. Applicants without this background may be required to complete additional undergraduate course work.

Genetics (GENE)
Forbes Building, Room 319-A
Phone: (520) 621-7511
Fax: (520) 621-7186
WWW: http://eebweb.arizona.edu/genet/
genweb/home.htm

Graduate Interdisciplinary Program in Genetics
Application Questions:
Karen Hill, (520) 621-7511, khill@u.arizona.edu
Advising Questions:
Kenneth Feldmann, (520) 621-7511

Degrees Offered: M.S., Ph.D.
(If the unit offers a master's degree, but initial admission is to the doctoral program only.)

Professors: Danny L. Brower (Molecular and Cellular Biology), Robert P. Erickson (Pediatrics, Molecular and Cellular Biology), William B. Heed (Emeritus), Conrad Istock (Ecology and Evolutionary 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), David W. Mount (Molecular and Cellular Biology), David C. Rowe (Family and Consumer Resources), Hans VanEtten (Plant Pathology), Samuel Ward (Molecular and Cellular Biology)

Associate Professors: Kenneth A. Feldmann, Chair, (Plant Sciences), Alison E.M. Adams (Molecular and Cellular Biology), Sue K. DeNise (Plant Sciences), Carol L. Dieckmann (Biochemistry), Jennifer D. Hall (Molecular and Cellular Biology), H. Eugene Hoyme (Pediatrics, Pathology, Obstetrics and Gynecology), Christina K. Kennedy (Plant Pathology, Molecular and Cellular Biology), Dennis T. Ray (Plant Sciences), Leland Pierson III (Plant Pathology), Steven E. Smith (Plant Sciences), J. Bruce Walsh (Ecology and Evolutionary Biology)

Assistant Professors: Lynn J. Manseau (Molecular and Cellular Biology), Marc J. Orbach (Plant Pathology), Roy Parker (Molecular and Cellular Biology), Linda L. Restifo (Neurobiology/Neurology), Mary C. Rykowski (Anatomy), Scott B. Selleck (Neurobiology, Molecular and Cellular Biology), Martin F. Taylor (Entomology)

Clinical Assistant Professor: Randall A. Heidenreich (Pediatrics)

Geneticists from various departments comprise the interdisciplinary program in Genetics, which offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in genetics. The areas of study emphasized by the program are molecular and cellular genetics, cytogenetics, and population genetics. Research opportunities include bacterial and bacteriophage genetics, gene regulation, developmental plant genetics, plant and animal cytogenetics, somatic cell genetics, cancer and clinical cytogenetics, quantitative genetics and animal breeding, ecological and evolutionary genetics, population genetics, human genetics, and biometrical principles as applied to individuals and populations, and genetic counseling.

Admission requirements include: completion of bachelor's degree with one year of biology, courses in genetics, ecology, physiology and developmental biology, chemistry through organic, mathematics through integral calculus, introductory physics, and statistics. In addition to materials required by the Graduate College, applicants are required to furnish the program with completed Committee on Genetics application forms, GRE scores on quantitative and verbal tests, and three letters of recommendation from persons qualified to evaluate the applicant's scholarly potential. The deadline for receipt of application forms for fall admission is March 1 and for spring admission, November 1.

Courses are available in a number of departments depending on the interests of the students.

501. Molecular and Medical Genetics (3) (Identical with PED 501, which is home).
509. Statistics for Research (4) (Identical with MATH 509, which is home).
512. Medical Ethics (1) [Rpt.9] 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) 97 (Identical with AN S 513, which is home).
516. *Bioinformatics and Genomic Analysis (3) (Identical with MCB 516, which is home).
520. History of Genetics (1) Experiments and discoveries which have led to the present state of knowledge in the various areas of genetics.
533.* Human Genetics (3) 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 533).
535.* Evolution II (4) (Identical with ECOL 535).
545. Concepts in Genetic Analysis (3) (Identical with MCB 545, which is home).
555. Molecular Mechanisms of Development (3) (Identical with MCB 555, which is home).
568. Nucleic Acids (4) (Identical with BIOC 568, which is home).
570. Molecular Genetics & Evolution (3) (Identical with MBIM 570, which is home).
574. Advances in Mammalian Genetics (2) [Rpt.1] (Identical with BIOC 574, which is home).
581. Genetic Counseling (2) [Rpt.6] 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 prenatal, pediatric, and adult genetic conditions. Limited to students in the genetic counseling training program except by consent of instructor.
589. Cancer Genetics (3) [Rpt.1] (Identical with CBIO 589, which is home).
595. Colloquium a. Genetics (1) [Rpt.1]
596. Seminar
j. Rounds (1) [Rpt.6] Limited to students in the genetic counseling training program except by consent of instructor.

601. Molecular and Cellular Biology (4)
Acquire a basic understanding of modern genetics, molecular biology and cell biology; and learn how to apply that understanding to human disease. Open to students in the Master's degree program in Genetic Counseling only.

627. Advanced Genetics (3) (Identical with PL S 627, which is home).

666. Human Microevolution (3) [Rpt.]
(Identical with ANTH 666, which is home).

670. Recent Advances in Genetics (2) [Rpt./10]
Recent advances in the field of genetics. (Identical with ECOL 670).

695. Colloquium
e. Science, Society, and Ethics (1) (Identical with MCB 695e, which is home).

Geography and Regional Development (GE06)
Harvill Building, Room 409
Phone: (520) 621-1652
FAX: (520) 621-2889
WWW: http://www.geog.arizona.edu

Application Questions:
Linda Koski,
koski@geog.arizona.edu

Advising Questions:
Brigitte Waldorf, (520) 621-7486,
bwaldorf@geog.arizona.edu

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

Concentrations: M.A. optional specialized tracks are available in regional development, physical geography, and critical human geography.

Professors: David A. Plane, Head, Michael E. Bonine (Near Eastern Studies), Terence Burke, Robert D. Carpenter (Emeritus), Lay J. Gibson, Lawrence D. Mann, Janice J. Monk (Southwest Institute for Research on Women), Gordon F. Mulligan, Leland R. Pederson (Emeritus), Richard W. Reeves, Thomas F. Saarinen (Emeritus), Arthur L. Silvers (Public Administration), Dan Stanislawski (Emeritus), Andrew W. Wilson (Emeritus), Ervin H. Zube (Renewable Natural Resources)

Associate Professors: D. Robert Altschul (Emeritus), Adrian X. Esparza, Lisa J. Graumlich (Dendrochronology), Charles F. Hutchinson (Arid Lands Resource Sciences), Katherine K. Hirschboeck (Climatology), Diana Liverman, Stuart E. Marsh (Arid Lands Resource Sciences), Sallie A. Marston, Brigitte Waldorf, Marvin Waterstone

Assistant Professors: Andrew C. Comrie, Susan L Craddock (Women's Studies), Beth A. Mitchneck, Stephen R. Yool, Emily H. Young

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 University's Interdisciplinary 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 the Ph.D. program, must petition the Department and 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 approved equivalent, 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 studies (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 Interdisciplinary 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 is 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 by the student's mentor and the Director of Graduate Studies.

Ph.D. Minor in Geography: Students majoring in other doctoral programs at The University of Arizona who elect a minor in geography must complete a minimum of 12 units of coursework in geography, including one core course (500, 657, or approved equivalent, 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 the potential committee members at an early date.

500. Current Geographical Research (3)
Major trends and issues in human and physical geography.

501. Introduction to Planning (3) (Identical with PLAN 501, which is home).

505. Principles of Economic Geography (3)
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, countryside and special features. Field trips. (Identical with L AR 507)

508.* Arizona and the Southwest (3) The changing character of the land and man's occupancy of it, with emphasis on Arizona; historically and problem oriented. Field trip.

509.* Russia and the Former Soviet Union (3) Political, population, and economic elements of contemporary Russia and the former Soviet
510. Development of Regional Planning (3) (Identical with PLAN 510, which is home).

511. * Middle America (3) Land, people, and culture in the major natural and cultural regions of Mexico, Central America, and West Indies. (Identical with LA S 511).

512. * South America (3) Physical and cultural bases of South America's geographic patterns, with emphasis on human settlement and problems of resource development. (Identical with LA S 512).

513. * Africa (3) Physical and human bases of regional contrasts, with emphasis on tropical environmental systems and changing patterns of resource utilization and development.

514. Analytic Methods in Planning and Management (3) (Identical with PA 514, which is home).

515. * Introduction to Water Resources Policy (3) (Identical with HWR 515, which is home).

517. * Geographic Information Systems for Natural Resources (3) (Identical with RNR 517, which is home).

516. * Computer Cartography (3) Introduction to the use of computers for map production, with emphasis on cartographic principles and practical experience with several user-oriented mapping programs. (Identical with RNR 516 and PLAN 516).

519. * Cartographic Modeling for Natural Resources (3) P, 481 or 581, or RNR 417 or 517. (Identical with RNR 519, which is home).

520. * Advanced Geographic Information Systems (3) (Identical with RNR 520, which is home).

530. The Climate System (3) Systematic examination of processes and circulations comprising Earth's climate. Emphasis on processes influencing geographic processes using examples of atmospheric environmental issues. P, 103A or ATMO/GEOG 171.

531. * Global and Regional Climatology (3) Description and analysis of the atmospheric circulation process that produces differences in climates throughout the world. Emphasis on the earth's problem climates and climatically sensitive zones most susceptible to floods, droughts, and other environmental stresses due to global change. P, ATMO/GEOG 171.


550. Metropolitan and Regional Planning (3) (Identical with PLAN 550, which is home).

553. * Locational Analysis (3) Industrial location theory and location factors, consumer travel behavior and market areas, geography of economic impacts, location of public facilities. (Identical with PLAN 553).

554. * Regional Analysis (3) Regionalization and geographic scale; spatial variation and well-being and development; multiplier and analysis; demographic-economic models; theories of regional growth; regional policy.

555. * Statistical Techniques in Geography, Regional Development and Planning (3) 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, on the one hand, and program planning, on the other. P, MATH 117R or 117S or equivalent preparation. (Identical with PLAN 557).

559. * Land Use and Growth Controls (3) Current planning and legal techniques to regulate the rate of growth, the sequence of growth, and the eventual total size of towns, regions, and states: concentration on case studies. (Identical with PLAN 559).

561. Resource Management (3) Examination and critical appraisal of social and behavioral science aspects of resource management, with special emphasis on factors affecting decision making. (Identical with PLAN 561).

563. Perception of Environment (3) Examination of interdisciplinary research on environmental perception; consideration of social and behavioral variables at all scales of environmental perception and planning. (Identical with PLAN 563).

565. * Physical Aspects of Arid Lands (3) The climate, landforms, hydrology, soils, and vegetation of deserts, with special emphasis on processes and distribution at micro-to-macro scales.

566. * The Middle Eastern City and Islamic Urbanism (3) (Identical with NES 566, which is home).


571. * Problems in Regional Development (3) Analysis of population growth trends, market areas, the role of transportation in development, regional specialization and economic structure, interregional migration, and regional policy issues. (Identical with AREC 571 and PLAN 571).


578. * Global Change (3) (Identical with GEOS 578, which is home).

583. * Geographic Applications of Remote Sensing (3) 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. 2R, 3L.

596. Seminar
k. Risk and Society (3) (Identical with ANTH 596K and HWR 596K).

597. Workshop
a. * Geography for Teachers (3)
b. Projects in Regional Development (3) [Rpt. / 1 P, 6 units of geographic techniques. Open to majors in Geography or Regional Development only.

605. Planning Theories and Perspectives (3) (Identical with PLAN 605, which is home).

611. Projects in Regional Planning (1 to 5) [Rpt./5 units] (Identical with PLAN 611, which is home).

657. Spatial Analysis (3) Formal analysis and modeling of spatial structures and processes; conceptual evaluation of point patterns, networks, surfaces, and interaction. P, 457 or 557. (Identical with PLAN 657).


695. Colloquium
a. Current Research (3) [Rpt./7 units] Required of all graduate students each semester in residence.

696. Seminar
a. Economic Geography (3) [Rpt./2]
b. Cultural Geography (3) [Rpt./2]
c. Physical Geography (3) [Rpt./2]
e. Area Study (3) [Rpt./3]
f. Research Methods (3) [Rpt./2]
g. Urban Geography (3) [Rpt./2]

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:
Bo Baylor, (520) 621-6004, gradinfo@geo.arizona.edu

Advising Questions:
Bo 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
The Department of Geosciences focuses on research and education dealing with the nature, genesis, and history of 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.

Master of Science: Designed to train students aspiring to professional employment in industry, in local, state, or federal 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 degree 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 12-unit minor is required in a related subject.

Doctor of Philosophy: Designed for students aspiring to professional employ-ment in professional geoscientists in research-oriented capacities in the academic community, industry, or government. Qualified students with a bachelor's degree 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 12-unit minor is required in a related subject.


503. * Physics of the Solar System (3) (Identical with PTYS 503, which is home).

505. Applied Multispectral Imagery (3) (Identical with G EN 509, which is home).

506. * Conservation Biology (3-4) (Identical with ECOL 506, which is home).

507. * Photogeology (3) (Identical with G EN 507, which is home).

509b. Conditions and Rates of Metamorphic Processes (3) An advanced treatment of the topic based primarily on the principles of classical thermodynamics, reaction-, order-disorder- and diffusion-kinetics, and heat transfer. P, 409a or 583 or consent of instructor.

510. Principles of Cosmochemistry (3) (Identical with PTYS 510, which is home).

514. Late Quaternary Geology (3) Paleoenvironment and geology 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. Domestic field trips. Enrollment limited to 10 students. P, 102, 104. (Identical with ANTH 514).

516. * Field Studies in Geophysics (3) (Identical with G EN 516, which is home).

517. * Sedimentology/Stratigraphy (3) Physical mechanisms of sedimentary basin formation, including flexure, thinning, and thermal contraction of the lithosphere; isostasy; subsidence analysis; sequence stratigraphy; paleocurrents and sediment provenance; tectonics of sedimentary basins. P, 302 or 544.

518. * Advanced Mineralogy (3) Principles of crystallography and crystal chemistry; thermodynamic and kinetic of minerals; macroscopic treatment and atomistic basis; phase transformations; systematic mineralogy. P, 209 or consult department before enrolling.


520. Meteorites (3) (Identical with PTYS 520, which is home).

521. * Structural Geology (4) GRD Integration of geological structures created through deformation of the Earth's crust. Emphasis on fundamental concepts and methods in
322. WLLa Golog Interpretation (3)
(Identical with G EN 522, which is home).
323.* Regional Structural Geology (3) [Rpt./3
Geologic mapping in a variety of rock types
and structural regimes, with emphasis on the
recognition and solution of regionally
significant structural problems. Field trips. P,
413.
325.* Regional Tectonics (3) Discussion of the
geology, geophysics, petrology, and geochemi-
ty of different types of orogenic systems and
their tectonic evolution. Methods of tectonic
regionalization and integration based on
lithostratigraphic assemblages and terranes, and
regional structural geology. Plate tectonic
regimes and kinematics.
326.* Cordilleran Tectonics (3) Geologic and
tectonic evolution of the North American
Cordillera based on analysis of geologic,
paleomagnetic, and paleobiogeographic
constraints and tectonic models.
327. Orogenic Systems (3) 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 Phanerzoic, Proterozoic, and into
Archean time.
328. Geologic Characteristics of Ore
Occurrence (3) Geological, geochemical,
and geophysical signatures of ore occurrence at the
scales of tectonic settings, provinces, districts,
330. *Chemical Evolution of the Earth (3)
Chemical differentiation and evolution of
Earth's mantle and crust according to major-
element, trace-element, and isotopic character-
istics of neodymium, hafnium, strontium, lead,
and other isotopes.
331.* Hydrogeology (4) (Identical with HWR
531, which is home).
332.* Introduction to Seismology (3-5)
Fundamentals of the generation, propagation,
and interpretation of seismic waves. Two
sections: earthquake seismology and explo-
ration seismology. Sections meet together for
introduction then students choose one (3
units) or both (5 units) for the remainder of
the semester. P, MATH 254, or consent of
instructor.
333.* Mine Investment Analysis (3) Economic
factors, including taxation, mineral depletion
allowance, and finance in the mining industry;
includes fundamentals of engineering
economics, capital budgeting, and risk analysis.
335. Advanced Subsurface Hydrology (3)
(Identical with HWR 535, which is home).
336. Ground Water Resource Evaluation (3)
Fees. (Identical with HWR 536, which is
home).
337.* Economics of Mineral Resource
Development and Production (3) Concepts
and methods of mineral economics; analyses of
selected mineral and energy commodities,
current economic and political issues, and
investment strategies in selected mineral
industries.
338. Biogeography (3) (Identical with ECOL
338, which is home).
339. Analytical Methods in Geophysics (3)
Transform theory, spectral analysis, asymptotic
series, special functions, probability. Applica-
tions to geophysical problems. P, MATH 422b.
340.* Geodynamics and Paleomagnetism (3)
[Rpt.] Large-scale tectonic problems ap-
proached by combined geophysical and
tectonic analysis in regional context. P, 20
units of geology, including 321, 3 units
geophysics, MATH 254; consult with
department before enrolling.
341. Soil Genesis (3) (Identical with SWES
541, which is home).
342. Ore Deposit Petrology (3)
Orthomagmatic, porphyry base metal, skarn,
and leached capping lithologic-mineralogic
studies by petrographic microscope, electron
probe, and advanced techniques. 1R, 6L P,
425/525 or CR, 464a.
344. Advanced Physical Sedimentology (3)
First half of course deals with mechanics of
flows and sediment transport, oscillatory and
unidirectional flows, waves and wave theory,
bedforms and flow regimes, sediment gravity
flows, liquefaction and fluidization. Second
half covers physical processes and facies in
alluvial fan, fluvial, eluvian, deltaic, nearshore,
shelf, slope and turbidite fan systems.
Emphasis is on clastic systems. Field trips. P,
302, MATH 254 or consent of instructor.
346.* Economic Mineral Deposits (3) GRD
Geology of metallic and nonmetallic ore
deposits. Economic considerations, processes
of formation, methods of study and explo-
arion, and description of geologic aspects and
settings of representative worldwide examples.
347.* Industrial Minerals and Rocks (3)
Geology, origin, mode of occurrence, and
methods of evaluation of nonmetallic mineral
deposits. 2R, 3L P, 446.
348.* Geophysical Exploration and Engineer-
ing (3) (Identical with G EN 548, which is
home).
349.* Mineral Exploration (3) (Identical with
G EN 549, which is home).
350. *Geomorphology (4) Concepts of
landform development, with emphasis on
fluvial processes and environmental applica-
tions. 3R, 3L Field trips. P, 101, 103.
(Identical with GEOG 350).
352.* Strategies in Environmental
Hydrogeochemistry (3) Origin, migration,
chemistry, and accumulation of petroleum;
reservoir mechanics, types of traps; recovery of
petroleum; oil shales and tar sands. 2R, 3L.
353.* Glacial and Quaternary Geology (3)
Glacial processes, landforms, and deposits.
Physical aspects of Quaternary
paleoenvironmental change and effects on
fluvial, eluvian, lacustrine, weathering, and mass
movement processes. P, 102, 104.
572. Global Biogeochemical Cycles (3)  
(Identical with GC 572, which is home).

573. Geology and the Urban Environment (3)  
Geologic processes that result in loss of life  
and/or property damage; emphasis on case  
studies of urban areas in the Southwest.  
Implications for public policy. 2R, 3L. All-day  
field trips. (Identical with PLAN 573).

576a-576b. Analysis of Biological Diversification  
(3-2) [Rpt./1] (Identical with ECOL  
576a-576b, which is home).

578. Global Change (3) Analysis of the entire  
Earth system through an examination of how  
its component parts and their interactions have  
changed in the past and may be expected to  
change in the future.  P, upper-division  
standing; introductory course work in  
biological and physical sciences. (Identical  
with ECOL 578, GEOG 578, HWR 578,  
and RNR 578).

581. Quaternary Palynology and Plant  
Macrofossils (2-4) Theory and techniques of  
identification and interpretation of pollen,  
speres, seeds, leaves, and wood of plants from  
sediment lakes, marshes, caves, and archaeologi-  
cal sites.  P, ECOL 472. (Identical with ANTH  
581).

582. Paleoclimatology (3) Topics in  
paleoclimatology including prediction of  
paleoclimatic patterns, proxy paleoclimatic  
indicators, and paleoclimatic cycles.

583. Physical Geochemistry (3) Principles of  
classical and elementary statistical thermody-  
namics. Thermo-chemical and -physical  
properties; equations of states for solids and  
gases; solutions; phase equilibrium; nonideal  
multicomponent systems with emphasis on  
geological and planetary problems.  P, MATH  
125a-125b, or 124, MATH 119 and/or consult  
with department before enrolling. (Identical  
with PTYS 583).

588. Soil Geochemistry (3) Soil mineralogy  
and organic matter, weathering and mass  
balance, stable isotopic tracers and impact on  
aquatic and atmospheric chemistry.  P, 101,  
103, CHEM 103b and CHEM 104b. Field trips.

589. Quaternary Geochronology (3) Review  
of quantitative dating techniques for Quater-  
nary geologists, including U/He, U-series, in situ  
 cosmogenic radionuclides, TL, amino acids and  
 other.  P, 101, 103, CHEM 103b and CHEM  
104b.

590. Remote Sensing for the Study of Planet  
Earth (3) (Identical with REM 590, which is  
home).

595. Colloquium  
a. Topics in Geosciences (1-3)  
b. Global Climate Change (1-3) [Rpt./1]  
(Identical with ATMO 595b, which is home).

c. General Circulation Observation and  
Modeling (1-3) (Identical with ATMO  
595c, which is home).

d. Dendrochronology: Physical Applications  
(3) [Rpt./1] (Identical with WS M 595e).

e. Dendrochronology: Biological Applications  
(3) [Rpt./1] (Identical with WS M 595f).

596. Seminar  
a. Mineralogy-Petrology-Geochemistry (1-4)  
[Rpt./6 units]

b. Economic Geology (1-4) [Rpt./6 units]

c. Geomorphology-Quaternary Geology (1-4)  
[Rpt./6 units]

d. Paleontology-Sedimentary Geology (1-4)  
[Rpt./6 units]

e. Structure-Tectonics (1-4) [Rpt./6 units]

f. Geophysics (1-4) [Rpt./6 units]

g. Dendrochronology (1-4) [Rpt./6 units]

h. Geosciences (1-4) [Rpt./6 units]

i. *Macroevolution (2) [Rpt./6 units]  
(Identical with ECOL 596p, which is  
home).

597. Workshop  
a. Phylogenetic Inference (2) (Identical  
with ENTO 597b, which is home).

b. *Dendrochronology (1-4) 3 or 6L. Field  
trips. (Identical with ANTH 597c and WS  
M 597c).

646a-646b. Advanced Ore Deposit Geology  
(4-4) Geology, characteristics and origins of  
ore deposits in igneous, sedimentary, and  
metamorphic rocks. Laboratories include field  
trips, analytical techniques, problem solving.  
2R, 6L. P, 446/456, CHEM 480a or CR.

650. Problems in Geomorphology (3)  
Application of quantitative methods to field  
problems. 2R, 3L. Field trips. P, 450.

651. Climatic Geomorphology (3) Effects of  
climatic changes on geomorphic processes,  
landforms, and soils; paleoclimatic and  
earthquake-hazards interpretations. 2R, 3L.  
Field trips.

652. Tectonic Geomorphology (3) Effects of  
tectonic movements on geomorphic processes  
and landforms; earthquake-hazards interpreta-  

German Studies (GER)  
Modern Languages Building, Room 571  
Phone: (520) 621-7385  
FAX: (520) 621-7385  
WWW: http://w3.arizona.edu/~germanst/  
index.shtml

Application Questions:  
Della Thomas, (520) 621-8123,  
della@u.arizona.edu

Advising Questions:  
Barbara Kosta, (520) 621-7385,  
bkosta@cit.arizona.edu

Degrees Offered: M.A.  
Concentrations: German literature and  
culture, Pedagogy.

Professors: David H. Chisholm, Albrecht  
Ehrenfried, Max Dunfer (Emeritus),  
Steven D. Martinson, Renate A. Schulz,  
David J. Woloshin (Emeritus)  
Associate Professors: Thomas Kovach,  
Head, Dennis l. Greene (Emeritus),  
Barbara Kosta, Babette Luz (Emerita),  
Kamakshi P. Murti, Roland Richter  
(Emeritus), Mary Wildner-Bassett

Lecturer: John R. Wendel

The department offers a program  
leading to the Master of Arts degree with a  
major in German Studies. Studies are  
available in the various areas of German  
language, literature, and culture in their  
more modern and contemporary aspects  
as well as in earlier historical and  
linguistic developments. Courses are also  
available in second language teaching  
methodology, applied linguistics, theory  
of second language acquisition, and  
testing for a minor option in the M.A.  
degree in German.

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 508a  
and 508b are required of all master's  
candidates; GER 579 is required of all  
graduate teaching assistants.

M.A. Thesis Option: Students may be  
permitted to write a thesis upon applica-  
tion to and consultation with the  
departmental Graduate Committee.  
Students approved for the thesis option  
must complete the 24 unit course work  
requirement (excluding 910). No more  
than 6 units may be earned for writing the  
thesis; students enroll for GER 910.

The student must pass both a written  
and an oral comprehensive examination.  
Prior to this examination each student  
must either have passed 575a or 575b  
successfully or give evidence of an  
equivalent proficiency in the use of  
written German and must rate Superior  
on the ACTFL/ETS Oral Interview Test or  
an equivalent assessment.

500. Intensive Reading German for the  
Sciences and Humanities (4) 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 informa-  
tion). Credit for non-majors only. Credit is not  
available for German Studies majors.

501. Appropriating and Reshaping the Past  
(3) Examines the creative reception of cultural  
arts found in oral traditions, religion,  
politics, historical events, and the arts in  
German-speaking cultures. P, 6 units of upper- 
deration German.
502. Genre as a Category for Organizing Experience (3) Examination of individual texts in relation to theories of genre, with attention to shifting definitions of genre and resistance to generic categories. P, 6 units of upper-division German.

503. Erziehung und Bildung in German Culture (3) Investigates theories of education and their reflection in literary works. The Bildungsgroman, for instance, discloses central elements of German culture and society. P, 6 units of upper-division German.

505. * History of the English Language (3) (Identical with ENGL 505).

506. Representing the "Other" (3) Explores narratives that construct the Other, the foreigner, and the outsider; discusses the politics of racism, sexism, and exclusion using texts from various fields. P, 6 units of upper-division German.

507. Criticism and Creativity in German Culture (3) Examines the relationship between theories of literature and literary practice, and the question of the nature of writing in general. P, 6 units of upper-division German.

508a-508b. Approaches to German Studies (3-3) An overview of research materials, methods, theories, and issues from which individual interests and concentrations in German studies can develop. Provides for the selection of faculty mentors.

509. Traditions and Modernism (3) Provides a critical overview of literary and intellectual currents of the "modern" period; explores the changing status and social function of literature. P, 6 units of upper-division German.

510. Repression, Revolution, Revision (3) 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) Explores the way German writers have dealt with basic issues of human communications.

520. History of the German Language (3) Examination of the semantic, socio-historical, and structural development of German from the age of migrations to the present. P, 8 units of upper-division German. (Identical with ENGL 520).

525a-525b. Old English (3-3) (Identical with ENGL 525a-525b, which is home).

525a-525b. * Old English (3-3) (Identical with ENGL 525a-525b, which is home).

555. * Music and German Literature (3) 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. (Identical with MUS 555).

575. * Advanced German Usage (3) CDT

579. * Issues in Foreign Language Teaching Acquisition and Teaching (3) Modern methods of language teaching with emphasis on German as a foreign language.

580. * Applied Linguistics for German as a Foreign Language (3) Issues in and methods of applied linguistics with emphasis on Germanic languages.

587. Testing and Evaluation in Foreign/Second Language Programs (3) 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, and SPAN 587).

594. Practicum
   a. Literature (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   b. L2 Acquisition and Teaching (1-5) [Rpt./5 units]
   c. Culture (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   d. Linguistics (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   e. Translation (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.

596. Seminar
   a. Literature (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   b. L2 Acquisition and Teaching (1-5) [Rpt./5 units]
   c. Culture (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   d. Linguistics (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   e. Translation (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.

597. Workshop
   a. *Literature (1-5) [Rpt./5 units]
   b. *Pedagogy (1-5) [Rpt./5 units]
   c. *Culture (1-5) [Rpt./5 units]
   d. *Linguistics (1-5) [Rpt./5 units]
   e. *Translation (1-5) [Rpt./5 units]

696. Seminar
   a. Literature (2-4) [Rpt.]
   b. Linguistics (2-4) (Identical with ENGL 696b, which is home).
   c. Culture (2-4) [Rpt.]
   d. L2 Acquisition and Teaching (2-4) [Rpt.]
   e. Translation (2-4) [Rpt.]

696b, which is home).

594. Practicum
   a. Literature (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   b. L2 Acquisition and Teaching (1-5) [Rpt./5 units]
   c. Culture (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   d. Linguistics (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   e. Translation (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.

596. Seminar
   a. Literature (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   b. L2 Acquisition and Teaching (1-5) [Rpt./5 units]
   c. Culture (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   d. Linguistics (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.
   e. Translation (1-5) [Rpt./5 units] P, competency at fourth-year undergraduate level or pass departmental placement examination.

597. Workshop
   a. *Literature (1-5) [Rpt./5 units]
   b. *Pedagogy (1-5) [Rpt./5 units]
   c. *Culture (1-5) [Rpt./5 units]
   d. *Linguistics (1-5) [Rpt./5 units]
   e. *Translation (1-5) [Rpt./5 units]

696. Seminar
   a. Literature (2-4) [Rpt.]
   b. Linguistics (2-4) (Identical with ENGL 696b, which is home).
   c. Culture (2-4) [Rpt.]
   d. L2 Acquisition and Teaching (2-4) [Rpt.]
   e. Translation (2-4) [Rpt.]
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 major'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 with aging processes include: FS 613, 636; PA 427/527; PSYC 556, 574; SER 555. Courses originating in gerontological studies and courses cross-listed with gerontology include:

524.* Gerontology: A Multidisciplinary Perspective (3) (Identical with PSYC 524, which is home).
527.* Aging and Public Policy (3) (Identical with PA 527, which is home).
530. Aging and Social Sciences (3) 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 Laboratory (1) (Identical with PHPR 447, which is home).
548.* Perspectives in Geriatrics (2) (Identical with PHPR 548, which is home).
550. Biology of Aging (3) 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. A recent course in a biological science is recommended, but not required.
557.* Law of the Elderly (2) 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 identification of legal resources (Identical with PA 557).
559.* Adult Development and Aging (3) (Identical with PSYC 559, which is home).
560a-560b. Methods in Aging Research (3-3) 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 critique of articles and development of research and evaluation projects. 560a is prerequisite to 560b.
570a.* Human Adaptability (3) (Identical with ANTH 570a, which is home).
576. Communicative Aspects of Aging (1) (Identical with SPH 576, which is home).
589. Health of the Older Adult (3) (Identical with NURS 589, which is home).
595. Colloquium a. Current Topics in Aging (1) (Rpt./3)
613. Family Issues in Aging (3) (Identical with FS 613, which is home).
636. Economics of Aging (3) (Identical with FS 636, which is home).

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.

572. Global Biogeochemical Cycles (3) 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 and HWR 572).

Graduate Interdisciplinary Programs
Administration Building, Room 322-A
Phone: (520) 621-8368
FAX: (520) 621-8367
WWW: http://grad.admin.arizona.edu/idps/idp/home.html
Application Questions: Jolene Newburn, (520) 621-8368, idp@ccit.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
Planning
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 Professions (HLTH/EXSS/MEDT)
Ina E. Gittings Building, Room 101
Phone: (520) 621-4850
FAX: (520) 621-1779
WWW: http://www.ahsc.arizona.edu/shrp.shtml

At the time this Catalog was being edited, the School of Health Professions and its major programs were undergoing reorganization and relocation. The School of Health Professions no longer offers programs leading to the Master of Arts and Master of Science degrees with a major in exercise and sport sciences. The M.S. degree, emphasis in exercise physiology, has been relocated within the Graduate Interdisciplinary Program in Physiological Sciences, described elsewhere in this chapter. Faculty in the School offer courses that are included as electives for the Master of Public Health degree. Students wishing to emphasize health education and occupational safety studies at the M.S. level should consider the Arizona Graduate Program in Public Health (see that entry elsewhere in this chapter).

Health Education (HLTH)
Arizona Health Sciences Center, Room 1115, (520) 626-3200
Associate Professors: Richard L. Papenfuss (Family and Community Medicine), Kam Nasser (Family and Community Medicine)
Assistant Professor: Scott J. Leischow (Family and Community Medicine)
Clinical Assistant Professor: Sheila H. Parker (Family and Community Medicine)
530. Theory-Based Approaches in Health Education/Health Promotion (3) Analysis of the epidemiological data to determine the health problems of our people, behavioral relationships, and the study and application of theory-based educational strategies designed to prevent health problems.

532. Program Planning and Education in Health Education/Health Promotion (3) Principles for planning, implementing, administering, and evaluating health education programs utilizing the "PRECEDE Model" as a framework.

535. Multicultural Health Beliefs (3) 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. Survey of Health Education/Health Promotion Literature (3) 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.

Exercise and Sport Sciences (EXSS)
Ina E. Gittings Building, Room 102
(520) 621-2785

The M.A. and M.S. degrees with a major in exercise and sport sciences are no longer offered. The M.S. degree emphasis in exercise physiology has been relocated within the Graduate Interdisciplinary Program in Physiological Sciences. No graduate courses in exercise and sport sciences will be offered after June, 1998.

Professors: Donna Mae Miller (Emerita), Frederick B. Roby (Emeritus), Mary P. Roby (Emerita)
Associate Professors: Boyd B. Baker, Patricia C. Fairchild, Bruce A. Larson, Richard A. Munroe (Emeritus), Kathryn R.E. Russell

510.* Sport in Contemporary Society (3) Study of contemporary sport from the perspectives of its personal, social, cultural, economic, and educational dimensions.


527. Psychology of Sport and Exercise (3) Examines the effects of motivation, personality, attitudes, competition, and group dynamics on sport performance as well as the psychological effects of exercise, exercise adherence, and exercise addiction. (Identical with PHIL 527).

528. Psychological Interventions and Ergogenic Aids for Peak Performance (3) The application and effectiveness of ergogenic aid mechanisms, particularly psychological interventions, in enhancing performance.

536. Administration of Sports Programs (3) Designed to provide a theoretical framework for students pursuing sports management careers and others interested in various functions involved in the conduct of sport programs.

566. Physical Activity in Aging and Chronic Diseases: Psychosocial Aspects (3) Psychosocial dimensions of exercise programs designed for populations with chronic diseases as well as for older populations.


582. Anatomical Basis of Sport Injuries (3) Comprehensive survey of bones, ligaments, muscles, nerves, and vessels of the trunk and upper and lower extremities, with emphasis on their relationship to sport injuries. 2R, 3L, P, CR 580.


584. Rehabilitation of Athletic Injuries (3) Principles in the planning and implementation of rehabilitation programs for injured athletes with emphasis on application of contemporary therapeutic exercise techniques. P, 580.


586. Physical Education and the Law (3) Investigation and analysis of legal parameters within which the physical educator and coach operate; negligence theory; common defenses; product liability; insurance; legal implications for program development and methodology.

588. Legal Aspects of Sports Administration (3) Development of administrative and coaching techniques from the legal perspective. Analysis of personnel procedures, purchase of equipment, athletic associations, certification, transportation, medical procedures, officiating, and the handicapped athlete as influenced by litigation. P, 586.

593. Internship
b. Sport Psychology (1-3) [Rpt/6 units] P, 529.

g. *Kinesiology (2) [Rpt/1] P, 562.

Graduate-level requirements include leading discussion of one of the colloquium topics and preparation of a mini-grant proposal on a colloquium topic.

597. Workshop
a. Biofeedback: Theory and Application (1)

793. Internship
a. Sport Psychology (1-3) [Rpt/2 units] P, 529.

Medical Technology (MEDT)
1435 N. Fremont Ave., Room 124
(520) 626-4064

Clinical Associate Professor: Harold L. Potter, Jr., Director
Clinical Assistant Professor: JoAnn Thomas
Clinical Instructors: Marlis Dinning, 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.

571R.* Lectures in Clinical Hematology (3) [Rpt/1] Lectures in basic hematology and hematological procedures including cell structure and function, inherited and acquired anomalies, hemostasis, cell enumeration and differentiation, cytogentic. P, consult program director before enrolling.

571L.* Fundamental Laboratory Techniques in Clinical Hematology (2) [Rpt/1] Basic laboratory techniques in clinical hematology with emphasis on manual and automated hematological procedures. Instruction includes proper procedural methodologies, quality control, the use of controls and standards, and interpretation of laboratory test results. P, CR, 471R/571R, consult program director before enrolling.

572R.* Lectures in Clinical Immunology and Immunohematology (4) [Rpt/1] Lectures in serological methods used in the clinical laboratory and interpretation of results; blood banking procedures. P, consult program director before enrolling.

572L.* Fundamental Laboratory Techniques in Clinical Immunology and Immunohematology (2) [Rpt/1] 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 interpretation of laboratory test results. P, CR, 472R/572R, consult program director before enrolling.

573R.* Lectures in Clinical Chemistry (5) [Rpt/1] Lectures encompassing the fundamental concepts of clinical laboratory chemistry including pathophysiology and clinical correlations. P, consult program director before enrolling.

574R.* Lectures in Clinical Bacteriology (5) [Rpt./1] Lectures relating to laboratory techniques used to safely isolate and identify pathogenic bacteria. Special media/techniques and organisms are covered. P, consult program director before enrolling.

574L.* Fundamental Laboratory Techniques in Clinical Bacteriology (2-1-1) [Rpt./1] 475a: Clinical Parasitology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant parasites. 475b: Clinical Virology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant viruses. 475c: Clinical Mycology and Mycobacteriology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant fungi and Mycobacterium sp. P, consult program director before enrolling.

575a-575b-575c.* Topics in Clinical Microbiology (2-1-1) [Rpt./1] 475a: Clinical Parasitology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant parasites. 475b: Clinical Virology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant viruses. 475c: Clinical Mycology and Mycobacteriology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant fungi and Mycobacterium sp. P, consult program director before enrolling.

576.* Principles of Laboratory Science (3) [Rpt./1] Basic principles of laboratory mathematics, biostatistics, body fluids analysis, urinalysis, quality control, and laboratory safety. P, consult program director before enrolling.


History (HIST)

Social Sciences Building, Room 215
Phone: (520) 621-5860
FAX: (520) 621-2422
WWW: http://w3.arizona.edu/~history

Application Questions:
Pat Alger, (520) 621-5860

Advising Questions:
Kevin Gosner, (520) 621-1168, kevgosn@history.arizona.edu

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


Associate Professors: Karen S. Anderson, Alan E. Bernstein, George Brutacker (Emeritus), Julia Clancy-Smith, Roger deLaux (Emeritus), Edwin M. Gaines (Emeritus), Juan R. Garcia, Kevin Gosner, Frederick Kellogg, Jack D. Marietta, Hermann Rebel, Laura Tabili, Douglas Weiner

Assistant Professors: Bert Barickman, Susan Crane, Shara Fett, Linda Darling, Maureen Fitzgerald, Alison Futrell, Matt Goldish, Reeve Huston, Katherine Morrissey, David Ortiz

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 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 of 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; or Asian history; comparative women's history; comparative/world history.

501.* Ancient Mesopotamia (3) (Identical with NES 501, which is home).

504a-504b.* History of Rome (3-3) 504a: The Republic to the death of Caesar. 504b: The Empire through the reign of Constantine the Great. 504a is not prerequisite to 504b. (Identical with CLAS 504a-504b).

505a-505b.* Medieval Europe (3-3) Major institutions and trends in Europe from the breakup of the Roman World to the 14th century. 505a is not prerequisite to 505b. P. 3 units of lower-division European history. (Identical with RELI 505a-505b).

506.* Medieval England (3) From the Norman conquest to the Hundred Years War, with emphasis on political, social, and cultural developments. P. 3 units of lower-division European history. (Identical with RELI 506).
557. *The Mexican Revolution (3)* A detailed examination of Mexico's social upheaval of 1910, and its implications for contemporary Mexican society. Offered in Guadalajara only.

558. *Topics in Comparative Women's History (3)* International history of a topic of the instructor's choice. P. 3 units of any history or women's studies course. (Identical with W S 558).

561. *The Ethnohistory of Mesoamerica and the Andes (3)* The impact of conquest and Spanish rule on the native peoples of Mexico, Central America, Peru, Bolivia, and Ecuador. Topics include: conquest and ecology; land and labor; religion and culture; adaptation and resistance. 2R, 1D. P, HIST 160, 351 or 368.

564. *History of Argentina (3)* Survey of Argentine history and culture from the colonial era to the present. P. 3 units of any lower-division Latin American history course. (Identical with LA S 564).

565a-565b. *History of Spain: Spanish Politics, Society, and Culture Since 711 (3-3)* Salient features of Spanish history beginning with the conquest of the Iberian Peninsula by the Moors in 711 and concluding with the consolidation of democracy in the 1980s and 1990s. 565a is not a prerequisite to 565b. P, 102, or 160, or 3 units of any history course.

566. *History of Brazil (3)* History of Brazil from 1500 to the present. (Identical with LA S 566).

567. *Contemporary Latin America (3)* Revolution, social change, and reaction in Latin America from 1930 to the present. P, junior or senior standing. (Identical with LA S 567).

568a-568b. *Asia and the West (3-3)* 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. (Identical with NES 568a-568b).

569. *History of Women in Latin America (3)* 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. (Identical with LA S 569).


572. *History of Medieval India (3)* Survey of Indian history from the 7th century to 1750. (Identical with NES 572).

573. *History of Modern India and Pakistan: 1750-Present (3)* Survey of political, social and economic developments in South Asia from the mid-18th century to the present. (Identical with NES 573).

574a-574b-574c. *History of Japan (3-3-3)* Social, cultural, economic and political history of Japan. 574a: From earliest times to 1500. 574b: 1500-1800. 574c: 1800-present. (Identical with JPN 574a-574b-574c). P. 3 units of any history course.

575a-575b-575c-575d-575e. *Periods in Chinese History (3-3-3-3-3)* [Rpt.] (Identical with CHN 575a-575b-575c-575d-575e, which is home).

576. *Modern China (3)* 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. (Identical with CHN 576).

579. *The Ottoman Empire to 1800 (3)* History of 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. (Identical with NES 579).

580. *The Middle East in the Twentieth Century (3)* (Identical with NES 580).

581. *Work, Motherhood and Female Identity in America: 1945 to the Present (3)* (Identical with W S 581, which is home).

582. *Social History of China (3)* (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. (Identical with W S 583).

584. *History of the Arab-Israeli Conflict, 1800-Present (3)* (Identical with NES 584, which is home).

585a-585b. *Social, Cultural and Political History of Iran from the 7th Century to Present (3-3)* 585a: 600-1500. From Islamic invasions to the aftermath of the Mongol invasions. 585b: The Iranian plateau in the modern era of western imperialism and nationalist Islamic responses. P, NES 277a, 277b, or consent of instructor. (Identical with NES 585a-585b, which is home).

587. *Islamic Mysticism (3)* Origin and development of Sufism and its impact on Muslim and non-Muslim worlds. (Identical with NES 587).

588. *History of Byzantium (3)* Political, social, and cultural history of Byzantium from A.D. 325 to 1453, including the Byzantine legacy in Europe and the Middle East. (Identical with CLAS 588 and RELI 588).


590. *Philosophy of History (3)* 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 era.

595. *Colloquium r.* Chinese History Since 1949 (3) (Identical with CHN 595r, which is home).

596. *Seminar a.* Advanced Studies in United States History (3) [Rpt./10]


c. Advanced Studies in European History (3) [Rpt./10]

e. Advanced Studies in the History of Women (3) [Rpt./10] (Identical with W S 695e).
f. Advanced Studies in Ancient History (3) [Rpt./10] Consult department before enrolling. (Identical with CLAS 695f).

g. Advanced Studies in Asian History (3) [Rpt./3] (Identical with EAS 695g).
h. Comparative History (3) [Rpt./6 units]
i. World History (3)
j. Historiography (3) Open to majors only.

696. *Seminar a.* Colonial U. S. History (3) [Rpt./10]
b. Nineteenth-Century U. S. History (3) [Rpt./10]
c. Twentieth-Century U. S. History (3) [Rpt./10]

d. Ancient History (3) [Rpt./10]
e. Medieval Europe (3) [Rpt./10]
f. Early Modern Europe (3) [Rpt./10] P, Latin and German required.
g. Nineteenth-Century Europe (3) [Rpt./10]
h. Twentieth-Century Europe (3) [Rpt./10]
j. Latin America: Modern Period (3) [Rpt./10] (Identical with LA S 696j).
k. Historical Writing and Editing (3) [Rpt./10]
l. Colonial Latin America (3) [Rpt./10] (Identical with LA S 696l).

n. Comparative Women's History (3) [Rpt./4] P, consult department before enrolling. (Identical with W S 696n, which is home).

o. History and Historiography of Colonial North Africa, c. 1800-1962 (3) (Identical with NES 696o, which is home).

r. Japanese History (3) [Rpt.] (Identical with JPN 696r).

Certain colloquia and seminars in other departments may be used for history graduate credit.
Hydrology and Water Resources

Harshbarger Building, Room 226
Phone: (520) 621-5082
FAX: (520) 621-1422
WWW: http://www.hwr.arizona.edu/deptinfo.html

Application Questions:
Terrie Handloser, (520) 621-3131, programs@hwr.arizona.edu

Advising Questions:
Terrie Handloser, (520) 621-3131, terrie@hwr.arizona.edu

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

Graduate study programs are individually planned to meet the student's special interests and professional objectives.

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, and three letters of recommendation. All students are expected to acquire basic computer programming skills.

Graduate study programs 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 majoring in hydrology unless equivalent courses were taken elsewhere. A Master's thesis is required for hydrology majors. Major's Thesis Report and Major's Thesis Publication options are also available for hydrology majors.

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 coursework prior to the oral qualifying examination.

Hydrology: 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 the fields but should acquire some proficiency in all aspects of hydrology and water resources.

500. Ecosystemology for Urban Planning (3) 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 PLAN 500).

503. Subsurface Fluid Dynamics (3) 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) 322 or 422a or 422b, C E 331 or A ME 331. (Identical with C E 503).

504. Numerical Methods in Subsurface Hydrology (4) Finite difference, finite element, and boundary integral methods for subsurface fluid flow and mass transport; applications to aquifers, unsaturated soils, earth structures. P, MATH 422a or consult department before enrolling. (Identical with C E 504).

505. Vadose Zone Hydrology (3) Fundamentals of flow and transport in the vadose zone, including multiphase flow. Methods for characterization of hydraulic properties. Vadose zone processes relative to ground water contamination. P, 407 or 503 or 518.

506. Water Quality Dynamics (3) 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, 517R/L.

508.* Vadose Zone Monitoring (2) Laboratory and field methods for characterizing water flow and contaminant transport through unsaturated geologic media. 6L. P, 407.


514.* Field Hydrology (Surface Water) (1) 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. Fee. P, 250 or 423 or 440.

515.* Introduction to Water Resources Policy (3) 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. P, MATH 125a (Identical with GEOG 515).


517R. Fundamentals of Water Quality (3) 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. 517R may be taken in conjunction with or independent of 517L; however, 517R is prerequisite to 517L. P, CHEM 103B, PHYS 241, and MATH 125B; CR or P, MATH 254.

The department offers programs leading to the Master of Science degree with majors in hydrology or in water resources administration and the Doctor of Philosophy degree with a major in hydrology or in water resources administration. The faculty offers competence in hydrogeology, hydrogeochemistry, hydrogeology/hydroclimatology, environmental hydrology, ground-water hydrology, surface-water hydrology, vadose zone hydrology, mathematical and statistical methods in hydrology (including numerical modeling), water resources administration, water resources systems, and planning, management, and administration.
517L. Fundamentals of Water Quality Laboratory (1) Field and laboratory methods in water quality sampling and analysis. Includes both wet chemical and instrumental methods of analysis. Fee. P, CR, 517R.


520. Water Resources Management, Planning, and Rights: A Policy Approach (3) 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) 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) (Identical with G EN 522, which is home).

523.* Hydrology (3) (Identical with C E 523, which is home).

524. Hydroclimatolgy (3) 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. P, non-majors should consult department before enrolling. (Identical with ATMO 524).

525. Water Quality Modeling (3) (Identical with C E 525, which is home).

526. Water Quality Management (3) Optimization and systems analysis techniques used in modeling; current models used in formulation and implementation of water quality policy. P, MATH 256. (Identical with C E 526).

527.* Computer Applications in Hydraulics (3) (Identical with C E 527, which is home).

531.* Hydrogeology (4) Hydrologic and geologic factors controlling the occurrence and dynamics of groundwater on regional and local scales. Fee. P, GEOS 101, 103; MATH 125a. (Identical with GEOS 531).

535. Advanced Subsurface Hydrology (3) Advanced aquifer and well hydraulics; heterogeneity, unsaturated flow; natural and artificial recharge; groundwater and surface-water interaction; mass and heat transport. P, MATH 223 or 322 or 422a or 422b. (Identical with GEOS 535).


540.* Advanced Surface Water Hydrology (3-4) Theory and selected design problems from fluvial dynamics, flood hydrology, flood routing, and water supply hydrology. 3R, 1D. Discussion section is mandatory for undergraduates. Field trip, P, 250R and 250L or 423, C E 321.

543. Environmental Risk and Economic Analysis in Water Resources (3) Applications of quantitative methods to water resource management; environmental risk analysis; benefit-cost analysis; optimization; structure and basis of planning process. P, MATH 125a.

545.* Statistical Hydrology (3) 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.

550a-550b.* Environmental Hydrology (3) Chemistry of surface and subsurface water, the predominant chemical processes affecting composition in relation to humanity's use; classification, identification, and mobility of contaminants; introduction to chemical and transport modeling, 550a (spring semester) focuses on inorganic chemistry. 550b (fall semester) focuses on organic aquatic chemistry. P, CR, 450a or 451; concurrent registration with 551 is not required for 550b.

551.* Environmental Hydrology Laboratory (1) Laboratory procedures related to chemistry of surface and subsurface water. P or CR, 450a or equivalent. Fee.

560.* Watershed Hydrology (4) (Identical with WS M 560, which is home).

563. Isotope Hydrology (3) (Identical with GEOS 563, which is home).

566.* Soil and Groundwater Restoration (3) (Identical with SWES 566, which is home).

569. Spatial Analysis for Hydrology and Watershed Management (2) (Identical with WS M 569, which is home).

570. Computer Simulation of Hydrochemical Processes (3) Introduction to the fundamentals of solving complex water chemistry problems using computer codes as tools. Equilibrium, mass transfer, or 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, 506 (recommended) or 517R/L.

572. Global Biogeoc hemical Cycles (3) (Identical with GC 572, which is home).

576. Advanced Natural Resource Economics (3) (Identical with AREC 576, which is home).

577. Advanced Topics in the Economics of Environmental Regulation (3) (Identical with AREC 577, which is home).

578.* Global Change (3) (Identical with GEOS 578, which is home).

581.* Environmental Policy (3) (Identical with POL 581, which is home).

582.* Applied Groundwater Modeling (3) Introduction to ground-water flow and transport modeling, with emphasis on model construction and simulation. 3R, 3L.

583.* Physical Oceanography and Limnology for Hydrologists (2) Origin, distribution, and characteristics of oceanic water; advective and convective processes; estuarine and shoreline processes; effect on coastal aquifers; classification and hydrologic regimen of lakes. P, MATH 125b.

584. Advanced Applied Groundwater Modeling (3) Advanced applied ground-water flow and transport modeling for saturated and unsaturated media using variety of current software packages. 2R, 1L. P, 482 or 582 or equivalent course.

590.* Remote Sensing for the Study of Planet Earth (3) (Identical with REM 590, which is home).

595. Colloquium
   a. Global Climate Change (2) [Rpt./1] (Identical with ATMO 595b, which is home).
   c. General Circulation Observations and Modeling (1-3) (Identical with ATMO 595c, which is home).

596. Seminar
   k. Risk and Society (3) [Rpt./1] (Identical with GEOG 596k, which is home).

597. Workshop
   a. Computational Tools EOS Hydrology (1-2) [Rpt./1] P, some previous knowledge of UNIX desirable.

603. Advanced Topics in Subsurface Hydrology (2) Topics to be selected among (a) geostatistical and stochastic analyses of flow and transport, (b) well hydraulics and pumping test analysis, and (c) flow and transport in fractured rocks. P, 503 or 535.

605. Soil Water Dynamics (3) (Identical with SWES 605, which is home).

642. Analysis of Hydrologic Systems (3) Presentation and evaluation of a variety of mathematical modeling techniques; presentation of theoretical basis of linear/nonlinear systems, advantages and limitations of various approaches, e.g., linear vs. nonlinear, lumped vs. distributed, used in hydrologic modeling; interrelation between function development and model calibration requirements. P, MATH 254.

643. Water Resources Systems Analysis (3) Applications of mathematical programming to the analysis of interactions of hydrology, engineering, economics, and socio-institutional environment in regional water resources systems. P, 521 or consult department before enrolling.

Information Resources and Library Science (IRLS)

1515 E. First St.
Phone: (520) 621-3565
FAX: (520) 621-3279
WWW: http://www.sir.arizona.edu

Application Questions:
Kathryn Wilka, (520) 621-3565, wilka@u.arizona.edu

Degrees Offered: M.A., Ph.D.
Professors: Charlie D. Hurt III, Director, Donald C. Dickinson (Emeritus), Margaret F. Maxwell (Emerita), Lawrence Clark Powell (Emeritus), Elinor C. Saltus (Emerita), Arnulfo D. Trejo (Emeritus)
Associate Professor: Helen M. Gothberg (Emerita), Charles A. Seavey
Assistant Professors, H. Martin Frické, Sandra G. Hirsch, Margaret Higgins

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 program is accredited by the American Library Association and 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) Introduction to information as it is used and defined by society. Geography of information, economics of information, and intellectual property concerns.
501. * Knowledge Structures I (3) 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.
504. * Foundations of Library and Information Services (3) Elements of librarianship, responsibilities, methods of evaluation of 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.
506. Research Methods I (3) Research methodology, research design, and elementary statistics.
509. Information Sources for Agricultural Scientists (1) (Identical with PL S 509, which is home).
543. * Knowledge and Society (3) (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.
581. * School Library Administration and Organization (3) Services, finances, personnel, evaluation, quarters, organization, and technical services in the school library.
588. Issues in Information Resources (3) [Rpt/3] Examines problems associated with current issues in information resources and other information centers.
589. Scholarly Communication (3) 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).
600. Introduction to Graduate Study in Music (3) (Identical with MUS 600, which is home).
601. Knowledge Structures II (3) Theory of classification, subject approaches to information, and advanced data coding.
606. Research Methods II (3) 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) (Identical with SIE 696g, which is home).
612. Expert Systems in Information Resources (3) Examines the role and place of expert systems. Emphasis on development of knowledge-based systems.
613. Systems Analysis and Evaluation (3) Introduction to quantitative methods for the design, analysis, and control of library systems.
614. Information Theory and Transfer (3) 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.
622. Advanced Information Resources (3) Analysis of information needs of subjects specialists. Approaches to evaluation of information exchanges and sources.
624. Health and Medical Informatics (3) Information systems used in health and medical settings. Particular attention is given to the integration of traditional and nontraditional methods of information transfer.
695. Colloquium
a. Theory of Classification (1-3)
b. Children's and Youth Services and Literature (2-3) [Rpt.]
696. Seminar
a. Current Research Trends (1-4) [Rpt.]
b. Current Resources in School Libraries (3)
c. Information Resources (3)
796. Seminar
a. Advanced Topics in Information Resources (3) [Rpt/2]
Degrees Offered: Ph.D.
Application Questions:
Graduate Interdisciplinary Program in Insect Science
WWW: http://grad.admin.arizona.edu/IDPs/insdinsc.html
FAX: (520) 621-1150
Phone: (520) 621-1152

Degrees Offered: Ph.D.

Assistant Professors: Leticia Avilés
Associate Professors: Diana E. Wheeler, Judith L. Bronstein
Professors: William S. Bowers (Entomology), Danny L. Brower (Molecular and Cellular Biology), Reginald F. Chapman (Arizona Research Laboratories, Division of Neurobiology), Rene F. Feyereisen (Entomology), Henry H. Hagedorn (Entomology), John G. Hildebrand (Arizona Research Laboratories, Division of Neurobiology), Margaret G. Kidwell (Ecology and Evolutionary Biology), Richard B. Levine (Arizona Research Laboratories, Division of Neurobiology), Nancy A. Moran (Ecology and Evolutionary Biology), Nicholas J. Strausfeld (Arizona Research Laboratories, Division of Neurobiology), Bruce Tabashnik (Entomology), Michael A. Wells (Biochemistry)

Associate Professors: Diana E. Wheeler, Chair (Entomology), Judith L. Bronstein (Ecology and Evolutionary Biology), Wayne P. Maddison (Ecology and Evolutionary Biology), Daniel R. Papaj (Ecology and Evolutionary Biology), Robert L. Smith (Entomology), Leslie P. Tolbert (Arizona Research Laboratories, Division of Neurobiology)

Assistant Professors: Leticia Avilés (Ecology and Evolutionary Biology), Judith Brown (Plant Sciences), Martha Hunter (Entomology), David R. Maddison (Entomology), Lynn J. Manseau (Molecular and Cellular Biology), David B. Morton (Arizona Research Laboratories, Division of Neurobiology), Lisa Nagy (Molecular and Cellular Biology), Linda L. Restifo (Arizona Research Laboratories, Division of Neurobiology), Martin F. Taylor (Entomology), Gary Thompson (Plant Sciences), Joy Winzering (Nutritional Sciences)

Associate Research Scientist: David N. Byrne (Entomology)

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. The 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. Advanced Topics in Ecology and Evolutionary Biology (4-3) (Identical with ECOL 500a-500b, which is home).

503R. Biology of Animal Parasites (3) (Identical with V SC 503R, which is home).

503L. Parasitology Laboratory (1) (Identical with V SC 503L, which is home).

505. Aquatic Entomology (3) (Identical with ENTO 505, which is home).

507. Insect Physiology (3) (Identical with ENTO 507, which is home).

508. Insecticide Toxicology (3) (Identical with ENTO 508, which is home).

511. Insect Behavior (3) (Identical with ENTO 511, which is home).

515R. Insect Biology (3) (Identical with ENTO 515R, which is home).

515L. Insect Biology Laboratory (1) (Identical with ENTO 515L, which is home).

517. Insect Systematics (4) (Identical with ENTO 517, which is home).

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

544. Insect Ecology (3) (Identical with ENTO 544, which is home).

545. Concepts in Genetic Analysis (3) (Identical with MCB 545, which is home).

552. Medical-Veterinary Entomology (4) (Identical with ENTO 552, which is home).

555. Molecular Mechanisms of Development (3) (Identical with MCB 555, which is home).

568. Nucleic Acids (4) (Identical with BIOL 568, which is home).

570. Biological Control (3) (Identical with ENTO 570, which is home).

588. Principles of Cellular and Molecular Neurobiology (4) (Identical with NRSC 588, which is home).

595. Principles of Systems Neurobiology (4) (Identical with NRSC 559, which is home).

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. Consult the Insect Science program office prior to enrolling. Open to majors only.
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) 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. Open to majors only.

503. Advanced Photojournalism (3) Reporting and interpreting the news through photos, photo documentaries, and photo analysis. Open to majors only. P, 301, 302.

505. The Study of News (3) Critical study and problem analysis of the media. Field work may include publication of conclusions.

506. Magazine Color Photography (3) Techniques for taking and editing color photographs to illustrate magazine articles. Preparation of resumes and photo portfolios. Field trips.

511. News Features (3) Writing the basic news feature article; specialized reporting and rewriting techniques. P, 206.

513. Reporting Public Affairs (3) Study and practice of gathering information on executive, legislative, and judicial levels in city, county, state, and federal governments, with emphasis on news sources and interpretive writing. P, 206, 208. Department consent required to enroll.

514. The News Agency: Arizona News Service (1) [Rpt.] Role and operations of the news agency, wire service or syndicate. Class members will form staff of Arizona News Service to supply content to newspapers and periodicals in Tucson and Phoenix. Field trips, P or CR, 411 or 413. Department consent required to enroll.

517. Sports News Writing (3) Students will cover sports events and write features. Interview and rewriting techniques. P, 206.


539. Ethics and the News Media (3) 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. (Identical with LA S 539).

550. Community Journalism: The Tombstone Epitaph (3) [Rpt.] Class members work as editorial staff to produce the local newspaper for Tombstone, Arizona. Intensive study of problems and responsibilities of community newspapers. P, 206, 208, discussion of preparation with instructor.

551. Community Journalism: El Independiente (3) [Rpt.] 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, 206, 208, discussion of preparation with instructor.


571. International Communications (3) Study of world news systems, including news gathering agencies, role of the foreign correspondent, the foreign press, the factors influencing international news flow.

596. Seminar
b. News Analysis (3) *Directions in News Technology (3) [Rpt./1].

Landscape Architecture (See Renewable Natural Resources, School of)....

Language, Reading and Culture (LRC)

Education Building, Room 512 Phone: (520) 621-1311 Voice/TTY
FAX: (520) 621-1853
WWW: http://www.ed.arizona.edu/depart/lrc/lrcinfo.htm

Application Questions: Graduate Secretary, lrcinfo@mail.ed.arizona.edu
Advising Questions: (520) 621-1311, lrcinfo@mail.ed.arizona.edu
Degrees Offered: M.A., M.Ed., Ed.S., Ed.D., Ph.D.

Professors: Richard Ruiz, Head, Patricia L. Anders, Kenneth G. Goodman, Yetta M. Goodman, Amelia Melnik (Emerita), Luis C. Moll, Judy Nichols Mitchell, William J. Valmont
Associate Professors: Adela A. Allen, John M. Bradley, Margaret B. Fleming (Emerita), Teresa McCarty, Marcello Medina Jr., Kathleen Short
Assistant Professor: Dana L. Fox
Clinical Assistant Professor: Arminda R. Fuentevilla

The department offers programs leading to the Master of Arts degree with majors in bilingual/bicultural education and to the Master of Arts degree with majors in bilingual/multicultural education and in language, reading, and culture. The department also offers programs leading to the Educa-

Current Index to Journals in Education (3) Linguistic, psychological, and cultural bases of decoding and comprehension, theories that influence practice; materials and practices that facilitate learning to read.

510. Foundations of Bilingual Education (3) Socio-cultural factors, language practices and education; analysis of theories and practices affecting bilingual learners; historical, social, and cultural influences; relationship of theory to the characteristics and needs of the bilingual learner.

512. Educating the Culturally Diverse (3) Issues faced in education associated with ethnic and linguistic pluralism in the United States; analysis of the interaction of school, community, cultural, and family factors in the education of diverse populations.

514. Bilingual Reading and Writing (3) Analysis of reading and writing situations encountered by bilingual students; phonological, semantic, and syntactic aspects of instruction; methods and materials. May be convened with 514.

515. Media and Reading, Language and Arts (3) Procedures for planning, creating, and using effective media presentations in reading and language arts instructional settings.

518. Methods and Materials in Bilingual Education (3) Analysis and evaluation of methods and materials used in bilingual education programs; effective strategies in first and second languages; concurrent and separate language approaches and cooperative models. P, 504.

527. Developing Language Arts Curriculum (3) Curriculum theory and models; staff development for implementing change; scope and sequence; planning effective learning experiences. P, 504 and 505.

528. Bilingual Curriculum Development (3) Theory and application of curriculum development to bilingual instructional programs: designs, organizational patterns, materials and media, change strategies, and evaluation.
530. Computer Application for Teachers (3) Introduction to computer applications for language arts and other educators; 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.

532. Pre-Reading and Beginning Reading Development (3) An examination of various aspects involved in pre-reading and beginning reading development, including psychological, sociological, physiological, linguistic, and educational considerations.

535. Content Area Literacy in a Multicultural School (3) Prepares teachers to integrate knowledge of cultural diversity and literacy processes with their content and specialization. P, admission to the College of Education.

537. Classroom Diagnosis and Instruction (3) Procedures for diagnosing and developing reading and writing skills for pupils of below-average achievement level. P, 505, 507 or CR.

545. Research in Computer Language Arts (3) 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 Psycholinguistic Perspective (3) 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) 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.

554. Applied Linguistics in Education (3) The application to curriculum, teaching, and learning of concepts from linguistics, psycholinguistics, and sociolinguistics. P, 551 or CR.

555. Application of Miscue Analysis (3) 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, 551 or CR.

559. Whole Language: Curriculum and Organization (3) Whole language pedagogy: theory, curriculum, organization, and practice. Application will be made to all levels in first and second languages. Field trip.

570. Language Research Methodology in Education (3) Investigation of procedures for conducting literacy research; examples of literacy research paradigms; critical analysis of evidence supporting literacy practices. P, 507 or 551.

578. Field Experience (3) Supervised experience in assessment and instruction of literacy-related practices. P, 504, 505 or CR.

580. Children's Literature in the Classroom (3) 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.

581. Multicultural Literature and Literacy (3) Analyzes the use of multicultural literature that fosters self-concept, acceptance, and a sense of identity to develop literacy. Includes readings from the major categories of multicultural literature about Black, Native, Hispanic, and Asian Americans.

583. Literature Discussions (3) 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.

597. Workshop (3) Southern Arizona Writing Project (3-9) [Rpt./12 units] (Identical with ENGL 597a, which is home).

599. Grammatical Analysis (3) [Identical with ENGL 612, which is home].

601. Metaphor and Culture (1-3) [Rpt./2 units] (Identical with SER 595a, which is home).

627. Curriculum Development and Supervision in Language Arts (3) 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, 527.

634. Reading Comprehension: Theories, Research and Methods (3) 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, 507.

635. Reading and Writing in Content Areas (3) Methodology appropriate for reading and writing to learn content; compatible organizational models; program implementation. P, 504, 505, 507 or 531 or CR.

638. Reading Diagnostic Laboratory (3-6) [Rpt./6 units] Supervised practice in reading assessment; identification of factors influencing reading achievement, evaluation, construction, and administration of assessment procedures; development of interview techniques. P, 507, 537.

639. Reading Instructional Laboratory (3-6) [Rpt./6 units] Supervised practice in teaching reading and writing; preparing, analyzing, and critiquing special instructional programs for students. Open to majors only. P, 507, 537.

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, 505, 533.

694. Practicum (1-3) [Rpt./1] (Identical with SER 595b, which is home).

696. Seminar (1-3) [Rpt./1] P, 15 graduate units including 504, 505.

723. Seminar (1-3) [Rpt./6 units] P, 15 graduate units including 504, 505.

795. Colloquium (1-3) [Rpt./15 units]

796. Seminar (1-3) [Rpt./15 units]

Latin (See Classics)

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) 621-4002,
rrps@ccit.arizona.edu

Advising Questions:
Raul Saba, (520) 621-4002,
rrps@ccit.arizona.edu

Degrees Offered: M.A.

Professors: Ellen Basso (Anthropology), Donald W. Carson (Journalism), Ken Clark (Architecture), Malcolm Compassio (Spanish and Portuguese), T. Patrick Culbert (Anthropology), Robert Dickinson (Atmospheric Sciences), Celestino Fernandez (Sociology), Roger Fox (Agricultural and Resource Economics). Donna J. Guy (History), Lain A. Guymo (Spanish and Portuguese), Boris S. Kozolchyk (Law), Gary Libecap (Economics), Oscar J. Martinez (History), Miguel Mendez (Spanish and Portuguese), Michael C. Meyer (History, Emeritus), Luis Moll (Language, Reading and Culture), Emilio Moran (Anthropology), Andrew Nichols (Family and Community Medicine), Leland Pederson (Geography and Regional Development), Jose Promis (Spanish and Portuguese), Eliana Rivero (Spanish and Portuguese), Richard Ruiz (Language, Reading and Culture), Jacqueline Sharkey (Journalism).
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, including a research seminar, are chosen in the area of concentration. The secondary area consists of a minimum of 9 units. The research seminar (596a) is 3 units. The 9 remaining units consist of the 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 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 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 subcommittee 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 a minimum of 15 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.
### Law (LAW)

1201 E. Speedway Blvd.
Phone: (520) 621-1373
FAX: (520) 621-9140
WWW: [http://www.law.arizona.edu](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:**
Boyd, Robert Emmet Clark (Emeritus), Winton D. Woods, Jr.

**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.**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>510</td>
<td>Courses of Crime and Public Policy (3) (Identical with PSYC 500, which is home).</td>
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<td>511</td>
<td>Development of Federal Indian Policy (3) (Identical with POL 506, which is home).</td>
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<td>Conflict of Laws (3)</td>
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<td>Labor Law (3)</td>
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<td>Taxation of Estates and Trusts (3)</td>
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<td>Antitrust Law (3)</td>
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<td>Corporate Law (3)</td>
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<td>Law and Medicine (3)</td>
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<td>525</td>
<td>Corporations I (3)</td>
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<td>Corporate Finance (2) P, 616.</td>
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<td>Estates and Trusts (4)</td>
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<td>Administrative Law (3)</td>
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<td>531</td>
<td>Law Review (1-3)</td>
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<td>Conflict of Laws (3)</td>
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<td>American Legal History (2)</td>
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<td>535</td>
<td>Jurisprudence (2-3)</td>
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<td>536</td>
<td>Mexican Law (2)</td>
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<td>537</td>
<td>Scientic Evidence (3)</td>
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<td>538</td>
<td>Federal Indian Law (3) (Identical with AIS 631).</td>
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<td>539</td>
<td>Federal and State Taxation of Multinational Transactions (3) P, 646.</td>
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<td>540</td>
<td>Commercial Transactions (3-3) 633b is not prerequisite to 633b.</td>
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<td>541</td>
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<td>542</td>
<td>Basic Insurance (3)</td>
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<td>Federal Tax Procedure (2) P, 646.</td>
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<td>544</td>
<td>Real Estate (3)</td>
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<td>545</td>
<td>Community Property (2)</td>
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<td>546</td>
<td>Mining and Public Land Law (2)</td>
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<td>547</td>
<td>Water Law (3)</td>
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<td>548</td>
<td>Federal Jurisdiction (3)</td>
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<td>Remedies (3)</td>
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<td>550</td>
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<td>Estate and Gift Taxation (3) P, 619.</td>
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<td>Torts II (3)</td>
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<td>556</td>
<td>Criminal Law (3)</td>
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<td>557</td>
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<td>Corporations II (2-3) P, 616.</td>
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<td>583</td>
<td>Basic Insurance (3)</td>
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<td>584</td>
<td>Federal Tax Procedure (2) P, 646.</td>
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<td>585</td>
<td>Real Estate (3)</td>
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<td>586</td>
<td>Community Property (2)</td>
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<td>587</td>
<td>Mining and Public Land Law (2)</td>
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<td>588</td>
<td>Water Law (3)</td>
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<td>589</td>
<td>Federal Jurisdiction (3)</td>
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<td>590</td>
<td>Remedies (3)</td>
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<td>591</td>
<td>Basic Remedies (3) 645a is Basic Trial Advocacy. P, 608, 609, 645b is Advanced Trial Advocacy. P, 608, 609, 645a.</td>
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<td>592</td>
<td>Income Taxation (3-5)</td>
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<td>593</td>
<td>Corporate Taxation (P) P, 646.</td>
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<td>594</td>
<td>Estate and Gift Taxation (3) P, 619.</td>
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<td>595</td>
<td>Contracts (5)</td>
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<td>596</td>
<td>Torts II (3)</td>
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<td>597</td>
<td>Criminal Law (3)</td>
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<td>598</td>
<td>Medical Law (3)</td>
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<td>599</td>
<td>Income Taxation of Estates and Trusts (3)</td>
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<td>600</td>
<td>Federal Tax Procedure (3)</td>
</tr>
<tr>
<td>601</td>
<td>Corporate Law (3)</td>
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<tr>
<td>602</td>
<td>Business Organization (3)</td>
</tr>
<tr>
<td>603</td>
<td>Employment Law (3)</td>
</tr>
<tr>
<td>604</td>
<td>Law and Medicine (3)</td>
</tr>
<tr>
<td>605</td>
<td>Constitutional Law II (4)</td>
</tr>
<tr>
<td>606</td>
<td>Corporations I (3)</td>
</tr>
<tr>
<td>607</td>
<td>Corporate Finance (2) P, 616.</td>
</tr>
<tr>
<td>608</td>
<td>Antitrust Law (3)</td>
</tr>
<tr>
<td>609</td>
<td>Estates and Trusts (4)</td>
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<tr>
<td>610</td>
<td>Immigration Law (3)</td>
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<tr>
<td>611</td>
<td>Administrative Law (3)</td>
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<tr>
<td>612</td>
<td>Law Review (1-3)</td>
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<td>613</td>
<td>Conflict of Laws (3)</td>
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<td>614</td>
<td>Labor Law (3)</td>
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<td>615</td>
<td>American Legal History (2)</td>
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<td>616</td>
<td>Jurisprudence (2-3)</td>
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<td>617</td>
<td>Mexican Law (2)</td>
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<td>618</td>
<td>Scientic Evidence (3)</td>
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<td>619</td>
<td>Federal Indian Law (3) (Identical with AIS 631).</td>
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<td>620</td>
<td>Federal and State Taxation of Multinational Transactions (3) P, 646.</td>
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<td>621</td>
<td>Commercial Transactions (3-3) 633b is not prerequisite to 633b.</td>
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<td>Income Taxation of Estates and Trusts (3)</td>
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653. Advanced Appellate Practice and Moot Court (2)
654. Environmental Legislation (2)
656. Sentencing Law (2)
657. Partnership Taxation (3) P, 646.
658. Securities Regulation (3)
659. International Humanitarian Law (3)
660. Land-Use Planning (3) (Identical with PLAN 660, which is home).
660a. Moot Court Board (2-2) 660b: Moot Court PLAN 660, which is home).
661a -661b. Moot Court Board (2-2) 661a:
660. Land -Use Planning (3) (Identical with
658. Securities Regulation (3)
659. International Humanitarian Law (3)
660. Land-Use Planning (3) (Identical with
Mulligan (Emeritus), Thomas R. Navin (Emeritus), Gregory B. Northcraft, Amnon Rapoport, George W. Summers (Emeritus)

Associate Professors: Marvin Fortman, David A. Tansik, Robert E. Tindall
Assistant Professors: Terri L. Griffith, Kenneth W. Koput, Lisa D. Ordoñez

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.

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 students.

500. Management Case Analysis and Presentation (3) 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) (Identical with PHL 502).

503. Human Resource Management (3) Principles, methods, research relevant to management of an organization's human resources, with emphasis on employment psychology, training, development, compensation. P. 305 or 502.

505. Organizational Power (3) Development of organizational power and influence techniques for individuals and groups. Uses cases and practical experience to build on motivation, negotiation, and group dynamics. P. 302.

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. CR, 502. Open to MBA students only.

539. Planning of New Ventures (3) New venture development, financial projections, resource assessment, and long-range planning. Open only to students in the entrepreneurship program. P. ECON 500a-500b, FIN 511, MKTG 500. (Identical with MKTG 539).

538. Marketing, Negotiation and Decision Tactics (3) Development of bargaining and decision-making skills through simulated negotiations and role playing. Open only to students in the entrepreneurship program. P. ECON 500a-500b, FIN 511, MKTG 500. (Identical with MKTG 538).

537. Finance for New Ventures (3) (Identical with FIN 537, which is home).

536. Gender Issues in Organizational Behavior (3) 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).

560. Management of Technology (3) 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. 305 or 502.

568. Environmental Scanning and Business Strategy (3) (Identical with MKTG 568, which is home).

The department offers a program leading to the Master of Science degree with a major in management information systems. The department also participates in programs leading to the Master of Public Administration, Master of Business Administration, and Doctor of Philosophy (major in management) degrees.

Management information systems involves the use of computers in organizations and the integration of computer skills with the functional areas of management. Education in management information systems enables students to pursue careers involving the use, definition, analysis, design, implementation, and operation of computer information systems.

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 (696b).

506. Business Communication in Operations Management (3) 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. C, 567. Open to MBA students only.

507a-507b. Information Systems Architecture and Data Communications (3-3) 507a: Fundamental concepts of operating systems. The principles and techniques required for engineering and understanding operating systems are covered. Examples from real systems are given to illustrate application of particular concepts. Hardware architecture that is relevant for understanding operating systems. 507b: Comprehensive view of data and computer communications. Explores key issues in the field, in the general categories of principles (including basic concepts and terminology used in the field); design approaches and applications in business; standards such as the IEEE, OSI, TCP/IP, and others. P, 507a.

511. Social Issues of Computing (3) Broad survey of the individual, organizational, cultural, social, and ethical issues provoked by current and projected uses of computers.

521a-521b. Systems Modeling and Simulation (3-3) 521a: Topics include concepts of simulation, simulation software, model validation, selecting input probability distributions, random variate generation, statistical analysis of output data. SIMAN simulation language is covered. Previous programming experience is helpful, but not required. P, fundamental knowledge of probability and statistics. 521b: Modeling and analyzing complex systems using advanced simulation and statistical techniques. A semester project is required. P, 521a or equivalent course. (Identical with C SC 521a-521b and IE 521a-521b).

522. Linear Programming and Applications (3) Recognition, formulation, and solution of linear programming models for decision making. Modeling issues illustrated using examples from systems design, manufacturing, logistics, finance, etc. P, MATH 119.

531a-531b. Data Structures and Database Management (3-3) 531a: Abstract data types, data structures and their implementation in Pascal programs. Data structures covered include stacks, queues, lists, and trees. 531b: 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 Codasyl 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, 531a.

541a-541b. Computer-Aided Information Systems Analysis and Design (3-3) Introduction to the management and techniques associated with software development, both domestically and internationally with focus on the analysis and design stages. Emphasizes international issues. Involves "hands-on" experience with Computer-Aided Software Engineering (CASE) tool. (Identical with C SC 541a-541b).

546. Algorithms for Graphs and Network (3) Model formulation and solution of problems on graphs and networks. Topics include heuristics and optimization algorithms for shortest paths, min-cost flow, matching, and traveling salesman problems. Credit is allowed for this course or ESE 546. P, 552 or ESE 544 or consent of instructor.

550. International Dimensions of Information Technologies (3) 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.

551. Advanced Business Programming (3) Business systems programming environment; basic and advanced CORBA; file organization and access methods; external sort and multi-key files; 4GLs in data processing. P, 501.

553. Software Systems (3) 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, 301.

554. Computer Graphics (3) Interactive computer graphics; user interface design; pictorial data structures and management. P, 531a.

557. Design and Control of Production Systems (3) Introduction to the basic concepts in operations management. Topics covered include project planning, aggregate planning, forecasting, classical inventory models, linear programming, and simulation. Open only to graduate students in BPA.

560. Management and Evaluation of Information Systems (3) 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. Open only to students admitted to BPA graduate programs. P, ECON 500 or consent of instructor.

572. Operations Management (3) Manufacturing operations from a tactical standpoint. Major topics include materials requirements planning, capability management, scheduling and JIT planning and control. P, 567 or consent of instructor.

573a-573b. Production and Operations Management (3-3) Productive systems, including service systems; inventory management; activities entailed in selecting, designing, operating, controlling, and updating systems. 573a: Forecasting, aggregate planning, MRP, inventory models under uncertainty, scheduling. P, 373. 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 the human problems and quantitative methods. P, 373.

574. Current Topics in Operations Management (3) Coverage of new techniques and technologies in operations management. Examples of topics that may be covered are JIT, OPT, robotics. P, 473b or CR.

575. Managing for Quality Improvement (3) Operational aspect of quality improvement. Topics include statistical process control, total quality management. P, 573.

576. Management of Service Operations (3) Application of operations management concepts to service organizations; exploration of critical issues such as location, layout, scheduling, and capacity management; case analyses and/or term project. P, 373.
577. *Materials and Logistics Management (3) Organization, management, and control of material flow processes; logistical strategies and relationships of procurement, handling, warehousing, transportation, and inventory control. P, 373, 473a.

578. *Project Management (3) Definition of programs and projects, organizational forms, developing the work breakdown structure, scheduling techniques (PERT and CPM), control mechanisms such as milestones, cost reports, and progress reports. Lectures and case analyses. P, 373.


580. *Introduction to Expert Systems (3) An in-depth technical background on the concepts and skills essential to analysis, design, and development of business expert systems. Topics include applications and development in AI, knowledge-based systems architecture, knowledge representation and acquisition, and Prolog; focus on business problem solving.

583. Stochastic Models in Management Science (3) Markov chains, models or arrival processes, continuous-time Markov chains, queuing theory, models of computer and manufacturing systems. P, MATH 123.

584. Combinatorial Optimization and Integer Programming (3) Introduction to the formation, solution, and implementation of integer programming models, for decision making where the choices are discrete. Topics include network flow models, computational complexity, branch-and-bound and cutting-plane methods. P, 422 or 522.


588. Systems Design for Management (3) Focuses on automated tools to support managers in organizing processes including office automation, decision support systems, GDSS; applications and methodologies for designing, implementing, and evaluating such systems and their organizational impact.

597. Workshop a. *Collaboration Computing (3) 611a:611b. Topics in Research Methodologies in MIS (3) 611a: 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: Provides a knowledge of research methodologies used in the MIS discipline, including experimental design, surveys, case studies, field work, and software engineering.

646. Combinatorial Optimization and Integer Programming (3) Formulation, solution and implementation of integer problems, for decision making where choices are discrete. Methods include branch-and-bound, cutting-plane methods and Lagrangean relaxation. Credit is allowed for this course or SIE 646. P, 522 or SIE 544 or consent of instructor.

671. International Issues (3) 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). Regional developments and problems. Sectoral emphases on international technological developments and issues related to the globalization of the information technologies. P, graduate standing and at least one 500-level MIS or equivalent course.

680. Advanced Topics in Artificial Intelligence (3) In-depth discussion of advanced AI topics such as natural language processing, cognitive modeling techniques, machine learning techniques, and neural network computing. Hands-on projects are required. P, 531a. Open to all graduate students.


796. Seminar a. Research Issues (3) [Rpt./6 units] Open to majors only.

357. Industrial Marketing (3) Problems and methods of marketing decision-making in industrial, government, and high-tech markets. P. 500.

359. Product Strategy (3) Formulating and implementing strategy for growth; analyzing and influencing market structure; developing, pricing, testing new entries; managing the portfolio. P. 500.

360. International Marketing (3) Marketing planning and strategies for foreign environments; cultural, political, economic factors affecting the international marketer, multinational corporation and multinational market groups. P. 500.

365. Management for Global Competitive Success (3) Developing comprehensive strategies and programs for delivering quality goods and services to consumers as a basis for global competitive success. P. 500 or consult department before enrolling.

368. Environmental Scanning and Business Strategy (3) 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. Open only to BPA graduate students. Includes case method approach to problems facing top management in making and effecting a strategic plan. P. 500, ECON 500, FIN 511. (Identical with ECON 568 and MAF 568).

572. Marketing Research for Managers (3) Specification of management information needs, evaluation of research proposals and findings, methods of gathering and analyzing data, administrative aspects of research and decisions. P. 500.

582a-582b. Multivariate Analysis in Management (3-3) 582a: Multiple, polynomial, stepwise regression including indicator variables, inference, remedial measures. 582b: Analysis of variance and covariance, principal components, discriminant analysis, canonical correlation. P. 552. 582a is prerequisite to 582b.

612. Survey and Qualitative Marketing Research Methods (3) 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. 500.

673. Experimental Research Methods in Marketing (3) Statistical, methodological, and interpretive issues in the design of laboratory and field experiments/ quasi-experiments for marketing and consumer research. P. 500.

695. Colloquium
   a. Research in Marketing (1) [Rpt./7]

696. Seminar
   a. Perspectives and Principles for Research in Marketing (3)

Materials Science and Engineering (MSE)
Mines Building, Room 135
Phone: (520) 621-6071
FAX: (520) 621-8099
WWW: http://www.mse.arizona.edu

Application Questions:
Geri Hardy, (520) 322-2960, geri@aml.arizona.edu
Advising Questions:
David Lynch, (520) 621-6071, Lynch@bigdog.engr.arizona.edu

Degrees Offered: M.S., Ph.D.
Professors: Donald R. Uhlmann, Head; Paul D. Calvert, William G. Davenport, Louis J. Demer (Emeritus), J. Brent Hiskay, Kenneth A. Jackson, W. David Kingery, David C. Lynch, David R. Poirier, Srini Raghavan, Richard A. Swalin (Emeritus), Terry T. Triffet (Emeritus), Michael C. Weinberg

Assistant Professors: Dunbar P. Birnie, III, Pierre A. Deymier, 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 department 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 requirements 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 scheduled graduate-level classes; 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 colloquium, 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 institutions. A student must take a minimum of 20 units in residence.

Applicants with undergraduate backgrounds in materials science and engineering or in related science disciplines 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 take 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 candidate 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. Exceptional B.S. applicants may be admitted directly into the Ph.D. program. Completion 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 requirements are available from the department office.


503. Applied Surface Chemistry (3) 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.


509. Transport Phenomena (3) Principles of momentum, energy, and mass transport, as applied to materials processing. 3ES. P, 240, MATH 254.


511. Mineral Processing (3) (Identical with MIN 511, which is home).

512. Physical Chemistry of Materials (3) Physical and chemical topics of interest to material scientists including surface chemistry, electrochemistry, and chemical kinetics. 3ES. P, 240.

523. Electrochemistry in Materials Science (3) Principles and applications of electrochemistry in materials science with emphasis on charge-transfer reactions at electrode-solution interfaces; including electrodeposition, electroforming, electrolss plating. 2.5ES, 0.5ED, P, 240.

524. Physics and Chemistry of Ceramic Materials (3) Ceramic crystal structures, crystal chemistry, phase equilibria, and sintering theory. 3ES. P, 260 or consult department before enrolling.

532. Solid-Fluid Reactions (3) (Identical with CHEE 532, which is home).


534. Advanced Topics in Electronic Materials (3) (Rpt.2) Topics to be selected from ferroelectrics, opto-electronics, wave guides, and semiconductor materials. (Identical with ECE 534 and OPTI 534).

535. Corrosion and Degradation (3) The science of corrosion and degradation reactions and its application to engineering problems. 2ES, 1ED, P, 331R, 412 or CHEM 480B or CR. (Identical with CHEE 535 and ENGR 535).


540. Thermodynamics of Condensed Phases (3) Advanced treatment of the principles of thermodynamics with application to electronic and optical materials; emphasis on solutions, defect chemistry and modeling of multicomponent systems. 3ES. P, 240.


544. Design Competition (3) Students utilize their research experience in formulating and developing a materials design project 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.

551. Atomistic Computational Techniques in Materials Science (3) 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) Introduction to the nondestructive testing and evaluation of the various classes of engineering materials. Methods considered include leak detection, penetrant, electromagnet, radiographic, ultrasonic, electrical, electronic, eddy current, acoustic emission, and thermal. 2R, 3L, 1ED, P, 331R or 360, or CR.

554. Electronic Packaging Principles (3) (Identical with ECE 554, which is home).

555. Physical Metallurgy and Processing of Steel (3) 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, 1ED, P, 331R or 360; 409 or A ME 442.

557. Integrated Circuit Laboratory (3) (Identical with ECE 557, which is home).

560. Materials Science of Polymers (3) Introduction to physical properties of polymers. Microstructure, crystallization, rheology, relaxation and mechanical properties. 1.5ES, 1.5ED. P, 331R or 360R.

561. Biological and Synthetic Materials (3) Discussion of structure and properties of biological materials and composites, such as bone, teeth and elastin. Synthetic materials as substitutes for biological materials, biocompatibility. 1.5ES, 1.5ED, P, CHEM 103a.

562. Structure and Properties of Polymers (3) 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. Topics include high modulus fibers, nonlinear optical properties, conducting polymers, and resins for composite materials. 1.5ES. 1.5ES. P, 460.

565. Microelectronic Packaging Materials (3) 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 565).

570. Technology of Polymers and Ceramics (3) Processing and properties of polymers and ceramics in a wide range of technological applications. Discussion of patent literature. 3ED. P, 240 or 331R.


578. Design, Production and Performance of Ceramics and Metals (3) How design procedures and outcomes for materials and material processing depend on social and cultural compromises among performance characteristics. (Identical with ANTH 578).

579. Culture and Materials Technology (3) (Identical with ANTH 579, which is home).

580. Experimental Methods for Microstructural Analysis (3) An introduction, through a combination of lectures and laboratory experiences, to both established and new techniques for microstructural characterization of materials. 3ES.

585. Technological Forecasting (3) Introduction to basic forecasting techniques which include causal models, trend extrapolation, growth curves, relevance trees, and other models. 2ES, 1ED, P, MATH 125b or knowledge of calculus. (Identical with ENGR 585).

586. Technology and Society (3) The evolution of our technological civilization will be discussed with emphasis on possible future models of technological organizations and on
the changing roles of the scientist and engineer. 1ES, 2ED. (Identical with ENGR 506).


595. Colloquium a. Materials (1) [Rpt./5]

Mathematics (MATH)
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Phone: (520) 621-2068
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WWW: http://www.math.arizona.edu

Application Questions:
Graduate Secretary, bridge@math.arizona.edu

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

Associate Professors: Bruce J. Bayly, Moysey Brio, Marta Civil, William E. Conway, Carl L. DeVito, Leonid Friedlander, Oma Hamara, Theodore W. Laetsch, Daniel Madden, Robert S. Maier, Douglas M. Pickrell, Marek Rychlik, Zhen-Su She, Frederick W. Stevenson, Richard B. Thompson, Douglas Ulmer, Joseph Watkins, Maciej P. Wojtkowski, Bruce Wood, A. Larry Wright

Assistant Professors: Robert Beals, Samuel Evans, Gregory Eyink, Lucas Hsu, Minhhyong Kim, Jiang-Hua Lu, Dinesh S. Thakur, Jan Wehr, Xue Xin

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 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 the departmental faculty.

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 413, 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. No 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 at most, 6 units of approved work outside the department may be included in the program.

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. A minor consisting of approved courses outside the department is also encouraged. 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, rings, 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.

502. * Mathematical Logic (3) Sentential calculus, predicate calculus; consistency, independence, completeness, and the decision problem. Designed to be of interest to majors in mathematics or philosophy. Credit allowed for 402 or 411a, but not both. P, 124 or 125a. (Identical with C SC 502 and PHIL 502).

503. * Foundations of Mathematics (3) 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, 215. (Identical with PHIL 503).

504. * History of Mathematics (3) 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, 125b.

506. Geometry for Elementary School (1-3) [Rpt./3 units] Various topics in geometry for elementary and middle school teachers; such as tesselations, symmetry, length, area, volume, geometric constructions, polychedra, efficiency of shapes, scale drawings taught with a variety of tools and approaches. Students will construct models, use hands-on materials, do laboratory activities, use the computer for geometric explorations and participate in geometric problem solving. P, certified elementary teachers with two or more years experience or consent of instructor.


509a-509b. * Symbolic Logic (3-3) (Identical with PHIL 509a-509b, which is home)

511a-511b. Algebra (3-3) Structure of groups, rings, modules, algebras, Galois theory. P, 415 and 416, or 413 and 415.
513. Linear Algebra (3) Vector spaces, linear transformations and matrices, eigenvalues, bilinear forms, orthogonal and unitary transformations. Credit allowed for 410 or 413, but not for both. P, 215.

514a-514b. Algebraic Number Theory (3-3) Dedekind domains, complete fields, class groups and class numbers, Dirichlet unit theorem, algebraic function fields. P, 511b.

515. Introduction to Abstract Algebra (3) Introduction to groups, rings, and fields. P, 323.

516. Second Course in Abstract Algebra (3) A continuation of 515. Topics may include Galois theory, linear and multilinear algebra, finite fields and coding theory. Polyà enumeration. P, 413.

517a-517b. Group Theory (3-3) Selections from such topics as finite groups, abelian groups, characters, and representations. P, 511b.

518. Topics in Algebra (3) [Rpt./36 units] Advanced topics in groups, rings, fields, algebras; content varies.

519. Topics in Number Theory and Combinatorics (3) [Rpt./36 units] Advanced topics in algebraic number theory, analytic number theory, class fields, combinatorics; content varies.


522a-522b. Advanced Analysis for Engineers (3-3) Laplace transforms, Fourier series, partial differential equations, vector analysis, integral theorems, complex variables. Credit allowed for 522a or 322, but not for both. Credit allowed for 522b or 424, but not for both. P, 254 or 355. 422a is not prerequisite to 422b. Both 522a and 522b are offered each semester.


524. Elements of Complex Variables (3) Complex numbers and functions, conformal mapping, calculus of residues. Credit allowed for 522b or 524, but not for both. P, 223.


526. Real Analysis of Several Variables (3) Continuity and differentiation in higher dimensions, curves and surfaces, change of coordinates; theorems of Green, Gauss and Stokes; exact differentials. P, 425.

527a-527b. Principles of Analysis (3-3) Advanced-level review of linear algebra and multivariable calculus; survey of real, complex and functional analysis, and differential geometry with emphasis on the needs of applied mathematics. P, 410, 424, and a differential equations course.

528a-528b. Banach and Hilbert Spaces (3-3) Introduction to the theory of normed spaces, Banach spaces and Hilbert space operators on Banach spaces, spectral theory of operators on Hilbert spaces, applications. P, 523a, 527b, or 583b.

529. Topics in Modern Analysis (3) [Rpt./36 units] 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) 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 theorem), knots and links or projective geometry. P, 215.

531. Algebraic Topology (3) Poincare duality, fixed point theorems, characteristics classes, classification of principal bundles, homology of fiber bundles, higher homotopy groups, low dimensional manifolds. P, 354a-354b.

534a-534b. Topology-Geometry (3-3) Point set topology, the fundamental group, calculus on manifolds. Homology, de Rham cohomology, other topics. Examples will be emphasized. P, 415 and 423.


538. Topics in Geometry and Topology (3) [Rpt./36 units] Advanced topics in point set and algebraic topology, algebraic geometry, differential geometry; content varies.

539. Algebraic Coding Theory (3) Construction and properties of error correcting codes; encoding and decoding procedures and information rate for various codes. P, 413. (Identical with EC 539)

543. Theory of Graphs and Networks (3) Undirected and directed graphs, connectivity, circuits, trees, partitions, planarity, coloring problems, matrix methods, applications in diverse disciplines. P, 323 or 243 or graduate standing. (Identical with CS 543).


547. Combinatorial Mathematics (3) Enumeration and construction of arrangements and designs; generating functions; principle of inclusion-exclusion; recurrence relations; a variety of applications. P, 215 or 243.

550. Mathematical Population Dynamics (4) (Identical with ECOL 350, which is home).

553a-553b. Partial Differential Equations (3-3) 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 estimates in Sobolev spaces. P, 523b or 527b or 583b.


557a-557b. Dynamical Systems and Chaos (3-3) 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, 422a-422b or 454a.

559a-559b. Lie Groups and Lie Algebras (3-3) Correspondence between Lie groups and Lie algebras, structure and representation theory, applications to topology and geometry of homogeneous spaces, applications to harmonic analysis. P, 511a, 523a, 534a-534b, or consent of the instructor.

560. Elementary School Probability (1-3) [Rpt./unit] Games and other activities that lead naturally to consideration of chance events and data analysis. Activities will relate to number and number 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 of experience or consent of instructor.


564.* Theory of Probability (3) Probability spaces, random variables, weak law of large numbers, central limit theorem, various discrete and continuous probability distributions. P, 322 or 323.


572. Theory of Computation (3) (Identical with C SC 573, which is home).

573. Introduction to Geostatistics (3) 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) [Rpt. /36 units] 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) Applications of machine computation to various aspects of algebra, such as matrix algorithms, character tables and conjugacy classes for finite groups, coset enumeration, integral matrices, crystallographic groups. P, 415 and a knowledge of scientific computer programming language. (Identical with C SC 576).

579. Game Theory and Mathematical Programming (3) Linear inequalities, games of strategy, minimax theorem, optimal strategies, duality theorems, simplex method. P, 410 or 413 or 415. (Identical with C SC 579).


581a-583b. Principles and Methods of Applied Mathematics (3-3) 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, 424 or 422 or CR, 520a.

586. Case Studies in Applied Mathematics (1-3) [Rpt./6 units] 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) Regular and singular perturbations, boundary layer theory, multiscale and averaging methods for nonlinear waves and oscillators. P, 422a-422b or 454.

588. Topics in Mathematical Physics (3) [Rpt./36 units] Advanced topics in field theories, mathematical theory of quantum mechanics, mathematical theory of Statistical mechanics; content varies.

595. Colloquium
a. Math Instruction (1) [Rpt./12 units]
b. Research in Mathematics (1) [Rpt./4]
c. Research in Applied Mathematics (1) [Rpt./4]

596. Seminar
a. Topics in Mathematics (1-3) [Rpt./12]
b. *Mathematical Software (3) [Rpt.] P, 254 or 355, knowledge of "C" programming.
c. Research on Learning (1) [Rpt./3] P, must be accepted into NSF-funded grant program, PRIME.
d. Initiating Reform in the Schools (1) [Rpt./3] P, must be accepted into NSF-funded grant program, PRIME.

597. Workshop
a. Numbers, Algebra and Functions (1-2) [Rpt./3] P, must be accepted into NSF-funded grant program, PRIME.

619. Information Theory (3) (Identical with ECE 636, which is home).

697. Workshop
a. Problems in Computational Science (3) [Rpt./1] (Identical with PHYS 697a).
b. Applied Mathematics Laboratory (3) P, Applied Mathematics core or equivalent. (Identical with PHYS 697b).

Mechanical Engineering (See Aerospace and Mechanical Engineering)
334. Media Industries (3) Examination of a specific topic in media industries: ownership and concentration; media markets and industrial integration. P, Media Arts advanced standing.


576. Broadcast and Cable Programming (3) Investigation of principles, techniques, and current issues in programming for radio and television stations (commercial and public) and cable systems. P, 101.

639. Methods of Media History (3) 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.

696. Seminars
a. Theory and Criticism (3) [Rpt./6 units] (Identical with CCLS 696a).

b. Media Arts History (3) [Rpt./6]
c. Readings in Media Arts (3) [Rpt./9]

Students may earn a maximum of 9 units in M AR 696, of which a maximum of 6 units may be earned in 696a or 696b.

Medical Technology
(See Health Professions)

Medicine (MED/ANES/FCM/MEDI/ NEUR/DBG/OPH/PAT/PE/Psy/ Path/RAD/SURG)
Arizona Health Sciences Center Room 2208
Phone: (520) 626-6518
Fax: (520) 626-4884

Please note: Some College of Medicine courses follow a schedule different from the standard academic calendar.

Interdepartmental (MED)
501. Preparation for Clinical Medicine (12) P, formal admission to the Ph.D./M.D. program and consent of the course director.

505. Social and Behavioral Science (6) P, formal admission to the Ph.D./M.D. program and consent of the course director.

596. Seminar
d. Medicine and Literature: The Human Perspective (2)

i. Comprehensive Cancer Care (1) [Rpt./1] (Identical with RONC 596l, 896l).

m. Mind: Body and Behavioral Health (2) [Rpt./1]

n. Research Methods for Clinical and Epidemiological Studies (2)

625. Human Neuroscience (6) Functional and morphological organization of the human central nervous system. P, consent of instructor. (Identical with NEUR 625, CBA 625, PHCL 825 and PSIO 825.)
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 preceptorships stress the applications of anesthesia, and pain. Clerkships and into the mechanisms of consciousness, in these areas, including investigations conducting both basic and clinical research and pharmacology. The department with particular emphasis on physiology applications of all of the basic sciences, medicine, critical care, and pain management.

Clinical Lecturers: Stacie Noble, Alan E. Zehngut

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 Atherosclerosis Prevention 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 master's degree in public health through a collaborative program with Arizona State University and the University of Arizona; the Preventive Medicine Residency offers postgraduate 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.

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

Research Professor: Ronald R. Watson

Clinical Professors: Pedro Luis Escobar, John Mattox, Alayne Yates

Associate Professors: Paul Gordon (Co-Head), Iris Bell, Louise Canfield, Larry C. Clark, Jennie Joe, Kambiz Nasser (Emeritus), Richard L. Papenfuss, Arthur B. Sanders (Surgery), Catherine M. Shisslak

Associate Professors of Clinical Family and Community Medicine: Pamela Reid-Duffy, Ilene Gordon, Barbara Hartmann, Bernhardt E. Stein

Research Associate Professors: Joel S. Meister, Janet Senf, Michael Shafer, Karen Unger

Clinical Associate Professor: Clifton Crutchfield

Assistant Professors: Antonio Estrada, Scott J. Leischow, Mark A. Nickher

Assistant Professors of Clinical Family and Community Medicine: Tammy Bassford, Enrique S. Corvalan, Lane P. Johnson, Patricia Lebensohn-Chialvo, Steven A. Menenhnett, Myra M. Muramoto, Victoria Murrain, Robert G. Rhode

Research Assistant Professors: Jeanne Carrigan, Brenda Cartmel, Howard J. Eng, Violet Siwak

Clinical Assistant Professors: Rebecca Bingham, Jacqueline A. Chadwick, Barbara Chester, Marc Darr, Carl
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.

500. Research (3-12) [Rpt./2]. P, basic science courses. (Identical with PHL 500).

501. Mind and Behavioral Medicine (2) [Rpt./1] 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, upper-division or graduate or credit in 195a.

532. Survey of Art Therapy (3) [Rpt./3 units] Surveys the development of art therapy in the United States through examination of the literature, theories, and current trends in the field.

539. Art, Symbolism, and Psychopathology (3) [Rpt./3 units].

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. (Identical with PHL 570).

571. International Comparison of Health Care Systems (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. (Identical with PHL 571).

572. Population Dynamics and Family Planning (3) Social/economic determinants and consequences of population growth; behavioral and health aspects of human reproduction; organization/evaluation of selected family planning programs. (Identical with PHL 572).

573. Health Issues of Women and Children (3) Knowledge base, social strategies, health policies, and programs relating to health and well-being of women, especially of child-bearing years, and children from infancy to adolescence. (Identical with PHL 573).

574. Health Administration and Policy (3) Management processes/roles of public health professionals; health service organization; policy issues and resource utilization/control; human resources management; public health trends. (Identical with PHL 574).

575. Environmental and Occupational Health (3) 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. (Identical with PHL 575).


577. Social and Behavioral Basis of Public Health (3) Social learning theory, diffusion of innovations, relationship of cultural values to behavioral change, social marketing, high-risk behavior intervention strategies, and communication issues. (Identical with PHL 577).

578. Public Health Nutrition (3) Community and individual nutritional assessment; risk profiles; planning, implementing and evaluating programs; international, national and local resources/programs; Healthy People 2000 goals. (Identical with PHL 578).

580. Community Based Research Methodologies (3) 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 576, 590a. (Identical with PHL 580).

581. Introduction to Community Health (3) 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) (Identical with NURS 587, which is home).

588. Healing Systems in the Southwest (3) (Identical with NURS 588, which is home).

593 Internship a. Public Health (1-12) [Rpt./12 units] (Identical with PHL 593a, which is home).

596. Seminar a. International Health: Clinical and Community Care (3) Open to health majors only.

g. Occupational Disease (1-2) [Rpt./4 units]. Open to medical or industrial hygiene students only. Consult department before enrolling. (Identical with PHL 596g).

h. Prevention and Control of Disease (1) [Rpt./4 units] Consult department before enrolling. (Identical with PHL 596h).
i. Seminar for Clinical Educators (4) (Identical with PHL 596i).

m. Practice of Community-Oriented Medicine in Rural Areas (2) (Identical with PHL 596m).

n. International Nutrition (2-3) (Identical with NSC 596n and PHL 596n).
o. Environmental and Occupational Health (3) P, consent of instructor.
p. Managed Health Care (3) (Identical with PHL 596p).

q. AIDS, Cancer, Nutrition Immunity (1) (Identical with PHL 596q).
t. Tropical Disease Problems (2) (Identical with PHL 596t).
u. Alcohol, Drugology to Treatment (3) (Identical with NUSC 596v, PHL 596v).
w. Diet and Disease Prevention (2) (Identical with PHL 596w).

619. FNP: Primary Care Ill (3) Third of three primary care courses preparing family nurse practitioners (FNPs). Focus is on assessment, diagnosis, and management of selected complex and/or urgent/emergent acute and chronic health conditions in primary care practice in individuals and families across the age continuum. P, admission to M.S. program and FNP option, 617, 618.

693. Internship e. Art Therapy (1-12) [Rpt./15 units] 3-9L. Consult department before enrolling.

696. Seminar g. Nutrition in a Bioculture Context (3) (Identical with ANTH 696g, which is home). 800. Research (2-16) [Rpt./2] (Identical with PHL 800).

803. Clinical Clerkship (6)

811. Subinternship a. Family Medicine (4-6)

815. Subspecialty a. Public Health and Community Medicine Rotations (4)

b. The Dying Patient (3) [Rpt./1] (Identical with PHL 815b).
c. Geriatrics in Family Medicine (4) P, consent of instructor before enrolling.

d. Problems in Community Oriented Primary Care (6-12)

e. Personal Change in Lifestyle Related Behavior (3-6)

f. Geriatrics (4-6) [Rpt./6 units] P, third-year rotation in P/C, CM, and MEDI. (Identical with MEDI 815f, which is home). P, admission to RONC 815h).

g. Cancer Epidemiology, and Prevention (3) P, none; statistics preferred. (Identical with RONC 815i).

h. Prevention and Control (3-15) (Identical with RONC 815j).

k. Special Nutrition Support (3)

l. Nutrition in Disease (3) P, BIOC 801, SBS-COPC
Preceptorship

a. Arizona Senior Clinical Preceptorship in Family and Community Medicine (AHED) (6-12)
c. Epidemiology at CDC (3) P, open to majors in medicine, public health, and nursing. Consult department before enrolling.
d. Verde Valley Rural Care (4-12)
e. Prison Health Care (3-5) Consult department before enrolling.
f. International Health (6-12)
g. AHEC/Border Health (3-12) Consult department before enrolling.
h. Caduceus Project: Healing Arts (3) P, completion of second year of medical school.
i. CUP (Commitment to Underserved People) (3) P, Students must participate in orientation and training; and community service during first and second year.
j. Family Medicine Special Studies (4-6) P, completion of basic sciences.
k. Mayo Group Practice (6) P, fourth-year medical students.

896. Seminar

a. *International Health: Clinical and Community Care (3) Open to health majors only. (Identical with PHL 896).
b. Behavioral Problem: Child and Adolescent (2) (Identical with PHL 896).
c. Principles and Practice of Home Health (2) Consult department before enrolling. (Identical with PHL 896).
d. Doctor-Patient Relations (2)
e. Nutrition in a Biocultural Context (3)
f. *International Nutrition (2-3) (Identical with PHL 896).
g. Public Health Nutrition (1) P, medical students year one, two.
  *Managed Health Care (3) [Rpt.] (Identical with PHL 896p).
t. *Tropical Disease Problems (2) (Identical with PHL 896).
u. Alcohol, Drugs: Biology to Treatment (3)

Available as both 596 and 896.

Medicine (MEDI)


Assistant Professors: Sharon Camhi, Ronnie Fass, The-Li Huo, John D. Palmer (Pharmacology), David S. Shimm (Radiation Oncology)

Clinical Professors: Robert O. Brandenburg, Todd Brodie, Kenneth Dessur, Morton Fuchs, Alan Gordon, Bernard Levine, Philip Levy, Robert Sankowsky, William Schr, 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. Knoer, Steven Massia, Mary O'Rourke, Yeh-Shan Peng


555. Cancer Therapeutics (3) (Identical with CBIO 555, which is home).

560. Clinical Cancer Biology (1) (Identical with CBIO 560, which is home).

596. Seminar

a. Pathophysiology and Immunology of the Clinical Manifestations of Coccidioidomycosis (2)

800a. Clinical Research in Minority Health Issues (4-16) Open to medical students only.

803. Clinical Clerkship (12)

810. Clerkship

a. Ambulatory Care (4-8) [Rpt./12 units] P, completion of third year of medical school.
b. Ambulatory Diagnosis and Therapeutics (6)
c. Clinical Geriatrics (3-12) [Rpt./1] P, MEDI 803.

f. Honors Course-Internal Medicine (12)
g. Primary Care Combined Internal Medicine/Pediatrics (Identical with PED 811g).
h. Medical Intensive Care Unit/Coronary Care Unit (4-6)
m. General Medicine - Acting Internship (4-8)
n. Non-Traumatic Emergency Care (3-6)

815. Subspecialty

a. Clinical Cardiology (4-8)
### 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 I. Johnson (Pediatrics), Alfred Kaszniaik (Psychology), Alan B. Rubens, Gary E. Schwartz (Psychology), William A. Sibley, Gary L. Wenk (Psychology)

Associate Professors: Geoffrey L. Ahern, Colin R. Bamford, Nathaniel T. McMullen (Anatomy), Erwin B. Montgomery, Jr., Naomi E. Rance (Pathology), Steven Z. Rapcsak

Assistant Professors: Valerie A. Cwik, David M. Labiner, Linda Restifo (Arizona Research Laboratory, Division of Neurobiology)

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 Bergon, Robert H. Hamilton, Dinesh Talwar

Clinical Lecturers: Jay B. Angevine (Anatomy), Wayne Bixeman, Terry D. Fife, Robert A. Foote, William H. Lawrence, Joseph J. Thomas, Jr., Richard A. Thompson, Francisco R. Valdivia

Research Assistant Professor: Lyn S. Turkstra

Assistant Research Scientist: Pelagie Beeson (Speech and Hearing Sciences)

### Obstetrics and Gynecology (OB G)

Professors: Kenneth Hatch, Head, Wayne Heine, Kathryn Reed

Associate Professor: Thomas Purdon

Assistant Professors: Timothy Geley, Alton Hallum, John Hoffman, Karen Lesser, James Maciulla, Nicholas Rogers, Hector Streeter

Instructors: Lynn Goolsby, Keith Harrigill

800. Research (3-18) [Rpt./1]

803. Clinical Clerkship (6-9)

810. Clerkship

- Preparation for Practice (4-6) P, 803.
- Preparation for Private Practice (3-6) P, 803.
- Gynecological Oncology (4) P, 803 and one other junior clerkship.
- Gynecological Surgery (4-6)

811. Subinternship

- Gynecological Oncology (3-6) P, 803.

815. Subspecialty

- Clinical Infertility (4-6) P, 803.
- Perinatal Medicine (3-6) P, 803.
- High-Risk Obstetrics (4-6) P, 803.
- Gynecology-Endocrinology (3-6) P, 803.
- Medical Gynecology (3-4)
- Reproductive Endocrinology and Fertility (4-6) P, 803.

891. Preceptorship

- Obstetrics and Gynecology (1-18)

895. Subspecialty

- Neurosurgical (3-6) P, 803.
- Neurosurgical (3-6) P, 803.
- Neurological and Neuromuscular Disorders (3-6) P, 803; consult department before enrollment.
- Clinical Evaluation and Treatment of Sleep Disorders (3-6) (Identical with MEDI 815v, which is home).

825. Human Neuroscience (6) (Identical with MED 825, which is home).

891. Preceptorship

- Obstetrics and Gynecology (1-18)

### Ophthalmology (OPH)

Professor: Barton L. Hodes, Richard R. Ober, Robert W. Snyder, Head

Associate Professors: Theresa R. Kramer, Joseph M. Miller, Millicent C. Palmer

Assistant Professors: Robert J. Noecker, Millicent C. Palmer

Clinical Professor: Robert M. Dryden

Clinical Associate Professor: Leonard Joffe

Clinical Assistant Professors: Richard W. Allinson, Denis Carroll, George S. Novalis, Reid Schindler

800. Research (6-18)

815. Subspecialty

- Ophthalmology (3-6)
891. Preceptorship

Pathology (PATH)
Associate Professors: James M. Byers III, H. Eugene Hoyne (Pediatrics), Naomi E. Rance, Ronald B. Schifman, Catherine M. Spier
Assistant Professors: William T. Bellamy, FAX: (520) 626-3636 Room 3301 Pediatrics (PED)
881. Preceptorship
801. General and Systemic Pathology (10) P, completion of required clerkships.
802. Clinical Clerkship (6) P, completion of basic sciences.
803. Clinical Clerkship (6)
810. Clerkship
a. Anatomic Pathology (1-18)
b. Clinical Pathology (1-18)
c. Special Topics (1-18) [Rpt.] P, 801
d. Anatomic/Clinical Pathology (4-6) P, completion of basic sciences.
891. Preceptorship
a. Pathology (1-18) [Rpt.]
b. Barrow Neurological Institute Neurology (4-6) P, completion of basic sciences.

Pediatrics (PED)
Arizona Health Sciences Center, Room 3301
Phone: (520) 626-5170 FAX: (520) 626-3636


501. General and Systemic Pathology (10) P, completion of the M.D./Ph.D. program and consent of the course director.
512. Biological Electron Microscopy (4)
(Identical with MCB 512, which is home).
515. Basic Human Pathology (4) 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, consult instructor before enrolling. (Identical with CBIO 515).
801. General and Systemic Pathology (10)
810. Clerkship
a. Anatomic Pathology (1-18)
b. Clinical Pathology (1-18)
c. Special Topics (1-18) [Rpt.] P, 801
d. Anatomic/Clinical Pathology (4-6) P, completion of basic sciences.
891. Preceptorship
a. Pathology (1-18) [Rpt.2]
b. Barrow Neurological Institute Neurology (4-6) P, completion of basic sciences.

Pediatrics (PED)
Arizona Health Sciences Center, Room 3301
Phone: (520) 626-5170 FAX: (520) 626-3636


501. Molecular and Medical Genetics (3)
Acquire a basic understanding of human molecular genetics and learn how to apply that understanding in the pathophysiology of disease. (Identical with GENE 501).
800. Research (1-18) (See College of Medicine Electives Manual).
801. Medical and Molecular Genetics (3)
Acquire a basic understanding of human molecular genetics and learn how to apply that understanding in the pathophysiology of disease.
803. Clinical Clerkship (6)
810. Clerkship
c. Inpatient Pediatrics (4)
811. Subinternship
a. Ambulatory Pediatrics (1-18)
b. Primary Care Combined Internal Medicine/Pediatrics (4) (Identical with MED 811g, which is home).
815. Subspecialty
a. Advanced Neonatology (4-6)
b. Pediatric Infectious Diseases (3-6)
c. Neurodevelopmental Follow-Up of High-Risk Infants (4-6) P, 803.
d. Cardiac Ultrasound Echo and Doppler (4-6)
e. Pediatric Cardiology (4-6)
f. Pediatric Neurology (4-6)
g. Pediatric Hematology/Oncology (4-6)
h. Pediatric Orthopaedics (3-6) P, completion of basic sciences.
i. Developmental and Behavioral Pediatrics (4-6) P, pediatric clerkship
j. Pediatric Pulmonary (4-6) P, 803.
l. Clinical Allergy (4-6) Open to medical students only. (Identical with MED 8151, which is home).
m. Ambulatory Pediatrics/Newborn Nursery (4-8) P, 803.
610. Subspecialty
a. Pediatric Surgery (4) (Identical with SURG 816a, which is home).
b. Pediatric Orthopaedics (3-4)
891. Preceptorship
d. BNI Pediatric Neurology (4) P, 803.
e. Pediatric Critical Care (4) P, 803.

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), Allan Beigel, Richard R. Bootzin (Psychology), Henry W. Brosin (Emeritus), Alfred W. Kasznik (Psychology), Alan I. Levenson, John C. Racy, 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, Eric M. Reiman
815. Subspecialty
a. Cancer Epidemiology and Prevention (3) P, none; statistics helpful. (Identical with FCM 815h, which is home).

815v. Subspecialty
a. Cancer Epidemiology and Prevention (1-6) P, none; statistics helpful. (Identical with FCM 815h, which is home).

815. Subspecialty
a. Introduction to Radiation Oncology (1-6) P, none; statistics helpful. (Identical with FCM 815h, which is home).

815. Subspecialty
i. Cancer Prevention and Control (3-15)

815. Subspecialty
i. Cancer Prevention and Control (3-15)

891. Preceptorship

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: David S. Shimm (Internal Medicine), Baldassarre D. Stea

Assistant Professors: Jesse Martinez, Eugene Gross, Kathy McGovern

Clinical Associate Professor: Chee Wai Cheng, Alan Hamilton (Surgery)

Clinical Assistant Professors: Bruce Lulu, Helen Fosmire

515. Subspecialty
h. Cancer Epidemiology and Prevention (3) P, none; statistics helpful. (Identical with EPI 515h, which is home).

555. Cancer Therapeutics (3) (Identical with CBIO 555, which is home).
Senior Clinical Lecturers: Merril W.
Assistant Professors: Carl A.
Research Assistant Professors: Joseph M.
Assistant Professors of Clinical Surgery: Melvin D.
Frederick J. Menick, Frank Walter

Friday
Joseph M. Leal, James H. Levi, William
Jay A. Katz, Theodore A. Kiersch,
Jr., Thomas H. Hicks, Lawrence R.
Jackson, Christopher T. Johnson,
Wegner, Robert L. Wilson, R. Wayne
Wachtel, John A. Wagner, Julie A.
Johnson, James R. Sicker, Jr., Thomas F. Norton, John A. Pierce,
Bruce A. Mallin, Robert B. Mammana,
L. Lovett, Claude A. Luekens, Jr., Bruce A. Mallin, Robert B. Mammana,
Larry F. Mann, James H. McLaughlin,
Bernard J. Miller, T. Herman Moore,
Thomas F. Norton, John A. Pierce,
William J. Quinlan, Allen Raczkowski,
Jacob B. Redkoph, Robert J. Reilly,
Melvin D. Roberts, F. William Rundle,
Edward W. Schneider, Lawrence A.
Schneider, Paul L. Schnur, Richard D.
Scott, Steven Seifert, Eugene Seklecki,
Gilbert D. Shapiro, James R. Sicker, Jr.,
Richard A. Silver (Exercise and Sport
Sciences), Neil G. Steinhoff, Bruce E.
Stewart, Burt S. Stroh, Stanley J.
Suffecool, Scott K. Swanson, Hugh C.
Theodore, Thomas M. Van Der Werf, Michael E.
Vance (Pharmacology and Toxicology),
Cecil C. Vaughn, Thomas
Wachtel, John A. Wagner, Julie A.
Weigler, Robert L. Wilson, R. Wayne
Wood, Jon D. Zolton

Research Lecturers: Stephen Harkins, Ann
Kerwin (Humanities)
Assistant Clinical Lecturers: Armando J.
Alfaro, Robert B. Bailey, Jr., Mark E.
Baldree, Leslie v. Boyer-Hansen,
Emmet T. Boyle, Robert B. Cravens,
Jr., Christopher P. Demas, T. Jess
Fowler, Alfredo Guervara, Jr., Daniel J.
Klemmedson, Thayne R. Larson,
Gregory W. Prian, Ronald D. Quintia,
Richard G. Smith, Howard M.
Steinberg, Jeffery D. Stuart, Max L.
Wertz

Research Associates: Kullervo H.
Hynynen (Radiation Oncology,
Aerospace and Mechanical Engineering),
Arlene W. Scadron
Research Specialists: Michael J. Bernas,
Peter Borgs

Specialists in Cardiac Transplant:
Christianne Dimassis, 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 preoperative evaluation in emergency, inpatient, and ambulatory
settings, proper operating room conduct
postoperative management. An
awareness of the nature and management
of surgical disease is developed by
three-oriented small group sessions,
rounds, and weekly conferences. The
surgery Specialty Clerkship reinforces
these basic skills by application to
specialty areas such as urology, orthopedics, neurosurgery, cardiothoracic
surgery, and otolaryngology.

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

Research Assistant Professors: Carl A.
Research Assistant Professors: Joseph M.
Assistant Professors of Clinical Surgery: Melvin D.
Assistant Clinical Lecturers: Armando J.
Alfaro, Robert B. Bailey, Jr., Mark E.
Baldree, Leslie v. Boyer-Hansen,
Emmet T. Boyle, Robert B. Cravens,
Jr., Christopher P. Demas, T. Jess
Fowler, Alfredo Guervara, Jr., Daniel J.
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Wertz

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Research Lecturers: Stephen Harkins, Ann
Kerwin (Humanities)
Assistant Clinical Lecturers: Armando J.
Alfaro, Robert B. Bailey, Jr., Mark E.
Baldree, Leslie v. Boyer-Hansen,
Emmet T. Boyle, Robert B. Cravens,
Jr., Christopher P. Demas, T. Jess
Fowler, Alfredo Guervara, Jr., Daniel J.
Klemmedson, Thayne R. Larson,
Gregory W. Prian, Ronald D. Quintia,
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Steinberg, Jeffery D. Stuart, Max L.
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Baldree, Leslie v. Boyer-Hansen,
Emmet T. Boyle, Robert B. Cravens,
Jr., Christopher P. Demas, T. Jess
Fowler, Alfredo Guervara, Jr., Daniel J.
Klemmedson, Thayne R. Larson,
Gregory W. Prian, Ronald D. Quintia,
Richard G. Smith, Howard M.
Steinberg, Jeffery D. Stuart, Max L.
Wertz

Research Associates: Kullervo H.
Hynynen (Radiation Oncology,
Aerospace and Mechanical Engineering),
Arlene W. Scadron
Research Specialists: Michael J. Bernas,
Peter Borgs

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Christianne Dimassis, Suzanne N.
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Specialist in Neurosurgery: David H.
Tallman

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L. Ramirez

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Shao

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settings, proper operating room conduct
postoperative management. An
awareness of the nature and management
of surgical disease is developed by
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rounds, and weekly conferences. The
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Elective courses in general and
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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
v. Clinics in Medical Ignorance (3-4) P, Junior standing.
w. Pediatric Urology (4)
y. Clinical Toxicology (4-6) P, fourth-year medical students.
z. Advanced Surgical Skills (3-6) P, general surgery.

816. Subspecialty
a. Pediatric Surgery (4) (Identical with PED 816a).
b. Hand Surgery (4)
c. Rural Pediatric Orthopedies (3-4)

891. Preceptorship
a. Surgery and Subspecialties (1-18) [Rpt./3]
c. General Surgery "B" (4-12) P, 803.
d. General Surgery "C" (4-12) P, 803.
h. Vascular Surgery (4-8) P, fourth-year medical students or completion of 803.
i. Perfusion Science (3) [Rpt./9 units] (Identical with PHCL 891L, which is home).

896. Seminar
a. Medical Ignorance (2) [Rpt./1]
b. Gene Therapy for Vascular Disease (2) (Identical with MED 896h, which is home).

Microbiology and Immunology (MBIM)
Life Sciences North, Room 644
Phone: (520) 621-6061
Fax: (520) 621-2100
Application Questions: Graduate Secretary, (520) 621-6061
Advising Questions: Norval Sinclair, (520) 621-4783
Degrees Offered: M.S., Ph.D.
Professors: John J. Marchalonis (Head), Harris Bernstein, Charles Gerba (Soil and Water Science), Marilyn Halonen (Pharmacology), Evan Hersh (Medicine), Junetsu Ito, Margaret Kay, Rein Kilson (Physics), Henry Koffler (Emeritus), William Meinke (Emeritus), George B. Olson (Emeritus), Kenneth Ryan (Pathology), Norval Sinclair (Veterinary Science), John Spizizen (Emeritus), Paul Sypherd
Associate Professors: Rodney Adam (Medicine), Nafees Ahmad, Emmanuel Akporiaye, Dominick Deluca, Richard Friedman, David Harris, Kit Lam (Medicine), James T. Sinski (Emeritus)
Assistant Professor: Douglas Lake
Research Associate Professor: Carol Bernstein
Lecturer: Vivian Gage

The graduate program in microbiology and immunology offers research opportunities in all major areas of microbiology and immunology. The research systems used include viruses, viroids, bacteria, bacterial plasmids, fungi, protozoans, parasites, cell and tissue culture, and animal models standardly used in immunological studies. The department offers the Master of Science and Doctor of Philosophy degrees with a major in microbiology and immunology.

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 are required for both the M.S. and Ph.D. programs.

501a-501b. Medical Microbiology (3-3) 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 required to be taken consecutively in order to receive a final grade. P. BIOC 462a-462b or equivalent.

503R. Biology of Animal Parasites (3) (Identical with V SC 503R, which is home). May be convened with MIC 403R.

503L. Parasitology Laboratory (1) (Identical with V SC 503L, which is home). May be convened with MIC 403L.

504. Molecular Parasitology (3) GRD (Identical with V SC 504, which is home). May be convened with MIC 404.

505. Eukaryotic DNA Replication (3) [Rpt./1] (Identical with CBIO 305, which is home).

511. Molecular Biology (1) (Identical with MCB 511, which is home).

512. Biological Electron Microscopy (4) (Identical with MCB 512, which is home).

517. Microbial Physiology and Gene Cloning (3) Biochemical and physiologic activities of microorganisms. P. CHEM 241b, 243b.

519. General Immunological Concepts (4) P, MCB 325, CHEM 241b, 243b. (Identical with V SC 519, which is home).

520. Pathogenic Bacteriology (3) P, MCB 325, CHEM 241b, 243b. Students are expected to be familiar with use of the World Wide Web and, ideally, have access via Netscape. Students must have an active e-mail address before the third class session convenes. (Identical with V SC 520, which is home). May be convene with V SC 420.

523. Mechanisms of Disease (5) (Identical with V SC 523, which is home). May be convene with MIC 423.

525. Environmental Microbiology (3) Current topics in water quality, aerobiology, and microbial biogeochemistry. P, MIC 205, CR, CHEM 241b, 243b. (Identical with SWES 525, which is home). May be convene with SWES 423.

526. Environmental Microbiology Laboratory (2) (Identical with SWES 526, which is home). May be convene with MIC 426.

527R. General Mycology (3) General mycology, with emphasis on the microfungi. P, MIC 205.

527L. General Mycology Laboratory (2) General mycology laboratory, with emphasis on the microfungi. P, 527R or CR.

529. General Virology (3) 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, 243b, MCB 411 (suggested). (Identical with MCB 529 and V SC 529). May be convene with MIC 429.

530. Introduction to Biophysics (2) (Identical with PHYS 530, which is home). May be convene with MIC 430.

531. Biophysical Theory (2) (Identical with PHYS 531, which is home).

532. Pathogenic Virology (3) [Rpt.] (Identical with V SC 532, which is home).

538. Ecology of Infectious Disease (3) (Identical with V SC 538, which is home). May be convene with MIC 438.

540. Biodegradation of Pollutants in Soil and Groundwater (3) (Identical with SWES 540, which is home). May be convene with MIC 440.

543. Research Animal Methods (3) (Identical with V SC 543, which is home). May be convene with MIC 443.

546. Environmental Biotechnology Laboratory (2) (Identical with SWES 546, which is home).


550L. Medical Mycology Laboratory (2) Laboratory experiments dealing with isolation and identification of fungi of medical importance. 6L. P. 550R or CR. (Identical with V SC 550L).

551. Molecular Mechanisms of Carcinogenesis (3) (Identical with CBIO 551, which is home).

552. Molecular Mechanisms of Microbial Pathogenesis (3) 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) (Identical with V SC 554, which is home). May be convene with MIC 454.

555. Cancer Therapeutics (3) (Identical with CBIO 555, which is home).

560. Development of the Immune System (4) 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 differenta-
Logical mechanisms involved in host responses; morphologic, physiologic, and biochemical characterizations of the lymphoreticular system. P, BIOC 462a.

562. Tumor Immunology (3) The immunologic 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 562a.)

570. Molecular Genetics and Evolution (3) 97 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) (Identical with VSC 575, which is home).


582. Immunotoxicology (2) (Identical with PCOL 582, which is home).

589. Cancer Genetics (3) (Rpt.) (Identical with CBIO 589, which is home).

596. Seminar
a. Current Problems in Molecular Biophysics (1) (Identical with PHYS 596a, which is home).

630. Experimental Methods for Research (4) Hands-on techniques necessary for pursuing a research career in Microbiology and Immunology. 12L. P, MIC 419, MBIM 501, 560 or 561, BIOC 460. Consult department before enrolling. (Identical with VSC 630).

695. Colloquium
a. Readings in Microbiology (1) [Rpt./6 units]
b. Immunopathology (1)
c. Molecular and Cellular Immunology (1)
f. Tumor Virology (1)
g. Host-Parasite Interactions (1) [Rpt.]
i. Immunology Data Analysis (1)
j. Readings in Immunology (1)

696. Seminar
a. Research (1) [Rpt.]

800. Research (3-6) P, consent of instructor and coordinator.

801a-801b. Medical Microbiology (3-3) this is a two-semester course with both semesters required to be taken consecutively in order to receive a final grade. P, BIOC 462a-462b or equivalent.

891. Preceptorship
a. Microbiology and Immunology (3-12) [Rpt./12 units]

**Mining and 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: Elsie Nonaka, (520) 621-6063, elsie@mge.arizona.edu

Advising Questions:
Janice Meyer, (520) 621-2147

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

Professors: Ben K. Sternberg, Head, Jay C. Dotson (Emeritus), William C. Peters (Emeritus)

Associate Professors: Charles E. Glass, Satya Harpalani, John Kemeny, Pinnaduwa Kulatilake, Mary Poulton

Assistant Professors: Douglas LaBrecque, Paul J. A. Lever

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in mineral 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. Students 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.

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 along 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)**


503. Rock Mass Joint Geometry Modeling (3) [Rpt./1] 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. 2R, 3L, P, 402, SIE 270.
505. Applied Multispectral Imagery (3) Application of image processing to mineral exploration, engineering geology, groundwater location, and pollution monitoring. P. 407. (Identical with GEOS 505).

507.* Photogeology (3) Use of aerial photographs in geologic mapping. 1R, 6L. 1.5ES, 1.5ED. P, GEOS 321. (Identical with GEOS 507).

515. * Rock Excavation (3) (Identical with MN E 515, which is home).

516. Field Studies in Geophysics (3) Seismic, magnetic, electrical, and gravity exploration techniques. Field trips. 3ED. P, 448 or 548. (Identical with GEOS 516).

522. Well Logging Interpretation (3) 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 GEOS 522 and HWR 922).


525. * Geotechnical Investigations (3) Senior design course emphasizing the investigation and analysis of geologic factors in the design and construction of engineering projects. 1R, 6L. 3ED.

526. * Health and Safety in Mining (1) (Identical with MN E 526, which is home).

527.* Geomechanics (3-4) (Identical with MN E 527, which is home).

529. Rock Slope Analyses and Design (3) (Identical with MN E 529, which is home).

537. Developments in Rock Mechanics (2) (Identical with GEOS 537, which is home).

545. * Fundamentals of Geostatistics (3) [Rpt./6 units] (Identical with MN E 545, which is home).

548. * Geophysical Exploration and Engineering (3) Principles of gravity, magnetic, seismic, and electrical exploration; acquisition and interpretation of data to define geologic structure and evaluate resources. 3R, 2ES, 1ED. P, PHYS 141, 242, MATH 223. (Identical with GEOS 548).


550. Earthquake Engineering (3) 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) (Identical with C E 551, which is home).

557. Fundamentals of Geomechanics (4) (Identical with MN E 557, which is home).


570. * Computer Methods in Geological Engineering (3) Use of computers to solve problems in geological engineering, including database access, computer mapping, contouring and extension, and multivariate analysis of geologic data. 3ED. P, introductory courses in computer programming, mathematics, and earth science.

580. The Mechanics of Fracture in Rock and Other Brittle Materials (3) (Identical with MN E 580, which is home).


590. * Remote Sensing for the Study of Planet Earth (3) (Identical with REM 590, which is home).

696. Seminar a Research (1-3) [Rpt.] (Identical with MN E 696a).

Mining Engineering (MN E)

501.* Analysis of Mine Operations (3) Use of operations research principles and techniques to analyze various problems in mine operations. 2ES, 1ED.

502.* Probability and Statistical Concepts in Geologic Media (3) (Identical with G EN 502, which is home).

503. Analysis of Mining Decisions (3) Use of geostatistics, system simulation languages, and computers to analyze various mining decisions related to reserve estimation and mine planning. P, 401, 420, 430.


511. Mineral Processing (3) 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. 2ES, 1ED. (Identical with MEE 511).

515.* Rock Excavation (3) 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. 2R, 3L. 1.5ES, 1.5ED. Field trips. P, C E 217. (Identical with G EN 515).

526.* Health and Safety in Mining (1) Fundamental concepts in the recognition, evaluation, and control of occupational safety and health hazards encountered in mining operations; includes a review of engineering management responsibilities to control accidents, a review of federal regulations and standards affecting the industrial workplace, and instruction regarding the interaction of industrial hygiene, safety, fire protection, and workers' compensation to control losses resulting from industrial accidents. 1ES. (Identical with G EN 526).

527.* Geomechanics (3-4) 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. 3R, 3L. 1.5ES, 1.5ED. P, C E 217. (Identical with G EN 527).


530. * Mine Examination and Valuation (3) Principles and procedures in mineral property valuation, geostatistical ore reserve estimation, engineering, economy, investment analysis, use of a microcomputer. 1ES, 2ED. P, 402, 220.

533.* Elements of Coal Mining (3) Coal geology, properties and use. Surface and underground methods and equipment: strip mining; continuous, conventional, longwall mining; ground control; ventilation; haulage; electrical power; drainage. Preparatory and reclamation. 2ED. P, 180, 406, ECE 207.


536.* Subsurface Environmental Engineering (3) Analysis of sources of heat, humidity, gases and dust in mines and other subsurface facilities. Design of engineering systems to control these pollutants. 1ES, 1ED. P, 406 or consult with department before enrolling.

537. Developments in Rock Mechanics (2) Discussion of new developments in rock mechanics and of areas of interest for future research. Field trips. P, 427 or 527. (Identical with G EN 537).


545. * Fundamentals of Geostatistics (3) [Rpt./6 units] Theory and application of geostatistics in solving various estimation/prediction problems frequently encountered in reserve estimation, in geotechnical and/or
621a-623b. Biology Update 1-2 (2-2) (Identical with BIO 623a-623b, which is home).

695. Colloquium
   a. Plant Biology (1) (Identical with PL P 695a, which is home).
   b. Plant Pathology (1) (Identical with PL P 695b, which is home).
   c. Science, Society, and Ethics (1) (Identical with GENE 695 and NRSC 695e).

697. Workshop
   a. Scientific Infrastructure (2) Open to majors only.

761. Laboratory Rotation I (2) [Rpt./1] Research project with graduate faculty for 8 weeks. 15 hours per week. Open to majors only.

762. Laboratory Rotation II (2) [Rpt./1] Research project with graduate faculty for 8 weeks. 15 hours per week. Open to majors only.

763. Laboratory Rotation III (2) Research project with graduate faculty for 8 weeks, 15 hours per week. Open to majors only.

801. Molecular and Cellular Biology (4) P, freshman medical students only.

Music (MUS/MUSI)
Music Building, Room 111
Phone: (520) 621-1454
FAX: (520) 621-1351
WWW: http://arts.music.arizona.edu/music/index.html

Application Questions:
Graduate Secretary, (520) 621-1454

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

Professors: Gary D. Cook, Director, James R. Anthony (Emeritus), John Boe (Emeritus), Andrew Buchhauser (Emeritus), Edna Church (Emerita), Robert Cutietta, Larry J. Day (Emeritus), Gordon Epperson (Emeritus), Billie R. Erlings, Elizabeth Ervin, Thomas Ervin, Richard Faith (Emeritus), Paula Fan, John R. Ferrell (Emeritus), Gregg I. Hanson, O. M. Hartisel (Emeritus), Jeffrey Haskell, Steven Hedden, Robert Hull (Emeritus), Jean-Louis Kashy, Timothy Kolosick, Jack Lee (Emeritus), Robert McBride (Emeritus), Carrol McLaughlin, Theodora M. McMillan (Emerita), Elizabeth Mosher, Robert Muczynski (Emeritus), Edward W. Murphy, James P. O'Brien, Margarette Ough (Emerita), Leonard A. Pearlman (Emeritus), Richard E. Peters (Emeritus), Jocelyn Reiter, Charles Roe, Anita Sammarco (Emerita), Anna Mac Sharp (Emerita) Maurice Skones (Emeritus) R. Warren Sutherland, Nicholas L. Zumbo

Associate Professors: Daniel I. Asia, Robert Billups, John T. Brobeck, William Dietz, Nancy Ferguson, Nohema Fernandez, John R. Fitch, Grayson Hirst, Keith M. Johnson, Jerry Kirkbride, Josef Knott, Rodney M. Mercado (Emeritus), Patrick Neher, Thomas Patterson, Faye Robinson, Jeffrey Showell, Rex Woods

Assistant Professors: Dwayne Dunn, Nancy Green, Jay Rees, Ed Reid, Jay Rosenblatt, Mark Rush, Janet Sturman

Coordinator, Mexican Studies in Music: Richard Obregon

The School of Music and Dance currently offers a program leading to the Master of Music degree with majors in composition, music education, musicology, music theory, and performance. The School also offers a program leading to the Doctor of Musical Arts degree with majors 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. A reading proficiency examination in either German, French or Italian will be required for the Doctor of Musical Arts degree with a major in performance and a concentration in voice. The School also offers programs leading to the Doctor of Philosophy degree with majors in music theory or music education. All candidates for admission to the Ph.D. program with a major in music theory must show evidence of satisfactory competencies in their fields of concentration. There are two minors, one in music with a minimum of 9 units and one in a field outside of music, also with a minimum of 9 units. German and French are the required languages for this degree. In the event a candidate works in a field of specialization that warrants it, another language, such as Greek, Latin, or Italian, can be substituted for French with the permission of the School of Music. The School also offers a program leading to the Doctor of Music Arts degree with majors 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. A reading proficiency examination in either German, French or Italian will be required for the Doctor of Musical Arts degree.
consideration is being given to possible changes from "majors" to "concentrations".

Applicants are required to audition by personal interview or by submitting a tape recording. Beginning 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. Admission is limited to applicants who exhibit superior musical aptitude and training and who show continued growth in their chosen fields of music.

**Music (MUS)**

500. Large Conducted Ensembles (1)
- b. Marching Band
- c. Campus Band
- d. Symphonic Band
- e. Wind Symphony
- f. Summer Chorus
- i. Symphonic Choir
- j. University Singers
- k. University-Community Chorus
- l. Chamber Choir
- m. Choraliers
- o. Symphony Orchestra
- q. Collegium Musicum
- r. Jazz Ensemble
- t. Mariachi Arizona

501. Coached Ensembles (1) Offering
- a. Accompanying
- b. Brass Ensemble
- c. Percussion Ensemble
- d. Guitar Ensemble
- e. Jazz Combo
- f. Saxophone Choir
- g. String Ensemble
- h. Woodwind Ensemble
- i. Steel Band
- j. Mariachi Arizona
- k. Electronic Music Ensemble
- l. Harp Ensemble (1) [Rpt./9 units total at all levels] I II

502. Small Conducted Ensembles (1)
- a. Chamber Winds
- b. Contemporary Ensemble
- c. Clarinet Choir
- e. Pep Band
- f. Flute Choir
- g. Recital Choir
- j. Trombone Choir

510a-510b. * Pedagogy (2-2) Study of methods and repertory suitable for studio teaching. Open to music majors in their major performance area only.

520a-520b. * Counterpoint (3-3) Practical study of the counterpoint of the 16th (in 520a) and 18th (in 520b) centuries. P, 220b.

521. Introduction to Graduate Music Theory (3) 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. 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. Registration restricted to singers and pianists. Open to majors only.

523a-523b. History of the Opera (3-3) Detailed study of the course of opera from its inception by the Florentine Camerata through Berg, Menotti, Stravinsky, Ginastera, Penderecki, Britten, and others. Open to majors only.

524. * History and Literature of Guitar (3) In-depth study of the evolution of the guitar, lute, and vihuela, including repertoire, style periods, and composers. Open to majors only.

525. History and Literature of the Wind Band (3) 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. 526a: Baroque through the early Romantic periods. 526b: Mid-Romantic through the Contemporary periods. P, 289. 526a is not prerequisite to 526b.

530. Music in the Renaissance (3) Vocal and instrumental genres from Dufay through Palestrina. Open to majors only.

531. Music in the Baroque (3) The age of the basso-continuo; instrumental and vocal genres from Monteverdi through J. S. Bach. Open to majors only.

532. Music in the Classical Period (3) The Viennese classical tradition from its origins to Beethoven. Open to majors only.

533. Music of the Twentieth Century (3) Contemporary idioms in music; study of genres, styles, and techniques from post-Romanticism to the present. Open to majors only.

534. Music Since 1950(3) [Rpt./1] Analysis of major works of the last half of the 20th century. P, 533 and 623, or by permission of instructor. Open to majors only.


537. Survey of Early Music (3) Intensive survey of music history from Gregorian chant to the late Baroque. This course may not be used to fulfill doctoral requirements in music. Open to majors only.


542. * Electro-Acoustic Studio Resources (3) II Advanced techniques: synthesis, processing, synthesizer programming, sampling, MIDI, computer-assisted techniques, sequencing and notation.


551. Behavioral Research in the Arts (3) Research methodologies as they apply to artistic behavior; emphasis on applying the results of existing studies to practice and on conducting original research.

555. * Music and German Literature (3) (Identical with GER 555, which is home).

560. Aesthetics of Music (3) Exploration of the problems of musical meanings, including a panoramic examination of what philosophers, musical composers, and others of critical intelligence have contributed to comprehensive theory.

570. Advanced Conducting (3) [Rpt.] Styles of choral, band, and orchestral literature, as they pertain to the problems of the conductor; references to the styles of all periods, with emphasis on the contemporary and modern.

597. Workshop
- o. * Level Orff Schulwerk (2)

600. Introduction to Graduate Study in Music (3) Bibliographical materials; research resources, techniques, and problems directed toward graduate study in music. Required of all doctoral candidates in music. (Identical with LI S 600).

605L. Opera Theatre (1-4) Training in all aspects of operatic production, including major singing roles, minor roles, opera chorus, opera scenes and chamber operas; technical training in set construction, make up, costumes, and lighting. Also may include operatic staging techniques. P, 4 units of 405, or consent of instructor.

620a-620b. History of Speculative Theory (3-3) Survey of speculative theory in music, classical Greeks to present.

621a-621b. Analysis of Music of the 18th and 19th Centuries (3-3) Intensive analysis of works written in the larger forms. 621a: 18th century. 621b: 19th century. Open to majors only. 621a is not prerequisite to 621b.

622. Theory Pedagogy (3) Study of the philosophies, procedures, techniques, and materials used in teaching theory at the college level.


630. The Music of Bach (3)

631. The Music of Mozart (3)

635. Choral Literature and Techniques (3) [Rpt./5] A research-oriented study of choral literature from all stylistic periods and genres from the Renaissance to the present; together with appropriate conducting techniques. 2R, 3L. Open to majors only. P, Graduate standing in choral conducting or choral music
education. No more than 18 units of this course may be applied to a graduate degree program.

640. Advanced Composition (2-6) [Rpt.]
Individual projects in composition. Open to theory and composition majors only.

650. Foundations and Principles of Music Education (3) History and philosophy of music education in the public schools, with emphasis on the basic concepts needed for effective teaching in the field of music, curriculum development, and evaluation of the music program.

651. Curriculum Development in Music (3) Principles and techniques of curriculum construction applied to the field of music.

652. Management Techniques in Music (3) The management of music at all levels of education, industry, and performance.

654. Psychology of Music (3) 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) Contemporary practices in planning, organizing, and evaluating learning experiences in music for college and university students. Open to music majors only.

696. Seminar
a. Music Education (1-6) [Rpt. 9 units]
b. Musicology (1-6) [Rpt. 9 units]
c. Music Theory (1-6) [Rpt. 5 units]
d. Composition (2) [Rpt. 8 units] Open to majors only.

e. Keyboard Studies (2)
f. Ethnomusicology (3) P, graduate standing or consent of instructor.

Performance Studies: Individual and Group Instruction (MUSI)
All of the courses listed below are offered both first and second semester.

See schedule of fees below.

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.

Rentals
Instruments are rented as available for use in regularly scheduled music activities according to a fee schedule. Any damage beyond normal wear and tear will be paid for by the renter of the instrument. All rental instruments must be returned by the end of the semester or on demand.

Pianos will be rented only to those enrolled in group, private instruction, or keyboard class. $5 for one hour practice per day. $10 for two hours practice per day. $15 for three hours practice per day.

Band and Orchestra Instruments: Rented only to those enrolled in ensembles or techniques and literature classes. $20 per semester.

Refunds will be made according to the refund schedule. No refund will be made on rental charges of $5 or less.

Near Eastern Studies (NES/ARB/PRS)
Franklin Building, Room 403
Phone: (520) 621-8013
FAX: (520) 621-2333
WWW: http://www.u.arizona.edu/~barbarac.homep.html

Application Questions:
Graduate Secretary, (520) 626-4973, neareast@ccit.arizona.edu
Advising Questions:
Adel S. Gamal, (520) 621-5465, neareast@ccit.arizona.edu

Degrees Offered: M.A., Ph.D.
Concentrations: Languages (Arabic, Persian, Turkish), Islamic studies, literature, history, and politics.

Professors: Charles D. Smith, Head, Ludwig A. Adamec, Michael E. Bonine, William G. Dever, Adel S. Gamal, Hamdi A. Qafisheh

Associate Professors: Julia Clancy-Smith, Esther Fuchs (Judaic Studies), William J. Wilson

Assistant Professors: Simin Karimi, Senzil Nawid, Amy Newhall, J. Edward Wright

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.

Master of Arts: Requirements include 30 units of course work with a thesis or, when a departmental paper is submitted in lieu of thesis, no fewer than 32 units. Two degree plans are available in consultation with an advisor: (1) a nonspecialist terminal program, multi-area if desired, and (2) a specialist program requiring a minimum of 2 years of an appropriate language. The specialist program normally requires three or more semesters and often serves as preparation for the Doctor of Philosophy degree program.

Doctor of Philosophy: This program requires completion of the Master of Arts degree (specialist program) or equivalent training plus those additional courses in the major and minor areas approved by the student's guidance committee.

**Arabic (ARAB)**

503.* Advanced Arabic I (3) Continuation of 402 with emphasis on oral and written comprehension and expression. P, 402.

504.* Advanced Arabic II (3) Continuation of 503 with emphasis on oral and written comprehension and expression. P, 403.


526.* Introduction to Arabic Linguistics (3) History and structure of the Arabic language in its various forms. P, 102, LING 101. (Identical with LING 526).

539a-539b. *Egyptian Arabic (3-3) Introduction to the Cairene dialect. Phonology, common greetings, basic vocabulary and grammar. P, one year of Standard Arabic.

595. Colloquium
a. *Readings in Modern Arabic Prose (3) [Rpt./1] P, 2 years of Arabic.
b. *Readings in Classic Arabic Prose (3) [Rpt./1] P, 2 years of Arabic.

**Near Eastern Studies (NES)**

501.* Ancient Mesopotamia (3) Sumerian, Babylonian, and Assyrian civilization from the first cuneiform documents to the fall of the neo-Babylonian empire, with special attention to issues of sociopolitical organization. P, 171, ANTH 101, 110 or consent department before enrolling. (Identical with HIST 501).


535.* Jewish Mysticism (3) (Identical with JUS 535, which is home).

538.* The Book of Psalms (3) (Identical with JUS 538, which is home).

542.* Transformation of Agrarian Societies in the Middle East (3) Dynamics, processes, and implications of rural change in the Middle East; focus on changes in peasant communities. P, 102, LING 101. (Identical with POL 542).

553. Advanced Hebrew (3) [Rpt.] (Identical with JUS 553, which is home).

557.* Prehistoric Mesopotamia (3) (Identical with ANTH 557, which is home).

566.* The Middle Eastern City and Islamic Urbanism (3) 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, 277a and 277b, or consent of instructor. (Identical with POL 542).

567.* Population and Development in the Middle East (3) Review of theories and research in population, resources and socioeconomic development, with emphasis on determinants and consequence of population growth and migration in contemporary Middle East. (Identical with POL 567).

568a-568b.* Asia and the West (3-3) (Identical with HIST 568a-568b, which is home).

570.* Religious History of India (3) (Identical with HIST 570, which is home).

572.* History of Medieval India (3) (Identical with HIST 572, which is home).

573.* History of Modern India and Pakistan: 1750-Present (3) (Identical with HIST 573, which is home).

574.* Archaeometry: Scientific Methods in Art and Archaeology (3) (Identical with ANTH 574, which is home).

580.* The Middle East in the Twentieth Century (3) The modern Middle East in the age of imperialism, world wars, state formation, decolonization, and Islamic resistance. (Identical with HIST 580). P, 277b or consent of instructor.

581a-581b.* Archaeology of Syria-Palestine in the Bronze and Iron Ages (3-3) 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.

584.* History of the Arab-Israeli Conflict, 1800-Present (3) Origins of Zionism, and Palestinian and other Arab nationalisms from the nineteenth century and the post-1948 Arab-Israeli state conflict in the Cold War era. P, 277b or consent of instructor. (Identical with HIST 584).

585a-585b.* Social, Cultural and Political History of Iran from the 7th Century to Present (3-3) 585a: 600-1500. From Islamic invasions to the aftermath of the Mongol invasions. 585b: The Iranian plateau in the modern era of western imperialism and nationalistic Islamic responses. P, NES 277a, 277b, or consent of instructor. (Identical with HIST 585a-585b).

587.* Islamic Mysticism (3) (Identical with HIST 587, which is home).

590.* Women in Middle Eastern Society (3) (Identical with ANTH 590, which is home).

593. Colloquium
b. *Special Topics in Near Eastern Studies (3) [Rpt./4]

c. *Women and the Literature of Identity in Modern Middle East and North Africa (3) (Identical with HIST 596c and S 596c).

d. *Medieval Cities in the 12th-16th Centuries: Cairo, Istanbul, Florence and Venice (3) (Identical with ARCH 596d).

m. Middle East: Topics in History and Civilization (3) [Rpt.] (Identical with HIST 596d).

n. Near Eastern Archaeology (3) [Rpt./6] (Identical with ANTH 596g).

w. *Feminist Approaches in the Bible (3) (Identical with JUS 596w, which is home).

696. Seminar
b. Cultural Anthropology (1-3) [Rpt./3] (Identical with ANTH 696b, which is home).
i. International Water Resource Management (1-3) [Rpt./2] (Identical with HWR 696i, which is home).


**Persian (PRS)**

503.* Advanced Persian I (3) [Rpt.] CDT Readings in Persian, with the objective of preparing the student for independent research. P, 402.

504.* Advanced Persian II (3) [Rpt.] CDT Readings in Persian, with the objective of preparing the student for independent research. P, 403.
Neuroscience (NRC)
Gould-Simpson Building, Room 611
Phone: (520) 621-8380
FAX: (520) 621-8282
WWW: http://www.arl.arizona.edu

Graduate Interdisciplinary Program in Neuroscience

Application Questions:
neuroscience@manduca.neurobio.arizona.edu

Advising Questions:
Graduate Students Advisory and Progress Committee, Gould-Simpson Building, Room 611, (520) 621-8380

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

(The unit offers a master's degree, but initial admission is to the doctoral program only.)

Professors: John G. Hildebrand, Chairperson (Arizona Research Laboratories, Division of Neurobiology), Carol A. Barnes (Psychology), Thomas G. Bever (Linguistics and Psychology), James R. Bloedel (Physiology), Richard Bootzin (Psychology), Thomas P. Davis (Pharmacology), Velma Dobson (Ophthalmology), Merrill F. Garrett (Psychology), Theodore Glattke (Speech and Hearing Sciences), Raphael F. Gruener (Physiology), Thomas J. Hixon (Speech and Hearing Sciences), Victor J. Fruby (Chemistry), Mary L. Johnson (Pediatrics), Alfred W. Kasznia (Psychology), and Cellular Biology), Cyma Van Petten (Psychology), Fraser A.W. Wilson (Psychology), Andrea Yool (Physiology)

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, neuropharmacology, and motor control. Information about the research interests of the faculty can be obtained from the program office.

503a. * Mammalian Systems Neurophysiology (3) (Identical with PSYC 503a, which is home).

503b. * Laboratory in Mammalian Systems Neurophysiology (3) (Identical with PSYC 503b, which is home).

506. Neural Encoding, Memory and Computation in the Mammalian Brain (3) (Identical with PSYC 506, which is home).

524. Gerontology: A Multidisciplinary Perspective (3) (Identical with PSYC 524, which is home).

582. Topics in Neural Development (2) 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 and PSIO 582).

583. Topics in Neural Plasticity (2) (Identical with MCB 583, which is home).

584. Cellular Neurobiology (2) (Identical with CBA 584, which is home).

585. Neural Mechanisms of Behavior (2) 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) 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, 588, or consent of instructor. (Identical with BIOC 586 and MCB 586).

587. Biology of Neurological Disease (3) Emphasis on reading, discussing, and presenting the primary literature pertaining to scientific investigation of neurological diseases, e.g., multiple sclerosis, stroke, epilepsy. For graduate and medical students. Contact program office before enrolling. (Identical with MCB 587).


595. Colloquium
b. *Developmental Neurobiology (1) [Rpt./6 units].

d. *Brain, Behavior and Computation (1) [Rpt./6 units].

695. Colloquium
a. Motor Control (2) (Identical with PSIO 695a, which is home).

699. Colloquium
a. Motor Control (2) (Identical with PSIO 699a, which is home).

c. Science, Society and Ethics (1) (Identical with MCB 695e, which is home).

700. Methods in Neuroscience (2-4) [Rpt.] Research rotations in the laboratories of faculty members within the neuroscience program. Consult neuroscience program office before enrolling.

701. Communication in Neuroscience (2) Preparation of an essay, and instruction in scientific writing. Open to majors only. P, consult neuroscience program office before enrolling.

Nuclear Engineering (See Aerospace and Mechanical Engineering)
Nursing (NURS)
Nursing Building, Room 316
Phone: (520) 626-6151
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), Pearl P. Coulter (Emerita), Sandra Ferntketch, JoAnn Glittenberg, Margarita A. Kay (Emerita), Alice J. Longman (Emerita), Beverly A. McCord (Emerita), L. Claire Parsons, Linda R. Phillips, Arlene M. Putt (Emerita), Pamela Reed, Gladys E. Sorensen (Emerita), Joyce Verran, Anne Woodti

Associate Professors: Terry Badger, Carrie Jo Braden, Evelyn M. DeWalt (Emerita), Rose Gerber, Mary E. Hazzard (Emerita), Elaine B. Jones, Lillian Lynch (Emerita), Kathleen May, Betty J. McCracken (Emerita), Virginia Miller (Emerita), Ida M. Moore, 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, Sandra Cromwell, Jean Davis, Judith Effken, Julie Erickson, Joan Haase, 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 is planned for 4 years and a minimum of 108 units of graduate credit. 33 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 36 units. If the nurse practitioner option is selected, a total of 42-48 units is required. This requires an internship of 6 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, and (3) references attesting to professional competence, (4) evidence of satisfactory completion of a course in elementary statistics, (5) scores on the aptitude test of the Graduate Record Examination, (6) a statement indicating academic and professional goals as well as research interests, and (7) evidence of skills in physical assessment. In addition, (8) computer literacy is required.

An automobile is essential because the clinical facilities are located throughout the Tucson area.

Degrees

The College of Nursing offers a graduate program with multiple exit options: 1) Students may elect to complete a M.S. program including a thesis or elect to also use the master's level courses as the first year of the Ph.D. program. In this option, a research proposal, rather than a thesis, is required and the M.S. degree is not awarded.

The nurse case-manager option within the master's level of the graduate program provides advanced nursing preparation in the care-provider role of nurse case-manager. The College of Nursing also offers nurse-practitioner options in the areas of adult nurse-practitioner, family nurse-practitioner, geriatric nurse-practitioner and psychiatric/mental health nurse-practitioner.

Master of Science: 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 program is the preparation of the clinical nurse-researcher. Applicants must present 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. Admission is based upon the evaluation of the following criteria: 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 for doctoral study; copies of published materials or research reports; and an evaluation of professional record and experience. A personal interview is required after all credentials are available.

A minor area of study which includes a minimum of 12 credits is required. The area of study may be selected from behavioral or biological sciences, or the disciplines of anthropology, philosophy, physiology, psychology, management and policy, sociology or statistics.

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.

502. Professionalizing Presentation Skills (1) (Identical with BIOL 502, which is home).

504. Conceptual Models (3) Theory and research surrounding conceptual models with emphasis on description of conceptual models.

521.* Nursing Care of the Child with a Handicap or Chronic Illness (3) Overview of congenital and acquired handicaps or chronic conditions in school age children. Assessment and management in the school setting of these children and their families. Open to majors only. P, 481, or consult college before enrolling.

522.* School Nursing Practice (3) Analysis and application of nursing in school systems. Program development and evaluation, health curriculum development, and principles of epidemiology for identification of high-risk groups. Open to majors only. P, 481, or consult college before enrolling.

530. Methods in Nursing Research (3) Critical examination of selected problems and methods in the nursing research process. Consideration is given to both qualitative and quantitative methods. (Identical with PHIL 530).

572. Adult Pharmacotherapeutics (3) 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, 580.

579. Issues in Rural Health (3) Topics include: community assessment, planning, and evaluation; interdisciplinary practice; health care issues for southwestern ethnic minority populations. (Identical with MAP 579, PHIL 579, PHPR 579, and PSYC 579).

580.* Principles of Physiology in Health Care (4) Selected physiologic functions and adaptive changes which occur in health and illness. Cellular physiology, the immune system,

584. Statistical Packages in Research (3) Analysis of data for research projects, theses, and dissertations using SPSS and SAS. Organization of data for statistical analysis, entering data and creating command files using the editor, writing, and debugging programs. Techniques for producing graphical output using SAS/GRAPH.

587. *Poverty and Health (3) 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. Advanced degree credit available for non-Ph.D. majors only. P, 6 units of social science. (Identical with FCM 587)

588. Healing Systems in the Southwest (3) 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 ANTH 588)

589. Health of the Older Adult (3) Current research of the aging process including physical and mental alterations; emphasis on physiological changes. Consult college before enrolling. (Identical with GERO 589)

600a:600b:600c:600d:600e. Nursing Theory and Practice (3-3-3-3-3) Maintenance, therapeutic, and preventive nursing care of persons in various settings. Student elects practice in one area of nursing: 600a child, maternal-newborn. 600b. Psychiatric-mental-health. 600c: Community health. 600d: Gerontology. 600e: Adult health.

601. Pathophysiological Alterations (3) 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, 500 or 3 units of graduate-level physiology.

603. Public Health Science (3) 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. Open to majors only. (Identical with PHL 603)

604. Developmental Concepts in Nursing (3) 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) 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. Open to majors only.

606. Social, Psychological Problems in Nursing (3) Focus on concepts of stress and training with emphasis on health-related outcomes. Nursing research on addictions, depression, abuse, and violence will be explored. Open to majors only.

607. Cross-Cultural Nursing (3) 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. Open to majors only. (Identical with PHL 607)

608. Cognitive Alterations (3) Client problems related to the processing of sensory information including etiological factors. Research-based nursing interventions for clients with cognitive alterations are examined. Open to majors only.

609. Health Assessment (3) 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. Open only to masters students in the NP options or by consent of the instructor.

617. FNP: Primary Care I (3) First of three primary care courses preparing FNPs. Beginning skills in health promotion, disease prevention, assessment/management of common health conditions in individuals and families. P, admission to M.S. level in nursing and FNP Option; NS80, N609 (concurrent); N694 (concurrent).

618. FNP: Primary Care II (3) Second of three primary-care courses preparing FNPs. Focus on assessment and management of selected acute and chronic health conditions in individuals and families across the age continuum. P, admission to M.S. program and FNP option; 609, 617, CR, 517, 694b.

619. FNP: Primary Care III (4) Third of three primary care courses preparing family nurse practitioners (FNPs). Focus is on assessment, diagnosis, and management of selected complex and/or urgent/emergent acute and chronic health conditions in primary care practice in individuals and families across the age continuum. P, admission to M.S. program and FNP option; 617, 618.

621. Educational Process (3) Theoretical and practical application of teaching-learning processes in classroom and clinical settings. Principles of teaching, learning, instructional design, testing. Micro-teaching included. 2R, 3L. Open to majors only.

622. Nurse Educator Role (3) Theoretical and practical application of curriculum development and process. Use of teaching-learning process. Preparation for nurse educator role. Directed practice teaching included. 1R, 6L. Open to majors only. P, 621. (Identical with PHL 622)

623. Clinical Agency Administration (3) Practical application of administrative processes in a nursing care delivery setting. Focuses on the use of selected skills essential to effective administration. Open to majors only. P, 624.

624. The Administrative Process (3) Theoretical background for nursing administration in care settings. Emphasis are on accountability, budgeting, management skills, constraints, and influences as related to nursing administration. Open to majors only. (Identical with PHL 624)

625. Advanced Role Development (3) 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. Open to majors only. P, 580.

626. Primary Care of Adults (3-4) 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. Open to majors only. P, 609.

627. Advanced Psychiatric Mental Health Nursing II (3) 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, 600a, graduate standing in nursing.

632. Research Utilization (3) Development and use of models and tools for facilitating the use of research in evidence-based nursing practice within organizational settings. 2R, 3L. P, 530.

633. Evaluation Research (3) 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 PHL 633)

634. Data Management in Health-Care Systems (3) 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. 2R, 1L. P, 530, 630.

640. Nursing Case Management I (3) Introduction to models of nursing case management, the case management process, and advanced nursing practice; applicable to clients in a variety of clinical settings. P, graduate standing.

Methods for structure, process, and outcomes indicators in a health care system. Strategies for measurement of health care systems, including analysis of extant and emerging philosophical and historical foundations of nursing systems. Focus is on the role of the systems manager in health care settings. Presentations with application to health care making and problem solving; cost-benefit analysis; project management; critical decision making. Applying the systems manager to health care settings.

650. Theory of Systems Management (3) Emphasis on critique, elaboration, and theory development in the role and for application of content into the role and for application of content from previous systems management courses. Two of the 3 hours of credit will be devoted to a practicalicum and preceptorship in a nursing system's environment and 1 hour will be a seminar to discuss clinical experiences in the role. P, 650, 645, 633, 603.

705. Nursing Metatheory (3) Examination of social forces affecting the health care system. Open to majors and minors in nursing. P, 504 or equivalent.

725. Study of Social Influences (3) In-depth analysis of extant and emerging philosophical bases of nursing for scientific inquiry. Open to majors and minors in nursing. P, 504 or equivalent.

795. Colloquium on Social Influences (1) (Identical with PHPR 447, which is home).

969. Seminar on Social Influences (1-3) P, 730 or consent of instructor.

706. Middle Range Theory (3) Introduction to ways of knowing, focus on middle range theories in nursing and related sciences. Emphasis on critique, elaboration, and theory testing strategies. Open to majors only. P, 705.

723. Study of Social Influences (3) In-depth analysis of social forces affecting the health care system. Open to majors only. P, admission to Ph.D. program.

730. Quantitative Methods in Clinical Nursing Research (3) Investigation of selected quantitative strategies appropriate to researching problems in clinical nursing. P, 530, 633, admission to Ph.D. program.

731. Qualitative Methods in Clinical Nursing Research (3) Application of selected qualitative research methods from the social sciences to clinical nursing. Open to majors only. P, 530, admission to Ph.D. program.

781a-781b. Instrument Construction (3-3) Deductive and inductive processes for constructing/testing instruments to measure nursing care interventions/patient outcomes. 781a: Instrumentation for behavior and objective phenomena. 781b: Instrumentation for subjective phenomena. Includes instrument strategies; experience developing a pilot measure. 2R, 3L. Open to majors and minors only. P, 705, 730, graduate level statistics. 781a is not prerequisite to 781b.

795. Colloquium on Social Influences (1)

Nutritional Sciences (N SC)
Shantz Building, Room 309
Phone: (520) 621-1187
FAX: (520) 621-9446
WWW: http://ag.arizona.edu/NSC/nschome.html

Application Questions:
Fred Wolfe, (520) 621-1187,
wolfe@ag.arizona.edu

Advising Questions:
Fred Wolfe, (520) 621-1187,
wolfe@ag.arizona.edu

Degrees Offered: M.S.
Concentrations: Dietetics, nutritional biochemistry
Professors: Fred Wolfe, Head, Mary Ann Kight, K.Y. Lei, John Marcello, Charles W. Weber
Associate Professors: Linda Houtkooper, Ralph L. Price, Edward T. Sheehan
Assistant Professors: Wanda Howell, Ann A. Jerkins, Scottie Misner, Joy Winerling

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 or N SC 558; 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.


520. Advanced Nutritional Science (3) Advanced physiology and biochemistry of nutrients with emphasis on present knowledge and current research topics in nutritional sciences. P, BIOC 460 or 462a.

540. Advanced Dietetics (3) Nutrition and metabolism in patient care as applied by the advanced-level practitioner. Open to majors in nutritional sciences only.

541. *Therapeutic Nutrition (4) 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, 408.

547. Perspectives in Geriatrics Laboratory (1) (Identical with PHPR 447, which is home).

595. Colloquium on Clinical Dietetics (3)

596. Seminar on Human Nutrition (1-3)


602. Metabolic Integration (3) 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, 462b.

609. Nutritional Biochemistry Techniques (3) Biochemical methods for evaluating metabolic functions of nutrients. 1R, 6L P, 408, CHEM 324 or 325, and 323 or 326. (Identical with AN S 609).

615. Chemistry and Metabolism of Lipids (3) Chemistry and structure of lipids and their digestion, absorption, transport, and utilization; current research in lipid metabolism and the role of lipids in certain disease states. (Identical with AN S 561).


622. Mineral Metabolism (2) Chemistry, metabolism, and biological function of minerals; current research in mineral requirements and toxicity. P, 408. (Identical with AN S 622).

628. Steroid and Lipoprotein Chemistry and Metabolism (2) 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, 602, BIOC 460 or BIOC 462a, 462b.

biochemical methods. 2R, 3L. Open to majors in nutrition and other health sciences areas only.

663. Chemistry of Food Carbohydrates (2)
Chemical and physical properties of carbohydrates important to their presence in food. P, BIOL 460, 462a.

665. Analysis and Purification of Proteins (3)
(Identical with AN S 665, which is home).

693. Internship
a. Dietetic Internship, ADA Accredited (1-6) [Rpt./2] Field trips. Begins Mid-August and continues for 46 weeks. Consult dept. before enrolling. Open to majors only. P.
Course work equivalent to American Dietetic Association DPD.

696. Seminar
b. Nutrition (1) [Rpt./6 units] (Identical with NUSC 696b)

Nutritional Sciences (NUSC)

Shantz Building, Room 308
Phone: (520) 621-5630
FAX: (520) 621-9446

Graduate Interdisciplinary Program in Nutritional Sciences

Application Questions: Ann A. Jenkins, (520) 621-5630, nusc@ag.arizona.edu
Advising Questions: William A. Stini, (520) 621-8206, stini@ccit.arizona.edu

Degrees Offered: Ph.D.

Concentrations: Human nutrition, animal nutrition, nutritional biochemistry

Professors: William A. Stini (Anthropology), Chair, David S. Alberts (Internal Medicine), Ronald E. Allen (Animal Sciences), Harris Bernstein (Microbiology and Immunology), David L. Earnest (Internal Medicine), Charles Gerba (Soil and Water Science), Fayez Ghisan (Pediatrics), J. Tal Huber (Animal Sciences), Mary Ann Kight (Nutritional Sciences), Otakar Koldovsky (Pediatrics), David K.Y. Lei (Nutritional Sciences), Timothy G. Lohman (Exercise and Sport Sciences), Anthony F. Philippus (Pediatrics), C. Brent Theurer (Animal Sciences), Marc E. Tischler (Biochemistry), Charles W. Weber (Nutritional Sciences)

Associate Professors: Larry C. Clark (Family and Community Medicine), Carlos Flores (Pediatrics), Donald V. Lightner (Veterinary Science), Ralph L. Price (Nutritional Sciences), Cheryl K. Ritenbaugh (Family and Community Medicine), Edward T. Sheehan (Nutritional Sciences), Ann M. Tinsley (Nutritional Sciences), Douglas Taren (Family and Community Medicine), David Van Wyck (Medicine), Roy Verdery (Medicine)

Assistant Professors: Iris R. Bell (Psychiatry), Wanda H. Howell (Nutritional Sciences), Ann A. Jenkins (Nutritional Sciences), Joy Winzerling (Nutritional Sciences)

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), animal nutrition, and nutritional biochemistry.

Requirements for admission must include undergraduate preparation in mathematics and one year each of general biology, organic chemistry with laboratory, and physics. A master's degree in an applicable field is required for admission. Application for admission must include a statement of purpose, three letters of recommendation, official transcripts, and GRE scores.

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.

596. Seminar
v. Alcohol, Drugs: Biology to Treatment (3) (Identical with F CM 596v, which is home).

605. Methods in Nutritional Research (3)
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./6 units] (Identical with N SC 696b, which is home).

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: Coherent optics, detectors, electro-optics, holography, image processing, diffractive optics, infrared technology, medical optics, nonlinear optics, optical data storage, optical design, optical fabrication and testing, optical properties of materials.

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, optical computing components, diffractive and binary optics, 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 Steward Observatory, the Arizona Research Laboratories, the Optical Circuity Cooperative, and the Optical Data Storage Center.

Applicants should hold a bachelor's degree in engineering, mathematics, or physics. Applicants must submit to the Associate Director, Academic Affairs, Optical Sciences Center, University of Arizona, P.O. Box 210094; Tucson, Arizona 85721-0094; one complete set of transcripts and at least two letters of recommendation. Scores on the general test and one subject (engineering, mathematics, or physics) test of the Graduate Record Examination are normally required. Students are normally admitted to begin their studies in optical sciences; students with majors in optical sciences, or equivalent in transferred course work. No minimum in any subject is required. Applicants with majors in optical sciences, or obtain approval for the equivalent laboratory experience. 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 6 of these units may be crosslisted with the student's major department (if other than optical sciences).

Because of the large number of applications received each year, early submission is encouraged.

Master of Science: There is no core curriculum for the Master of Science degree, and students are allowed considerable freedom in planning their study programs. Students must select 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 laboratory 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 successfully completing an appropriate course in technical writing); and a final oral examination, based comprehensive 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 comprehensive examination.

Doctor of Philosophy: 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 or provide evidence of equivalent laboratory experience. 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 6 of these units may be crosslisted with the student's major department (if other than optical sciences).

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502. Introduction to Optical Design (3) Rays and wavefronts, Snell's Law, mirror and prism systems, Gaussian imagery and cardinal points, paraxial ray tracing, stops and dispersion, systems of thin prisms, system analysis using ray trace code, chromatic aberrations and achromatization, monochromatic aberrations, ray fans, spot diagrams, balancing of aberrations, aspheric systems. P, PHYS 142 or 241.


504. Mathematical Methods for Optics (3) Complex variables, Fourier theory and applications to imaging, coherent and incoherent imaging, other integral transforms, special functions and orthogonal polynomials, linear algebra, integral equations, green's functions. P, MATH 223, PHYS 142 or 241.


505L. Fundamentals of Physical Optics Laboratory (1) Laboratory in support of 501 and 505. P, 501 or 505.

506. Radiometry and Detectors (3) Generation and propagation of black body and other radiation, projected areas, solid angle, inverse square and other laws, isotopic and other surfaces, absorption, reflection, transmission, scattering, imaging and non-imaging detectors, figures of merit, noise, vision, color, film, calibration and measurement, spectrometers and radiometers. P, 502.

507. Solid-State Optics (3) Basic concepts in crystals and in optical response, optical properties of phonons and semiconductors, quantum wells, electro-optical properties of bulk semiconductors, optical nonlinearities, solid state devices and laser diodes. P, 503, 511 or PHYS 371.


511L. Lasers and Solid-State Devices Laboratory (1) Gas and semiconductor lasers, MOEMS and on-chip elements, mode locking, spectrum analysis, exotons and quantum wells, noise, modulators and detectors, second-harmonic generation. P, 503 or 511, CR 507.

512. Introduction to Fourier Optics (3) Mathematical background, convolution, the Fourier transform, linear filtering, two-dimensional operations, diffraction, image formation. P, MATH 223, PHYS 142 or 241.
512L. Mathematical Optics Laboratory (1) Laboratory in support of 504, 508 and 512. P, 504 or 512 and C SC 227 or SIE 270.

513. Optical Testing (3) Fringe analysis, wavefront aberrations and analysis, measurement of optical components, surface figure, surface finish, length, refractive index and transfer functions. P, 505, 506.


514. Aberration Theory (3) Aberration theory; geometrical image formation; diffraction; pupil, spread, and transfer functions; random wavefront perturbations; system effects, image evaluation; image processing. P, 506.

517. Lens Design (4) 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. 2R, 6L. P, 506.


527. Holography (3) Historical background; the Gabor hologram; the hologram as a zone plate; Fresnel, image, Fourier-transform, and reflection holograms; practical holography; limitations. P, 505. (Identical with ECE 527).


531. Image Processing Laboratory for Remote Sensing (3) (Identical with ECE 531, which is home).

532. Computer Vision (3) (Identical with ECE 532, which is home).

533. Digital Image Processing (3) (Identical with ECE 533, which is home).

534. Advanced Topics in Electronic Materials (3) [Rpt./2] (Identical with MSE 534, which is home).

538. Medical Optics (3) 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, 512.


550. Fundamentals of Remote Sensing (3) Historical development of remote sensing, the sun and the electromagnetic spectrum; radiometry; radiometry of optical systems; spectroradiometric instruments; reflectance, definitions and measurement; atmospheric properties, measurements and effects; satellite optical sensors; radiometric calibration of sensors; atmospheric correction. 558. Radiometry (3) Units and nomenclature; Planck's law; black bodies, grey bodies; spectral emitters; Kirchhoff's law; flux concepts; axial and off-axis irradiance; radiative transfer; normalization; coherent illumination; radiometric instruments. P, 501.

559. Imaging and Infrared Techniques (3) 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 the Solid State (3) (Identical with PHYS 561, which is home).

563. Photoelectronic Imaging Devices (3) Intensifiers; camera tubes; storage tubes; specifications; evaluation; applications; electronic optics, human visual process, photon detection. P, PHYS 132.

566. Optical Detectors (3) 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, 502 and 506, 507.

568. Solid State Imaging Devices (3) Charge transfer devices, monolithic and hybrid focal planes, photoconductive, photovoltaic, and pyroelectric detectors, figures of merit, time-delay integration (TDI), fast zero, transfer efficiency, MTF, double-correlated sampling, input techniques, output techniques, buried channel vs. surface channel devices. Composite video characteristics. P, 507.

573. Atomic and Molecular Spectroscopy for Experimentalists I (3) (Identical with PHYS 573, which is home).

574. Atomic and Molecular Spectroscopy for Experimentalists II (3) (Identical with PHYS 574, which is home).


577. Optics of Thin Films (2) Dielectric interference films; semiconductor and metallic films; planar wave guide films; design methods for multilayer interference filter coatings; thin film components for integrated optical circuits. P, 505.

587. Fiber Optics Laboratory (3) Fiber characteristics; fiber preparation; single and multimode fibers; sources; coupling; communication systems; multiplexing techniques; fiber-optic sensors. P, ECE 456. (Identical with ECE 587).

590. Remote Sensing for the Study of Planet Earth (3) (Identical with REM 590, which is home).

590L Colloquium
a. Current Subjects in Optical Sciences (1) [Rpt./2]

596. Seminar
c. Issues in Science and Technology Policy (3) [Rpt./6 units] (Identical with PHYS 596e, which is home).

597. Workshop
a. Optical Shop Practices (3) P, 513, 513L.


637. Principles of Image Science (3) Mathematical description of imaging systems and noise; introduction to inverse problems; introduction to statistical decision theory; prior information, image reconstruction and radiation transform; image quality; applications in medical imaging, other imaging systems. P, 504 or 512, 508.

638. Advanced Medical Imaging (3) 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, 504 or 512 or equivalent.

656a-656b. Atmospheric Radiation and Remote Sensing (3-3) (Identical with ATMO 656a-656b, which is home).

657. Principles of Optical Data Storage (3) 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) 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
The Department of Pharmaceutical Sciences includes the academic disciplines of pharmaceutical chemistry, pharmacognosy, biopharmaceutics, pharmacokinetics, pharmacometrics, and pharmacy administration/pharmaceutical economics. 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) pharmacokinetics/biopharmaceutics, (2) pharmacometrics, (3) pharmacy administration/pharmaceutical economics, and (4) pharmaceutical chemistry/pharmacognosy.

A bachelor's degree in pharmacy or Pharm. D. degree is generally required for pharmacy administration/pharmaceutical economics. 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. Correspondence for the programs should be directed to the Department Head.

Teaching is part of the graduate learning process, and one or more years of teaching is generally required of graduate students. A thesis/dissertation based upon research is required. Graduate study programs are individually planned based upon research is required. Correspondence for the programs should be directed to the Department Head.


508a-508b. * Pharmacokinetics Discussion (1-1) Discussion related to the application of pharmacokinetic principles with case-study examples. CR, 407 for 508a, 408 for 508b.


512. Quantitative Structure-Activity Relationships (3) Approaches to the quantification of pharmacological actions of drugs on the basis of chemical structure.

513. Pharmaceutical Economics (3) Application of management principles to problem solving and decision making techniques in the provision of pharmaceutical services within the institutional environment. Field trips. Open to majors only. P, 511.

514. * Toxicokinetics (3) Introduction to the principles of pharmacokinetics as they are applied to the biological and chemical sciences for the quantitative study of drugs and toxic agents. Toxicokinetics involves the development of quantitative models to describe the time course of absorption toxicity, especially as it relates to the drug or toxin disposition. Issues in experimental design, extrapolation of data from animals to humans, and aspects of risk assessment.

527. * Antineoplastic Drugs (2) Discovery and development of natural and synthetic antineoplastic drugs; preclinical screening and toxicity evaluation; phase I, II, and III clinical studies in humans. P, 437b or CR.

536. Pharmaceutical Chemistry and Pharmacology (4) (Identical with PCOL 536, which is home).

537a-537b. * Medicinal Chemistry (3-2) 537a: Continuation of the comprehensive survey of the medicinal chemistry of drugs, including agents acting on the autonomic, cardiovascular, hematopoietic, inflammatory, and gastrointestinal systems, vitamins and radiopharmaceuticals. P, 436. 537b: Continuation of the comprehensive survey of the medicinal chemistry of drugs, including agents acting on the endocrine and central nervous systems. P, 436, 437a.

542. Professional Practice Management (3) Management of professional situations and the interaction among patients, colleagues, and other health-care providers, with application to institutional, community, and clinical pharmacy practice. P, 445.

545. * Medication Use and the U.S. Health Care System (3) An overview of the U. S. health care system and the consumers, providers, payers, and regulators that comprise it. The role of pharmacy and pharmacists within the health care system will be explored, including an examination of social, behavioral, and economic factors associated with the prescribing, dispensing, and use of medications.


548. Perspectives in Geriatrics (2) Multidisciplinary approach to the health-care needs of the elderly, including medication use, nutrition, health care agencies, and roles of individual health care professionals. Open to non-majors. P, CR, 447 for non-majors. (Identical with GERO 548 and N SC 548).

561. * Methodology in Pharmaceutical Research and Drug Literature Evaluation (3) Application of research design, statistical methods, evaluation techniques, and ethical dimensions to critically evaluate published literature, research reports and proposals. P, MATH 263.

583. * Perspectives of Cancer Care for Health Professionals (3) (Identical with NURS 583, which is home).

585. * Advanced Clinical Pharmacokinetics (3) Advanced pharmacokinetic principles emphasizing the application of mathematical methods to the study of drug effects in humans. P, (Identical with PCOL 590, which is home).
relationships to therapeutic drug monitoring in patient care situations. P, PHSC 407, 408a, or consult department before enrolling.

589. Clinical Pharmacotherapy of Mental Disorders (2) A multidisciplinary approach to clinical psychopharmacology, therapeutics, and diagnosis of mental disorders for health professionals.

596. Seminar a. Pharmaceutical Chemistry (1) [Rpt./5]
b. Pharmaceutical Chemistry Research (1) [Rpt./5]
c. Pharmaceutics Research (1 to 2) [Rpt./5]
Open to majors only.
d. Pharmaceutics (1) [Rpt./5 units]
e. Pharmacy Administration (1) [Rpt./5]
f. Pharmacy Administration Research (1) [Rpt./5]

601. Advanced Physical Pharmacy (3) Applications of physical chemistry to pharmacy. P, physical pharmacy or physical chemistry course.


606. Industrial Manufacturing Pharmacy (3) Pharmaceutics as applied to various aspects of industrial pharmacy. Field trips.

609a-609b. Pharmacokinetics (3-3) Quantitative treatment of kinetics of drug absorption, distribution, metabolism, excretion and pharmacologic response, including development of mathematical models for these processes and use of digital computer for simulation and nonlinear regression analysis. P. 407.

611. Pharmaceutical Education Research (3) 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) Survey of research methodology for studying administrative, social and behavioral aspects of health care and pharmacy practice; strategy for selecting and modifying existing research tools for particular purposes. (Identical with PHL 612).

621. The Pharmaceutical Industry (3) Economic and organizational factors in the development, production, and distribution of drugs and the structure of the industry. (Identical with PHL 621).

630a-630b. Advanced Organic Medicinals (4-3) Rational drug design, recepter site theories, mechanism of drug action, and metabolic pathways of medicinal agents; chemical and enzymatic synthesis of important pharmaceuticals. P, 437b, PCOL 471b.

632a-632b. Natural Medicinal Products (3-3) Origin and isolation of steroidal and alkaloidal drugs and other natural products of interest. P, 437b, PCOL 471b.

634. Biomedical Applications of Mass Spectrometry (3) 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) [Rpt.]
b. Administrative Clerkship (1-15) [Rpt.]

695. Colloquium a. Research in Gerontology (1) (Identical with GERO 695a, which is home).

815. Pharmacy Subspecialty I. Research (3) 15-30L. P, or CR, 10 units of PHPR 810. (Identical with PHPR 8151, which is home).

Pharmacology (PHCL)
College of Medicine, Room 5103 Phone: (520) 626-7218 FAX: (520) 626-2204 WWW: http://www.pharm.arizona.edu (Department, College of Medicine) Professors: I. Glenn Sipes, Head (Anesthesiology, Pharmacology, Pharmacology and Toxicology), David S. Alberts (Medicine), R. Vasken Aposhian (Molecular and Cellular Biology), Klaus Brendel, Rubin Bressler (Medicine), Thomas P. Davis, A. Jay Gandolfi (Anesthesiology, Pharmacology and Toxicology), Marilyn J. Halonen (Microbiology, Respiratory Sciences, Internal Medicine), R. J. Huxtable, David G. Johnson (Medicine), Eugene Morfin (Medicine, Physiology), John D. Palmer (Medicine), Frank Porreca (Anesthesiology), Garth Powis (Pathology), Charles W. Putnam (Surgery), William R. Roeseke (Medicine), Robert R. Sloviter, Henry L. Yamamura (Biochemistry, Arizona Research Laboratories, Psychiatry) Associate Professors: John W. Bloom (Medicine, Respiratory Sciences), Dean E. Carter (Pharmacology and Toxicology), Robert T. Dorr (Medicine, Cancer Center), Timothy Fagan (Medicine), Edward D. French, Josephine Y. Lai, Ronald M. Lynch (Physiology) Assistant Professors: Qin Chen, Bernard W. Futscher (Cancer Center), Douglas F. Larson (Surgery), Andrea J. Yool (Physiology) Research Associate Professors: Philip D. Kanof, Mark L. Witten (Pediatrics) Research Lecturer: 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)

801. The Pharmacological Basis of Therapeutics (6) II 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.


1. Research (5) I II S 15-30L. P or CR. 10 units of PHPR 810. (Identical with PHPR 8151)

825. Human Neuroscience (6) I (Identical with CBA 825)

891. Preceptorship a. Pharmacology (3-12) [Rpt./12 units]

1. Perfusion Science (1-3) [Rpt./25 units] 1 II 5 (Identical with SURG 8911). Students register for 3 units Fall and Spring Semesters and one unit Summer Session I and II.

Pharmacology and Toxicology (PCOL)
Pharmacy Building, Room 236 Phone: (520) 626-2823 FAX: (520) 626-2466 WWW: http://www.pharm.arizona.edu (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 (Pharmacology), Lincoln Chin (Emeritus), Paul F. Consore, A. Jay Gandolfi, (Anesthesiology, Pharmacology), James R. Halpert, Wayburn S. Jeter (Emeritus), Arnold M. Martin (Pharmaceutical Sciences), Albert L. Picchiioni (Emeritus), William A. Remers (Pharmaceutical Sciences), Findlay E. Russell, Karl H. Schram (Pharmaceutical Sciences), Barbara N. Timmermann (Pharmaceutical Sciences), Theodore G. Tong (Pharmacy Practice and Science) Associate Professors: Daniel C. Liebler, Neil E. MacKenzie (Pharmaceutical Sciences, Biochemistry), Charlene A. McQueen, John W. Regan, Assistant Professors: William T. Bellamy (Pathology), Clifford D. Crutchfield (Family and Community Medicine, Health Education), Robert T. Dorr (Pharmacology, Medicine, Cancer Center), John B. Sullivan (Surgery),
501. The Pharmacological Basis of Therapeutics (6) II 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 601 and course equivalent to BIOL 462a.

502. Environmental Monitoring and Analysis (2-4) I (Identical with OSH 502)

508.* Insect Toxicology (3) II (Identical with ENTO 508)

509. Statistics for Research (4) I II (Identical with MATH 509)

510.* Physical Exposures (3) II (Identical with OSH 510)

515. Toxicokinetics (3) II 1993-94 (Identical with PHSC 515)

520. Clinical Pharmacology (2) I Effects of drugs on natural history of disease; drug-drug interactions; drug testing designs; drug abuse; drug literature evaluation; aspects of clinical toxicology. P, 501.

523.* Mechanisms of Disease (5) II (Identical with VSC 523)

536. Medicinal Chemistry and Pharmacology I (4) II General principles of medicinal chemistry and pharmacology, and comprehensive survey of anti-infective and antiinflammatory drugs. Graduate level requirements include term paper. P, 307, BIOL 460, CHEM 241b, 243b, or CR PSIO 480. (Identical to PHSC 536).

537a-537b. Medicinal Chemistry II and III (3-2) 537a: I Continuation of the comprehensive survey of the medicinal chemistry of drugs, including agents acting on the autonomic, cardiovascular, hematopoietic, inflammatory and gastrointestinal systems, vitamins and radiopharmaceuticals. P, 536. 537b: II Continuation of the comprehensive survey of the medicinal chemistry of drugs, including agents acting on the endocrine and central nervous systems. P, 436, 537a. Graduate-level requirements include extensive use of the current literature and emphasis on drug design principles. P, 536.

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. P, ECOL 182. 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, BIOL 462a, 462b, or 411 and 511.

553. Toxicology and Chemical Exposures (2-4) I (Identical with OSH 553)


566.* Physiology Laboratory (3) II (Identical with ECOL 566)

571a-571b. Pharmacology II and III (4-2) I Continuation of the comprehensive survey of the pharmacology of drugs, including agents acting on the autonomic, cardiovascular, hematopoietic, and inflammatory systems. P, 536. 571b: II Continuation of the comprehensive survey of the pharmacology of drugs, including agents acting on the endocrine and central nervous systems. P, 536, 571a. Graduate-level requirements include an in-depth research paper on a current topic. P, 536.

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. Only open to nursing majors or with permission of the course coordinator. Graduate-level requirements include a term paper on nursing pharmacology.

574. Clinical Toxicology (2) I Prevention, characteristics, diagnosis and rational management of diseases caused by drug overdose, toxic household products, poisonous plants, venemous animals, environmental and industrial toxicants. Graduate students will complete sixteen hours in the Poison Information Center. P, 572 or 571b.

576. Environmental Toxicology Alternate Year 1999-2000 (3) II Toxicity of agricultural and industrial chemicals, with emphasis on air and water pollutants; decision-making in environmental issues and risk assessment. P, 6 units of biology and organic chemistry, PCOL 602a. (Identical with ENTO 576)

580. Systems Physiology (5) II (Identical with PSIO 580)

582. Immunotoxicology (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, 602a-602b, MIC 419 or equivalent.

584.* Fundamentals of Industrial and Environmental Health (3) I (Identical with OSH 584)

585.* Industrial Ventilation (3) II (Identical with OSH 585, which is home).

586a-586b. Introduction to Pharmacology and Toxicology Research (1-1) 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.

587.* Advanced Industrial and Environmental Health (3) II (Identical with OSH 587)

593. Internship (1-3) I II

596. Seminar a. Advanced Graduate Research (1 to 3) [Rpt./3] I II

b. Current Concepts in Industrial Hygiene (1) [Rpt./3] I II
c. Advanced Toxicology (1-2) [Rpt./3] I II

597a. Computer-Assisted Instruction (1) I II This course will be a series of hands-on tutorials on the technical and aesthetic aspects of the use of computer models for the creation of effective presentations. Basic tools and skills necessary for seminar presentations, and more sophisticated means of organization and expression of materials will be covered.

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 will be employed whenever appropriate. Lecture may be arranged separately by non-majors. Toxicology majors take lecture/laboratory (4 units). Elective for pharmacology majors and others should take lecture only (2 units). 2R, 6L. P. CHEM 325, 326

602a-602b. Biotoxicology (3-1) 602a: I Lecture. Mechanisms of organ directed toxicities in animals. Chemical carcinogenesis, teratogenesis and mutagenesis. Open to non-majors. P. organic chemistry, two semesters of biology, one semester of biochemistry. 602b: II Laboratory. Proper use of animals in toxicology and pharmacology research, focuses on organ specific toxicities. (Identical with PHIL 602a-602b) (602a is identical with CBIO 602a)

610. Topics in Advanced Toxicology (1-3) [Rpt./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, 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) I (Identical with CBA 605)

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.
Pharmacology and Toxicology (PCOL)

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Phone: (520) 626-7218
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Graduate Interdisciplinary Program in Pharmacology and Toxicology

Application Questions:
Sandi Sledge, (520) 626-7218, sledge@u.arizona.edu

Professors: David S. Alberts (Medicine), H. Vasken Apothesis (Molecular and Cellular Biology), G. Timothy Bowden (Radiation Oncology, Molecular and Cellular Biology), Klaus Brendel, Rubin Bressler (Medicine), Dean E. Carter (Pharmacology), Paul F. Consone, Thomas P. Davis, A. Jay Gandolfi (Anesthesiology, Pharmacology), Marilyn J. Halonen (Microbiology, Respiratory Sciences, Internal Medicine), James R. Halpert, Ryan J. Huxtable, David G. Johnson (Medicine), Michael Mayersohn (Pharmaceutical Sciences, Pharmacy Practice and Science), Paul F. McDonagh (Surgery), Eugene Morkin (Medicine, Physiology, Pharmacology), John D. Palmer (Medicine) Frank Porrec (Anesthesiology), Garth Powis (Pathology, Pharmacology), Charles W. Putnam (Surgery, Pharmacology), William R. Roeseke (Medicine, Pharmacology), Findlay E. Russell, I. Glenn Sipes, (Anesthesiology, Pharmacology), Robert R. Sloviter, Henry I. Yamamura (Biochemistry, Arizona Research Laboratories, Psychiatry)

Associate Professors: Edward D. French, Chair (Pharmacology), John W. Bloom (Pharmacology, Medicine, Respiratory Sciences), Robert T. Dorr (Pharmacology, Medicine, Cancer Center), Timothy C. Fagan (Pharmacology, Medicine), Josephine Y. Lai (Pharmacology), Daniel C. Liebler, Ronald M. Lynch (Physiology, Pharmacology), Charlene A. McQueen, John W. Regan Assistant Professors: William T. Bellamy (Pathology), Qin Chen, Bernard W. Futscher (Cancer Center), Douglas F. Larson (Surgery), Mark A. Nelson (Pathology), John B. Sullivan (Surgery), Richard R. Vaillancourt, Andrea J. Yool (Physiology)

Research Professor: Claire M. Payne (Microbiology and Immunology)
Research Associate Professors: Ronald J. Lukas (Pharmacology), Thomas L. Smith (Pharmacology)
Research Assistant Professors: Mark L. Witten (Pediatrics), Margaret M. Briehl (Pathology)

All students accepted into the doctoral program are offered financial assistance in the form of graduate assistantships or traineeships. Graduate assistants/trainees are exempt from nonresident tuition. Also available are registration fee scholarships.

The department of Pharmacology and Toxicology in the College of Pharmacy cooperates with the department of Pharmacology in the College of Medicine, through the Committee on Pharmacology and Toxicology, in offering programs leading to the Master of Science degree with a major in toxicology (a specialization in industrial hygiene is also offered), the Master of Science degree with a major in pharmacology (a specialization in perfusion science is also offered), and the Doctor of Philosophy degree with a major in pharmacology and toxicology.

Pharmacology (M.S. and Ph.D.)

Pharmacology is the science concerned 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. Professional pharmacologists tend toward careers combining basic research and teaching in academia or basic and applied research in industry or research institutes.

Toxicology (M.S. and Ph.D.)

Toxicologists study the adverse effects of chemicals on living systems. Of particular concern is understanding the basic molecular and cellular mechanisms by which environmental pollutants, industrial chemicals, and drugs produce tissue injury, cancer, reproductive failure, immunosuppression, and other diseases. The applied aspect of toxicology utilizes our understanding of toxicology to reduce the health risk from exposure to potentially toxic chemicals. Toxicology is a growing science with many opportunities for basic and applied research.

Perfusion Science (M.S. Pharmacology)

Perfusion science incorporates the investigation of pharmacological, biomaterial, laboratory, and clinical aspects of extracorporeal circulation. This discipline will prepare students for professional practice in perfusion with a wide range of experiences including cardiovascualr research, systems design and development, cardio-pulmonary bypass, and life support systems. This is a special tracking associated with the M.S. Pharmacology degree.

Industrial Hygiene (M.S. Toxicology)

Industrial hygiene is the applied science concerned with the anticipation, recognition, evaluation, and control of chemical and physical agents that can affect health status in occupational and environmental settings. An industrial hygiene concentration prepares students for professional practice in a wide range of private and public sector organizations. This is a special tracking associated with the M.S. Toxicology degree.

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
Neuropharmacology/Toxicology
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) 621-9599
WWW: http://w3.arizona.edu/~phil/

Application and Advising Questions:
Joseph T. Toller, toller@aruba.ccit.arizona.edu

Degrees Offered: M.A.*, Ph.D.
(The program offers a master's degree but initial admission is to the doctoral program only).


Associate Professors: Thomas Christiano, David Schmitz, Joseph T. Toller.

Assistant Professors: Jenann Ismael, David Owen, Margaret Reimer, Houston Smit

The University of Arizona's philosophy graduate program in 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 in addition 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 one course in 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. A substantial proportion of 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.

502. * Mathematical Logic (3) (Identical with MATH 502, which is home).

503. * Foundations of Mathematics (3) (Identical with MATH 503, which is home).

509a-509b.* Symbolic Logic (3-3) 509a: Intermediate propositional logic and quantificational theory, natural deduction, axiom systems, elementary metamathemes, introduction notions of modal logic, selected topics in philosophy of logic. 509b: Advanced propositional logic and quantificational theory, metaphemes on consistency, independence, and completeness; set theory, number theory, and modal theory; recursive function theory and Godel's incompleteness theorem. (Identical with MATH 509a-509b and CS 509a-509b).

510a-510b.* History of Moral and Political Philosophy (3-3) Reading and analysis of selected texts from the Greeks to the present. 510a focuses on the history of moral philosophy and 510b on the history of social and political philosophy.

512. * Readings in Greek Philosophy (3) (Rpt./1) (Identical with GRK 512, which is home).

514. * Philosophical Logic (3) Introduction to modal logic; problems of interpretation and application; extensions to such areas as tense logic, epistemic logic, deontic logic.


519. * Induction and Probability (3) Basic philosophical problems concerning justification of induction, confirmation of scientific hypotheses, and meaning of probability concepts.


522. Linguistic Semantics and Lexicology (3) (Identical with LING 522, which is home).

523a-523b.* Philosophy of the Physical Sciences (3-3) 523a: 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. 523b: Theories and models. Measurement, experimentation, testing hypothesis. Philosophical problems concerning explanation, causation, and law of nature.

524.* Philosophy of Social Sciences (3) Theories, concepts, and forms of understanding in the social sciences. Possible topics: rational choice and decision at the individual and social levels, democracy, and market mechanisms. P, one course in philosophy.

525.* Philosophical Issues in Feminism (3) Issues in philosophy raised by feminism and recent studies of gender. Possible topics: the sources of gender differences; gender and the nature of knowledge; gender differences in conceptions of morality; feminist political theories; the nature of mothering.

530a-530b.* Ethical Theory (3-3) 430a: Metaethics-meaning of moral terms, relativism, subjectivism, ethics and science, social contract theory. 430b: Normative ethics-Utilitarianism, egoism, rights, natural law, justice, deontological duties, blameworthiness and excuses.

534.* Social and Political Philosophy (3) Fundamental concepts of politics; leading social and political theories, such as anarchism, socialism, Marxism.

536.* Games and Decisions (3) Classical theory of subjective probability, utility, and rational choice, with applications to games theory and social welfare theory. P, MATH 119.

537. Psycholinguistics (3) (Identical with LING 537, which is home).

538a-538b.* Philosophy of Law (3-3) 538a: Nature and validity of law; law and morality, judicial reasoning, law and liberty. 538b: Problems about justice, compensation and contracts and/or responsibility and punishment. (Identical with POL 538a-538b).

540.* Metaphysics (3) Topics include free will and determinism; causation; personal identity, necessity and essence, truth, realism and ontology.

541.* Theory of Knowledge (3) Critical examination of some of the major problems concerning evidence, justification, knowledge, memory, perception and induction.


550. * Philosophy of Mind (3) Topics include the nature of mental states; the relation between mind and brain; and analysis of perception, emotion, memory, and action.

551. * Philosophy and Psychology (3) Investigation of philosophical issues arising from current work in psychology including perception, reasoning, memory, motivation, and action.

555. * Philosophy and Artificial Intelligence (3) Interdisciplinary problems lying at the interface of philosophy and artificial intelligence. (Identical with PSYC 555).

563. * Philosophy of Language (3) Survey of basic issues in the philosophy of language such as: speech acts, reference, meaning, logical form. (Identical with LING 563).

564. Formal Semantics (3) (Identical with LING 564, which is home).

565. * Pragmatics (3) Study of language use, its relationship to language structure and context; topics such as speech acts, presupposition, implication, performatives, conversations (Identical with LING 565).

567. Early Analytic Philosophy (3) The 50 year rise of analytic philosophy from Frege through early Russell to Wittgenstein's Tractatus.

570. * Greek Philosophy (3) [Rpt./1] Topics in Greek philosophy. May be selected from the pre-Socratics, Socrates, Plato, Aristotle and post-Aristotelian philosophy. (Identical with CLAS 570). 571a-571b. * Rationalism and Empiricism (3-3) 571a: Rationalists of the 17th and 18th centuries: Descartes, Spinoza, Leibniz, and Kant. 571b: Empiricists of the 17th and 18th centuries: Locke, Berkeley, Hume. 572a-572b./ Ancient Philosophy (3-3) [Rpt.] 572a: A philosophical introduction to the major works of Plato. 572b: A philosophical introduction to the major works of Aristotle. (Identical with CLAS 572a-572b).

596. Seminar
   a. Ethics (3) [Rpt./2]
   b. Metaphysics (3) [Rpt./2]
   c. Epistemology (3) [Rpt./2]
   d. Social and Political Philosophy (3) [Rpt./2]
   e. Philosophy of Law (3) [Rpt./2] (Identical with LAW 596g)
   f. Philosophy of Physical Science (3) [Rpt./2] (Identical with PHYS 596h)
   g. Philosophy of Mind (3) [Rpt./2]
   h. Philosophy of Language (3) [Rpt./2]
   i. History of Philosophy: Ancient (3) [Rpt./2]
   j. History of Philosophy: Recent (3) [Rpt./2]
   s. Philosophy of Mathematics (3) [Rpt./2]
   v. Philosophy and Cognitive Science (3) [Rpt./2]

Physics (PHYS)

1118 E. Fourth St., Room 260
Phone: (520) 621-2290
FAX: (520) 621-4721
WWW: http://www.physics.arizona.edu

Application Questions: Iris Wright, (520) 621-2290, iris@galileo.physics.arizona.edu

Advising Questions:
   Michael A. Shupe, (520) 621-2290, shupe@uazhep.physics.arizona.edu

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


Assistant Professor: Elliott Chen

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 work 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 during the first week of classes, a qualifying examination. 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; (2) take 21 of the 30 required graduate units in physics and pass a comprehensive final oral examination; (3) pass the written and oral parts of the comprehensive examination for the Doctor of Philosophy degree.

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 and research assistantships and fellowship support which are available to the student's academic record and financial needs. Fellowships are also available to first-year graduate students.

502. Medical Physics (3) CDT Basic physics of the human body: the principles of mechanics, electricity, sound, light, and radiation as they apply to physiology, with emphasis on instrumentation for diagnosis and treatment. P, 103 or 132; MATH 124 or equivalent.

503. Quantum Optics and Lasers (3) (Identical with OPTI 503, which is home).

511. Analytical Mechanics (3) Laws of motion as developed by Newton, d'Alembert, Lagrange, and Hamilton; dynamics of particles and rigid bodies. P, 410.

513. Topics in Advanced Mechanics, Nonlinear Physics, and Chaos (3) Modern topics in classical mechanics, including canonical perturbation theory, invariant mappings, nonintegrated system stochastic behavior, and applications to semi-classical quantum theory. P, 511.


529. Information and the Foundations of Physics (3) (Identical with OPTI 529, which is home).

530. Introduction to Biophysics (2) CDT Concepts and experimental techniques of molecular biophysics; physical properties of biological macromolecules and cell organelles, optical interactions, macromolecular transitions, molecular mechanism or regulation. P, 103 or 132, CHEM 103a-103b. (Identical with MIC 530).

531. Biophysical Theory (2) 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 Demonstrations (1-3) Introduction to teaching materials and laboratory demonstrations illustrating principles of classical and modern physics, with emphasis on demonstrations and direct experience. Advanced degree credit available for non-majors only. P, two semesters of physics.

535. Advanced Atomic Physics (3) 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, 511, 515b, 570b.

545. Experimental Physics (1) [Rpt.] Sections a, b, c, d. Students select one to three sections from the five-week lectures listed below. Each section is available for one unit of credit. Credit can be given only once for each topic. None is prerequisite to any other. P, 141, 142, 241, or 151, 152, 251, or consult department before enrolling.

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, Light Scattering and Optics of Small Particles (1) Laboratory experiments with microscopes and polarized scattered light to characterize small particles and surfaces, optical constants, lasers, remote sensing.

d. Experimental Geometrical and Physical Optics (1) Experimental measurements of geometrical and optical properties of basic optical elements—lenses, prisms, gratings, optical fibers, etc.


551. Nuclear Physics (3) Theory of nuclear systems, including stability, decay, nuclear forces, scattering, reactions, structure and interaction with electromagnetic radiation. CR, 570a-570b.


556. Electrodynamics of Conducting Fluids and Plasmas (3) (Identical with PHYS 556, which is home).


563. Experimental Condensed Matter Physics (3) 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, superconductivity. P, 460/560, 475-476.

570a-570b. Quantum Mechanics (3-3) Principles of quantum mechanics, wave mechanics and matrix mechanics; applications to atomic structure and spectroscopy. P, 475, 476 recommended but not required.

570c. Intermediate Quantum Mechanics (3) Formal quantum mechanics; scattering theory, relativistic wave equations; applications of DIRAC equation; angular momentum; symmetry; optical theorems; dispersion relations and path integral formulations.


573. Atomic and Molecular Spectroscopy for Experimentalists I (3) 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. P, 242 or 252. (Identical with OPTI 573).
Physiological Sciences (PS)

Arizona Health Sciences Center,
Room 4204
Phone: (520) 626-2898
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WWW: http://www.physiol.arizona.edu/PhysioSci/

Graduate Interdisciplinary Program in Physiological Sciences

Application Questions:
MS: Christine Coronado, (520) 621-2785, coronado@u.arizona.edu
PhD: Holly Lopez, HollyL@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: Paul F. McDonagh (Surgery), Chair, Ronald E. Allen (Animal Sciences), Eldon J. Braun (Physiology), Reginald Chapman (Arizona Research Laboratories, Division of Neurobiology), William H. Dantzler (Physiology), Robert W. Gore (Physiology), Joseph F. Gross (Emeritus), Raphael F. Gruener (Physiology), Patricia Hoyer (Physiology), Otakar Koldovsky (Pediatrics), Richard Levine (Arizona Research Laboratories, Division of Neurobiology), Timothy G. Lohman (Exercise and Sport Sciences), Robert S. McCuskey (Anatomy), Erwin B. Montgomery (Neurology), Eugene Morkin (Internal Medicine), L. Claire Parsons (Nursing), William R. Roeseke (Internal Medicine), Timothy W. Secomb (Physiology), Douglas G. Stuart (Physiology), Charles M. Tipton (Exercise and Sport Sciences), Marc E. Tischler (Biochemistry), Stuart K. Williams (Surgery), Stephen H. Wright (Physiology)

Associate Professors: Ann L. Baldwin (Physiology), Janis M. Burt (Physiology), Ralph F. Fregosi (Exercise and Sport Sciences), Robert J. Gillies (Biochemistry), Ronald L. Heimark (Clinical Medicine), Howard Y. Lien (Internal Medicine), Catherine Racowsky (Obstetrics/Gynecology), John W. Regan (Pharmacology/Toxicology), Raymond B. Runyan (Anatomy), Mark E. Wise (Animal Sciences)

Assistant Professors: Parker B. Antin (Animal Sciences), Debora L. Hamernik (Physiology), Erik J. Henriksen (Exercise and Sport Sciences), Gail F. Koshland (Physiology), Ronald M. Lynch (Physiology), Ana M. Pajor (Physiology), Andrea J. Yool (Physiology)

Research Associate Professors: Thomas M. Hamm (Physiology), Richard C. Schaeffer (Physiology)

The interdisciplinary Program in Physiological Sciences offers graduate work leading to the Doctor of Philosophy degree with a major in Physiological Sciences. Beginning Fall 1997, the Master of Science degree, formerly offered through the Exercise and Sport Sciences Program, will be merged into the Physiological Sciences Program and offered as well. Research training is an integral part of the Ph.D. program. The research areas of the faculty in the program can be broken down into five broad categories: cardiovascular biology, cell and molecular physiology, exercise physiology, neurobiology, and renal and transport physiology.

Master of Science: It is expected that successful applicants for the M.S. degree program in Physiological Sciences will have completed courses in the basic sciences, such as anatomy, biology, biochemistry, mathematics, physiology, and physics. Consequently, the strength of a student's application will depend partially on his or her science background. Specifically, the following prerequisite courses should be evident on the transcript: two semesters of anatomy; two semesters of inorganic chemistry with laboratories (biochemistry strongly recommended); one semester of mathematics (preferably calculus); two semesters of physics with laboratory; one semester of exercise physiology (or a strong background in biology/physiology may satisfy this prerequisite).

The Master's degree in Physiological Science has the following requirements: PSIO 570/571 Research Design in Physiological Sciences + Laboratory (3 units), and at least one course in physiology, such as PSIO 580 Systems Physiology (3 units), PSIO 503 Cellular and Molecular Physiology (5 units), PSIO 601/601/620 Systems Physiology (7 units). 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.

All master's students must complete a final examination as part of the degree requirements. There are two ways a student can meet this requirement: (1) by completion of a thesis and an oral examination in defense of the thesis; (2) by completion of a research project and preparation of a manuscript for publication; in addition, the findings of the research project must be presented in a departmental seminar. Most students
currently enrolled in this program select the second method of completing the final examination requirement.

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 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 580); Readings in Systems Physiology (PSIO 602); Intro 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, Exercise and Sport Sciences, Nutritional Sciences, Physiology, and Veterinary Science/Microbiology. Details of these courses may be found in listings in this Catalog.

Physiology (PSIO)
Arizona Health Sciences Center, Room 4103 Phone: (520) 626-7642 FAX: (520) 626-2382 WWW: http://www.physiol.arizona.edu/CELL

Associate Professors: Ann L. Baldwin, Janis M. Burt, Ralph R. Fregosi (Exercise and Sport Sciences), Erik Henriksen, Y.H. Howard Lien (Internal Medicine), Ronald M. Lynch (Pharmacology), Paul McDonagh (Surgery), Wayne J. Morgan (Pediatrics), L. Claire Parsons (Nursing), Catherine Racowsky (Obstetrics/Gynecology)

Assistant Professors: Debora Hamernik, Gail F. Koshland, Richard J. Lemen (Pediatrics), Ana M. Pajor, Mark E. Wise (Animal Sciences), Andrea M. Yool (Pharmacology)

The Department of Physiology teaches and does scholarly work on physiological mechanisms of significance to medicine. In both teaching and research, the orientation of the department is broad, encompassing single cell, organ, and total body function.

The Department of Physiology participates in offering a program of instruction leading to the Master of Science degree in a major in physiological sciences and the Doctor of Philosophy degree through the Graduate Interdisciplinary Program in Physiological Sciences. For admission and degree requirements, see Physiological Sciences in this chapter and also see chapter VI: Requirements for Master's Degrees and Requirements for Doctoral Degrees.

Current research areas of the faculty in the Department of Physiology include: cellular physiology and transport; circulation and respiration, including microcirculation; comparative physiology; endocrinology; gastrointestinal physiology; mathematical physiology; muscle physiology, neural mechanisms, including motor control; regulation of bone formation; renal mechanisms; and reproductive and developmental mechanisms.

The specialized nature of the material and equipment required for courses given in the College of Medicine may necessitate some limitation of enrollment. Medical students will receive preference in courses required for the M.D. degree. All other students must obtain the permission of the instructor before enrolling. Graduate students already enrolled in College of Medicine departments will be given preference.

In addition to the courses listed below, the Department of Physiology offers temporary courses in the following areas, subject to faculty availability and student interest: neurophysiology, renal physiology, physiology of muscle, molecular and cellular endocrinology, peripheral vascular physiology, respiratory physiology, gastrointestinal and developmental physiology, membrane transport processes in physiology, and cardiac physiology.

Principles of Neuroanatomy (4) (Identical with CBA 502, which is home).

Cellular and Molecular Physiology (5) Through 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 and vascular function. P, CHEM 103b, 104b, 241b, 243b; PHYS 103; MATH 125a-125b; BIOL 460.

Biological Electron Microscopy (4) (Identical with MCB 512, which is home).

Exercise Physiology (3) Regulation and adjustment of physiological systems during acute exercise and adaptations with chronic exercise in various populations and environments; emphasizes physiological mechanisms. P, BIOL 460 or 462a, CHEM 103a-103b, 104a-104b, 241a-241b, 243a-243b, PSIO 201, 202, MATH 117/5, 118, PHYS 102, 103.

Physiological Sciences Laboratory (2) Laboratory techniques in systems physiology. Emphasis on data acquisition, analysis, and interpretation. Writing-Emphasis Course* for physiological sciences majors. P, CR, 240.

Evaluation and Regulation of Body Build and Composition (3) Laboratory and field assessment of body fat, lean body mass and comatotype, anthropometry; body build and composition of the athlete; morphology of fat and lean tissue; exercise and dietary regulation of obesity and chronic underweight. P, 201 and 202.


Physiology Laboratory (3) (Identical with ECOL 566, which is home).

Comparative Physiology (3) (Identical with ECOL 568, which is home).

Research Design in Physiological Sciences (2) Study of research designs, methodologies, and data analysis procedures pertinent to the physiological sciences; emphasis is on the selection of research problems and interpretation of research articles.

Laboratory in Research Design for Physiological Sciences (1) Laboratory experiences in literature retrieval systems; data analysis procedures by calculator, microcomputer, and mainframe computer, critical analysis procedures of research articles, and participation in a research project. CR, 570.

Statistical Analysis (3) Analysis of research designs and data analysis procedures in the field of exercise and sport sciences with emphasis on appropriateness of selected designs and interpretation of various data analysis procedures. Statistical power, reliability, covariance, and multiple regression techniques and use of micro- and mainframe data analysis software. P, 570 and 571.
595. Colloquium
a. *Research in Physiological Sciences (1-2) [Rpt./3 units]
d. Environmental Physiology (2) [Rpt./1] P, consent of instructor.
e. *Endocrinology and Metabolism (2) [Rpt./1] P, 420.
f. *Integrative Cardiorespiratory Physiology (2) [Rpt./1] P, 420.
g. *Kinesiology (2) [Rpt./1] P, 462.
i. Body Composition (2) [Rpt./1] P, 445 or 554.
j. *Molecular Neurobiology (2) Open to graduate students in PS, PCO II, and NEUR. P, consent of instructor.
k. *Mathematical Techniques in Physiology (2) P, MATH 125a-125b, 160.
l. **Muscle Physiology (2) P, 503.
m. **Assignments in Motor Control (1) P, 480 or equivalent. Consult department before enrolling.
n. **Endocrinology (2).
o. **Renal Physiology (2) P, 580 or equivalent.
p. **Molecular and Cellular Excitability (2).
q. **Peripheral Vascular Physiology (2) P, 580 or equivalent.
r. **Membranes and Transport (2).
s. **Systems Neurophysiology (2).
**Available as both 595 and 895.

596. Seminar
a. Physiology Series (1) [Rpt./3] Open to majors only.
b. Physiology: Preparation and Presentation (1) [Rpt.] Open to majors only. Consult with department before enrolling.
c. Physiology Student Forum (1) [Rpt./3 units]

601. Systems Physiology (7) Comprehensive study of systems physiology. Designed for graduate students throughout the University. Consult department before enrolling. P, 503 or equivalent. CHEM 243b, MATH 123, PHYS 103. (Identical with PCOL 580).

582. Topics in Neural Development (2) (Identical with NRS C 582, which is home).

585. Neural Mechanisms of Behavior (2) (Identical with NRS C 585, which is home).

588. Principles of Cellular and Molecular Neurobiology (4) (Identical with NRS C 588, which is home).

589. Principles of Systems Neurobiology (4) (Identical with NRS C 589, which is home).

595. Colloquium
a. *Research in Physiological Sciences (1-2) [Rpt./3 units]
d. Environmental Physiology (2) [Rpt./1] P, consent of instructor.
e. *Endocrinology and Metabolism (2) [Rpt./1] P, 420.
f. *Integrative Cardiorespiratory Physiology (2) [Rpt./1] P, 420.
g. *Kinesiology (2) [Rpt./1] P, 462.
i. Body Composition (2) [Rpt./1] P, 445 or 554.
j. *Molecular Neurobiology (2) Open to graduate students in PS, PCO II, and NEUR. P, consent of instructor.
k. *Mathematical Techniques in Physiology (2) P, MATH 125a-125b, 160.
l. **Muscle Physiology (2) P, 503. May be convened with 595.
m. **Assignments in Motor Control (1) P, 480 or equivalent. Consult department before enrolling.
n. **Endocrinology (2).
o. **Renal Physiology (2) P, 580 or equivalent.
p. **Molecular and Cellular Excitability (2).
q. **Peripheral Vascular Physiology (2) P, 580 or equivalent.
r. **Membranes and Transport (2).
s. **Systems Neurophysiology (2).
**Available as both 595 and 895.

596. Seminar
a. Physiology Series (1) [Rpt./3] Open to majors only.
b. Physiology: Preparation and Presentation (1) [Rpt.] Open to majors only. Consult with department before enrolling.
c. Physiology Student Forum (1) [Rpt./3 units]

695. Colloquium
a. Motor Control (2) [Rpt./8 units].

Planetary Sciences (PTYS)
Space Sciences Building, Room 317
Phone: (520) 621-2828
FAX: (520) 621-4933
WWW: http://www.lpl.arizona.edu

Application Questions:
Joan Weinberg, Graduate Admissions Secretary, (520) 621-6954, jweinbe@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)*

Concentrations: observational planetary astronomy, physics of the sun and interplanetary medium, and observational, experimental, and theoretical studies of planetary atmospheres, surfaces and interiors.


Associate Professors: Willy Benz, Jonathan I. Lunine, Carolyn Porco
Assistant Professor: Timothy D. Swindle

Participating Scientists from the Lunar and Planetary Laboratory
Senior Research Scientists: Lyle A. Broadfoot, Larry A. Lebofsky, Bill R. Sandel
Associate Research Scientists: Jay B. Holberg, Lon L. Hood
Assistant Research Scientists: Robert McMillan, Ann Vickery, Roger Yelle

The department offers multidisciplinary programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in planetary science. 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. Students are normally admitted to the doctoral program only. In certain circumstances, however, students may be admitted to the Master of Science degree program as a terminal or intermediate degree.

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: This program is available only in special circumstances, with the concurrence of the faculty. At least 18 units drawn from the graduate core curriculum and a thesis suitable for publication are required.

Doctor of Philosophy: All students must complete the 15-unit core program consisting of 505a-505b-505c, 510, and
554 (though exceptionally well-prepared students may have parts of this requirement waived). An additional minimum of 21 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 3 or 4 years following successful completion of the comprehensive examination, which should be taken by the end of the second year of graduate enrollment.

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 and the Graduate Admissions and Advising Committee, which will also designate a chair. The student must pass a written comprehensive examination consisting of the final examinations or the 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 current missions in which the faculty are participating 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 and the Ultraviolet Explorer.

Laboratory staff and students also make use of major observatories around the world, including the NASA Infrared Telescope Facility on Mauna Kea, Hawaii, and conduct a regular program of planetary, solar, and stellar infrared spectrometry using the NASA Kuiper Airborne Observatory. The University is continuing to develop a new observatory site on Mt. Graham, northeast of Tucson. The department participates in interdisciplinary 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) Survey of planetary physics, planetary motions, planetary interiors, geophysics, planetary atmospheres, asteroids, comets, origin of the solar system. P, PHYS 142 or PHYS 251. (Identical with ASTR 503 and GEOS 503).


510. Principles of Cosmochemistry (3) Chemical compositions of solar system objects; equilibrium and nonequilibrium chemical processes applied to planets; cosmochronology. (Identical with GEOS 510).

518.* Modern Astronomical Instrumentation and Techniques (3) (Identical with ASTR 518, which is home).

519.* Physics of the Earth (3) (Identical with GEOS 519, which is home).

520. Meteorites (3) Classification; chemical, mineralogical and isotopic composition; cosmic abundances; ages; interaction with solar and cosmic radiation; relation to comets and asteroids. P. 510. (Identical with GEOS 520).


530.* Chemical Evolution of the Earth (3) (Identical with GEOS 530, which is home).

541a-541b.* Dynamic Meteorology (3-3) (Identical with ATMO 541a-541b, which is home).

544. Physics of High Atmospheres (3) Physical properties of upper atmospheres, including gaseous composition, temperature...
Planning (PLAN)

Architecture Building, Room 214
Phone: (520) 621-9597, (520) 621A3661
FAX: (520) 621-9820

Graduate Interdisciplinary Program in Planning

Application Questions:
Karen Young, youngk@email.arizona.edu, (520) 621-9997

Advising Questions:
Kenneth Clark, clarkek@email.arizona.edu, (520) 621-3661

Degrees Offered: M.S.

Professors: Kenneth N. Clark, Chair, School of Planning, (3) (Identical with ASTR 545)

Robert W. Bechtel (Psychology), Michael Bonine (Geography), Nathan Buras (Hydrology and Water Resources), Hana J. Cottler (Renewable Natural Resources), Kenneth E. Foster (Arid Lands Studies), Lay J. Gibson (Geography), R. Frank Greig (Emeritus), William Havens (Landscape Architecture), Robert Hershberger (Architecture), David A. King (Renewable Natural Resources), Diana Liverman (Geography and Regional Development), W. Kirby Lockard (Emeritus), Lawrence D. Mann (Geography), Fred S. Matter (Architecture), Gordon F. Mulligan (Geography), Phil R. Ogden (Range Management), Richard W. Reeves (Geography), Sandra Rosenbloom (Architecture), Thomas F. Saarinen (Geography), Arthur L. Silvers (Public Administration and Policy), Soroosh Sorooshian (Hydrology and Water Resources), Ervin H. Zube (Renewable Natural Resources)

Associate Professors: D. Robert Altschul (Geography), Barbara Becker, Harry Der Boghosian (Architecture), Michael D. Bradley (Hydrology and Water Resources), Nader V. Chalafoun (Architecture), Dennis C. Doxtader (Architecture), Adrian A. Esparza (Geography and Regional Development), H. Randall Gimblett (Renewable Natural Resources), Charles E. Glass (Mining and Geological Engineering), Alfredo R. Huete (Soil and Water Science), Stuart E. Marsh (Arid Lands Resource Sciences), David A. Plane (Geography), Charles M. Poster (Architecture), Donovan C. Wilkin (Renewable Natural Resources), Robert H. Wortman (Civil Engineering)

Assistant Professor: Stephen R. Yool (Geography)

The interdisciplinary Program in 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 501, 544, 554, 584, 605, 611, 660, 684, 696b and 593 (Internship). Areas of concentration include: sustainable community design, environmental resource planning, land use and transportation planning, and international/ borderlands planning.

The program requires completion of a projects course (PLAN 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 Program Chair for further information.

500. Ecosystemology for Urban Planning (3) (Identical with HWR 500, which is home).

501. Introduction to Planning (3) Development of cities and urban planning profession; function and scope; principles and practices in community, environmental land use, transportation, and borderlands planning. Field trip. (Identical with GEOG 501).

504. Public and Policy Economics (3) (Identical with PA 504, which is home).

510. Development of Regional Planning (3) Survey of the historical development of the planning profession; the evolution of American planning as a response to urbanization. Open to majors only. Credit allowed for this course or 301 but not for both. (Identical with GEOG 510).

514. Analytic Methods in Planning and Management (3) (Identical with PA 514, which is home).

523. Health and Public Policy (3) (Identical with PA 523, which is home).

527. Aging and Public Policy (3) (Identical with PA 527, which is home).

544. Site Planning (3) 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 all criteria to a realistic development project is required. (Identical with ARCH 544).

550. Metropolitan and Regional Planning (3) Survey and evaluation of concepts and examples, including metropolitan, economic...
development, state and national, and environ-
mental plans in the U.S. and abroad. (Identical
with GEOG 550).

553. * Locational Analysis (3) (Identical with
GEOG 553, which is home).

557. * Statistical Techniques in Geography,
Regional Development and Planning (3)
(Identical with GEOG 557, which is home).

559. * Land Use and Growth Controls (3)
(Identical with GEOG 559, which is home).

561. Resource Management (3) (Identical with
GEOG 561, which is home).

563. Perception of Environment (3) (Identical
with GEOG 563, which is home).

565. Project Planning and Modeling (3)
(Identical with C E 565, which is home).

567. Geographical Analysis of Population (3)
(Identical with GEOG 567, which is home).

568. * Urban Transportation Planning (3)
CDT (Identical with C E 568, which is home).

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

573. * Geology and the Urban Environment
(Identical with GEOS 573, which is home).

576. The Land Development Process (3)
[Rpt. /1] (Identical with GEOG 576, which is
home).

581. * Computer Cartography (3) (Identical
with GEOG 581, which is home).

583. * Geographic Applications of Remote
Sensing (3) (Identical with GEOG 583, which
is home).

584. * Planning the Built Environment (2)
(Identical with ARCH 584, which is home).

597. Workshop
a. Architecture (3-8) [Rpt. 1] (Identical with
ARCH 597a, which is home).
b. * Community Design for Non-Designers (3-
6) (Identical with ARCH 597l, which is
home).

605. Planning Theories and Perspectives (3)
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).

611. Projects in Regional Planning (1-5)
[Rpt./5 units] Lectures, laboratory, and field
projects covering various aspects of profes-
sional practice. P, 605, 24 units toward
a graduate degree in planning. Field trips.
(Identical with GEOG 611).

657. Spatial Analysis (3) (Identical with
GEOG 657, which is home).

660. Land Use Planning (3) Review of
the principal legal devices available to implement
planning decisions on community design
(official map, subdivision control), the use of
land (nuisance, convenants and zoning) and
housing needs (including urban renewal).
Special attention will be paid to the signifi-
cance and legal effect of a comprehensive plan
and to the social and economic effects of
planning decisions. (Identical with LAW 660).

665. Quick Response Transportation Planning
Methods (3) (Identical with C E 665, which is
home).

668. Urban Public Transportation Systems
(3) (Identical with C E 668, which is home).

684. History of Planning (1) 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 will be discussed
where relevant. P, CR 584.

696. Seminar
b. Financing Public Services (3) (Identical
with ARCH 696b).
h. Land-Use Regulation (3) (Identical with
MAP 696h, which is home).

j. Environmental Planning (3) (Identical with
MAP 696j, which is home).
k. Planning Administration (3) (Identical with
MAP 696k, which is home).

Plant Pathology (PL P)
Forbes Building, Room 204
Phone: (520) 621-1828
FAX: (520) 621-7186
WWW: http://ag.arizona.edu/PLP/plphome.html

Application Questions: Claudia Jackson,
cjackson@ag.arizona.edu
Advising Questions: Hans Van Eeten,
vanetten@ag.arizona.edu

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

Professors: Merritt R. Nelson, Head,
Stanley M. Alcorn (Emeritus), Robert
L. Gilbertson, Richard B. Hine
(Emeritus), Christina Kennedy,
Michael A. McClure, Edward L. High,
Jr. (Emeritus), Michael E. Stanghellini,
Hans D. Van Eeten

Associate Professors: Hans E. Test
(Former), Martha C. Hawes, Iraj J.
Misagh, Leland S. Pierson, III

Assistant Professors: Marc Orbach,
Zhongguo Xiong

The department offers programs
leading to the Master of Science and
Doctor of Philosophy degrees in
a major in plant pathology. Subject area
specialties within the department include
mycology, nematology, virology, microbi-
ology, 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 interaction. These research
programs include studies at the molecu-
lar, cellular, organinal, and ecosystem
level and a number of programs empha-
size rhizosphere interactions.

Applicants to the department should
have a bachelor's degree and a solid
background in biology, biochemistry,
botany, molecular biology, or microbiol-
ogy 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 prepara-
tion, 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) (Identical with AGTM
502, which is home).

512. Biological Electron Microscopy (4)
(Identical with MCB 512, which is home).

516. Plant Nematology (2) The nature,
ecology, classification, and control of
nematode diseases in plants. P, 551, or consent
of instructor.

528. * Microbial Genetics (3) 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,
ECOL 320, or PL S 312. (Identical with ECOL
528, MCB 528, MIC 528, SWES 528 and V SC
528).

550. Advanced Plant Pathology (4) Topics
include major concepts in classical and
molecular genetics of plant-pathogen
interactions; physiology, biochemistry,
and molecular biology of plant pathogenesis;
principles of plant epidemiology and theories
and practices of plant disease control. P, 305
or consent of instructor.

551. * Biology and Characterization of Plant
Pathogenic Agents (4) 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. 3R, 3L. P, 305 and at least one laboratory
course (e.g., MIC 205, MCB 181/182, etc.) or
consent of instructor. (Identical with MIC 551).

575. Advanced Mycology (3) Biology of fungi,
including morphology, physiology, classifica-
tion, genetics, ecological significance and
economic importance; emphasis on plant
pathogens and environmentally essential fungi.
2R, 3L. P, 427 or consent of instructor.

596. Seminar
a. * Contemporary Topics in Plant Pathology
(1-3) [Rpt. /12]
b. * Research Discussions (1-3) [Rpt. /3]
Plant Sciences

Forbes Building, Room 303
Phone: (520) 621-1219
FAX: (520) 621-7186
WWW: http://ag.arizona.edu/PLS/plshome.html

Application Questions:
Shirley Weber, (520) 621-1219, sweber@ag.arizona.edu

Advising Questions:
Judith Verbeke, (520) 621-8423, verbeke@ag.arizona.edu

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

Concentrations: Plant biology, agronomy, and horticulture.


Assistant Professors: Kenneth Marcum, Lucinda A. McDade, Karen S. Schumaker, Kathryn C. Taylor, Gary A. Thompson, Jian-Kang Zhu

In addition to a commitment to prepare undergraduates for careers after graduation, 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 agronomy/ horticulture with aspects of plant production, genetics both as the study of genomic structure and function as well as its more applied use for the improvement of crop plants, plant growth and development, physiology, and cell and molecular biology. The department encourages students to integrate the more classical aspects of these areas with recent innovations in order to develop the more applied use for the improvement of crop plants, plant growth and development, physiology, and cell and molecular biology. 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 anatomy 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 are expected 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.

595. Colloquium
b. Current Topics in Plant Science—Advanced Topics in Plant Science (1-3) [Rpt/4] P, graduate standing or consent of instructor.

596. Seminar
d. *Plant-Insect Interactions (1) [Rpt/5] (Identical with ENTO 596d, which is home).

620. Plant Biochemistry (3) 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, BIOL 462a and 462b, PL S 560.

627. Advanced Genetics (3) 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, 312 or ECOL 320. (Identical with GENE 627).


695. Colloquium
a. Plant Biology (1) (Identical with PL P 695a, which is home).
b. Plant Pathology (1) (Identical with PL P 695b, which is home).

696. Seminar
a. Plant Science (1) [Rpt/4]

Political Science (POL)
Social Sciences Building, Room 315
Phone: (520) 621-7600
FAX: (520) 621-5051
WWW: http://www.arizona.edu/~polsci/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, Jeanne Nienaber Clarke, John E. Crow (Emeritus), David Gibbs, Donald R. Hall (Emeritus), Paulletta Kurzer, Deborah R. Mathieu, Barbara Norrander, Daniel J. O’Neil, V. Spike Peterson, David Wilkins, John P. Willerton

Assistant Professors: Brian Crisp, Bradford S. Jones, 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 either one or two 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 upon the chosen area or areas of concentration.

Doctor of Philosophy: In addition to an area of concentration, each student must complete two supervised areas of concentration. Either two foreign languages or one foreign language at high proficiency or advanced training in methodology are required. Finally, each student must complete two supervised original research papers prior to taking the comprehensive examination. The department may waive the require-

ment 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) 1 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, 102.


510. * Struggle for the Presidency (3) (Identical with COMM 510, which is home).


525. * Liberalism and Its Critics (3) Recent theories of liberalism and the major criticisms of liberal ideas, such as communitarianism and feminism. P, 160 or PHIL 110, 113, or 121.

527. * The Marxist Legacy (3) A critical survey of the main currents of Marxism from Marx to the present. P, junior standing, 160, or PHIL 110, 113 or 121.

528. * Problems in Contemporary Political Theory (3) Intensive examination of selected problems and concepts in political theory. P, 160 or PHIL 110, 113, or 121.

529. * The U.S.-Mexican Borderlands in Comparative Perspective (3) Describes and analyzes the Mexican-United States Borderlands emphasizing several elements of the Borderlands culture, society, economy, and polity, as well as the evolution of borderlands in comparative perspective. P, 102. (Identical with LA S 529, MAS 529).

531. * Political Culture and the Dynamics of Change in American Society (3) 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. P, 102.

532. * Pressure Groups (3) 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, 102.

533. * Feminist Political Theory (3) Examines the tradition of Western political theory through a gender-sensitive lens and surveys the development of feminist political theory. P, 160 and W S 100. (Identical with W S 533).

536. Violent Crime and Political Order (3) 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 childhoods. P, 102, plus an introductory level course in psychology, sociology, or anthropology.


538a-538b. Philosophy of Law (3-3) (Identical with PHIL 538a-538b, which is home).

541. Arab-Israeli Conflict (3) Traces the birth and growth of the Arab-Israeli conflict since 1948 with particular attention to the internal impediments to conflict resolution on both the Arab and Israeli sides. Also surveys the role of the Great Powers in Middle East politics generally. P, 102. (Identical with NES 541).

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

543. Soviet and Post-Soviet Politics (3) 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, 120. (Identical with RSS 543).

544. East European Politics (3) Divergent models of Communist development, from East Germany to Yugoslavia; political, economic, social, and cultural reform. P, 140.

545. Comparative Political Revolution (3) Examination of the causes and consequences of 20th-century revolutions and the revolutionary process, with emphasis on contemporary events. P, 140.

547. Latin-American Political Development (3) Presentation of strategies for development in Latin America; examination of case studies from Cuba, Brazil, Chile, Guatemala, and other countries. Open to juniors and seniors only. P, 140. (Identical with LA S 547).

548. Government and Politics of Mexico (3) Description and analysis of Mexico's political economy, its political system, and its foreign policy, with emphasis on Mexican-U.S. relations. P, 140. (Identical with LA S 548 and MAS 548).

549. The Politics of Cultural Conflict (3) Comparative examination of the approaches of different types of political systems to domestic conflict of a racial, religious, linguistic, or ethnic nature. P, 140.


554. Introduction to International Relations (3) 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, 120, 140.

555. American Foreign Policy (3) Analysis of the Cold War, Congressional-Executive clashes over foreign policy control, approaches to policy analysis. P, 120.

556. International Law (3) The international system; legal-political problems, including territory, environment, seas. P, 120.

557. Inter-American Politics (3) Survey and analysis of the leading political and economic issues at controversy between the United States and Latin America. P, 102 or 140. (Identical with LA S 557).


559. Modern Chinese Foreign Relations (3) 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, 120. (Identical with CHN 559).

560. Feminist and IR Theories (3) 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 290. (Identical with W S 561).

561. International Relations of East Asia (3) National interests, issues and conflicts, relations, and influence of domestic politics in interstate relations in East Asia. P, 120. (Identical with EAS 564).

562. Population and Development in the Middle East (3) P, 120. (Identical with NES 562, which is home).


568. Administrative Law (3) Law governing the organization, powers, and procedures of the executive and administrative establishment, with emphasis on the limitations imposed by the American constitutional system. P, 102.

569. Women and the Law (3) Legal status of women in America, including constitutional protections, marriage and family relationships, educational and vocational opportunities, political rights, criminal law. P, 102. (Identical with W S 576).

570. American Indians and the Supreme Court (3) Examination of the U.S. Supreme Court as a policy-making institution, with analysis of major court opinions affecting tribal sovereignty and individual Indian rights in such areas as tribal status and federal relations, treaty law, Indian land title, jurisdiction. P, 334. (Identical with AIS 578).

571. Research Design (4) Introduction to experimental and quasi-experimental research design; survey research; the use of aggregate statistics; historical documents and life-history materials; participant observation; unobtrusive methods.

572. Methods of Political Inquiry (3) Systematic examination of problems of scope and methods of inquiry in the discipline of political science; intended for seniour students with the discipline and to prepare them for scholarly research in the field.

573. Environmental Policy (3) Role of government in management of energy, natural resources and environment; process and policy alternatives; special attention to the Southwest. P, 102. (Identical with HWR 581, PA 581 and RNR 581).

574. Research and Methodology (4) Quantitative techniques and computer applications in political science.


576. Development of Federal Indian Policy (3) European colonial precedents through the treaty-making period. federal policy from treaty-making to the present. (Identical with AIS 584 and LAW 584).

577. Political Risk and Intelligence Analysis (3) Examination of political risk and intelligence analysis with emphasis on forecasting political developments in nations.

578. Race and Public Policy (3) Examination of the race issue in the context of American politics. 487a focuses primarily on the African experience in America from 1619, when the first slaves were led onto the beach at Jamestown, to approximately 1910 when segregation had replaced slavery. P, 102. 487b focuses on race related events and policies during the urban/industrial transformation, the Depression and New Deal, World War to the
Brown Decision in 1954, the Civil Rights years to the present. P. 487a. (Identical with AFAS 587a-587b and AIS 587a-587b).

589 Public Choice (3) (Identical with ECON 589, which is home).

590 Teaching Political Science (3) 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 student status.

595 Colloquium a. American Politics (3) c. Political Theory (3) d. Comparative Politics (3) e. International Relations (3) g. Public Policy (3) [Rpt./2] (Identical with PA 595g).

i. Management and Policy for Ecological Sustainability (3) [Rpt.] (Identical with PA 596i and RNR 596i).

682 Advanced Research Methods (3) [Rpt.] Advanced quantitative techniques and computer applications in political science. P. 579 and 582.

696 Seminar i. International Water Resource Management (1-3) [Rpt./2] (Identical with HWR 696i, which is home). v. Public Choice I (3) (Identical with ECON 696v). w. Public Choice II (3) (Identical with ECON 696w).

Psychology (PSYC)
Psychology Building, Room 312
Phone: (520) 621-7447
FAX: (520) 621-9306
WWW: http://w3.arizona.edu/~psych/

Application Questions: Peggy Collins, (520) 621-7456, lcollins@ccit.arizona.edu

Advising Questions: Elizabeth L. Glisky, (520) 621-9289, glisky@u.arizona.edu

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

The department offers programs designed for students seeking completion of the Doctor of Philosophy degree with a major in psychology. Concentrations are available in clinical psychology (cognitive neuropsychology, psychopathology and affective disorders, health psychology and community and family mental health); cognition and neural systems (neurobiology of learning, memory and aging, cognitive and computational neuroscience, neurophysiology, and psychopharmacology); cognitive psychology (perception, memory, psycholinguistics, cognitive neuropsychology, cognitive development, 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.

500-500b. Current Issues in Psychological Theory and Research (3-3) Intensive examination of a range of content areas addressed in contemporary psychological theory and research. Open to psychology graduate students only.

501 Principles of Psychophysiology (3) 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 501a, P. 501a, 502, and 490. CR. 401b.

502. Principles of Neuroanatomy (4) (Identical with CBA 502, which is home).

503 Principles of Mammalian Systems Neurophysiology (3) Topics in the neurophysiology of sensation, perception, cognition, and action in mammals; the application of modern research methods to the understanding of higher brain function. Enrollment is restricted to those concurrently enrolled in the laboratory. P. NRSC 588, CR. PSYC 403b. (Identical with NRSC 503a). Open only to psychology majors and individual studies majors with a psychology subject area.

503b Laboratory in Mammalian Systems Neurophysiology (1) Neurophysiology laboratory including stereotactic surgery, microelectrode recording of neural signals, electrical and chemical stimulation, and principles of analog and digital signal processing. P. 501a, 502, CR 403a. (Identical with NRSC 503b). Open only to psychology majors and individual studies (IDS) majors with a psychology subject area.

504 Human Brain-Behavior Relationships (3) 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, 290, 302.

506.* Neural Encoding, Memory, and Computation in the Mammalian Brain (3) Theoretical principles and biological mechanisms by which information is represented, categorized, stored, and recalled in specific central nervous system (CNS) circuits in the course of adaptive behavior. P, one advanced course in neurobiology, biological or cognitive psychology, one advanced course in mathematics or computer science.

507a-507b. Statistical Methods in Psychological Research (3-3) Statistical research design, methods and metascience. 507a: Variants and extensions of the general linear model including bivariate and multiple regression, analysis of variance and covariance, planned orthogonal contrasts and multiple comparisons, simultaneous and sequential canonical correlation analysis, discriminant function analysis, and multivariate analysis of variance. 507b: Application of the structural equations modeling to manifest variable (path analysis) and latent variable (multivariate) causal analysis, confirmatory and exploratory factor analysis, and hierarchical (variance component) linear models, including generalizability theory, meta-analytic, and growth curve parameter models.

508. Methods for Field Research (3) Research problems and methods particularly relevant to field research. The logic of inquiry and approaches to data analysis appropriate to field trials and quasi-experimental research.

509. History of Psychological Theories and Research (3) Development of psychology as a science; schools, systems, theories, major advances, famous investigators. Open to majors only.

511.* Animal Behavior (3) Systematic study of animal behavior. Analysis of environmental and genetic determinants of behavior, special behavioral adaptations in animals, and sociobiological concepts. P, 290. Open only to psychology majors and individual studies majors with a psychology subject area.

512.* Animal Learning (3) Animal learning with emphasis on interspecies comparisons. P, 290. Open only to psychology majors and individual studies majors with a psychology subject area.

513.* Drugs, Brain and Behavior (3) 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, 101, 290, 302.

515. The Design of the Mind: Genes, Adaptation, and Behavior (3) Part I: Basic mechanisms of behavioral evolution, genetics, and natural selection, as well as other factors impacting 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, 230, 290, 240 or 340, or consent of instructor. Students should ideally also have some background in cognitive psychology, e.g., 325. (Identical with FS 515).

517.* Invertebrate Behavior Laboratory (3) Animal behavior laboratory in behavioral manipulation, observation, and data recording with invertebrate animals. 3L, 2R. P, 101, 230 and 290.


524.* Gerontology: A Multidisciplinary Perspective (3) Biological, psychological, and social issues in aging, including brain changes with age, cognitive change with age, and the social impact of increasingly older populations demographically. (Identical with GERO 524).

526.* Advanced Human Memory (3) Examines the processing systems that underlie human learning, memory and cognition, emphasizing cognitive, neuroscientific, and computational approaches to research and theory. P, 290, 325.

528. Cognitive Neuroscience (3) Recent advances in analysis of the neural bases of cognitive functions, such as learning, memory, and thinking.


536. Visual Cognition (3) Recent advances in the area of perception and attention, with emphasis on visual process.

537. Psycholinguistics (3) (Identical with LING 537).

538.* Computational Linguistics (3) (Identical with LING 538, which is home).

539.* Animal-Human Communication (3) (Identical with ECOL 539, which is home).

541.* Language Acquisition (3) (Identical with SP H 541, which is home).

542. Topics in Psycholinguistics (3) 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).

543.* Advanced Language Development (3) 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 standing or consent department before enrolling; one lower-division course in cognitive psychology, developmental psychology, or linguistic theory. (Identical with LING 543).

545.* Neural Network Modeling: What and Why (3) Hands-on introduction to basic neural modeling. Examination of ways in which modeling is and is not relevant to understanding the architecture of cognitive systems. P, 290 or 346 or 402 or graduate standing, college-level algebra skills, familiarity with either Macintosh or PC compatible microcomputers. (Identical with PHIL 545).

547.* Psychology of Values and Preference (3) [Rpt./1] Variable content (consult schedule): learning, cognition, perception, psycholinguistics, emotion, others. P, 290 and 6 units of upper-division psychology, or graduate standing. Open only to psychology majors and individual studies majors with a psychology subject area.

548. Topics in Language and Cognition (3) [Rpt./1] Variable content, including language acquisition, the relation between language and spatial cognition, and the evolution of mind. P, graduate majors in linguistics and psychology; others consult with department before enrolling. (Identical with LING 548).


555.* Philosophy and Artificial Intelligence (3) (Identical with PHIL 555, which is home).

556.* Psychology of Death and Loss (3) Basic concepts in a psychology of death and loss, with emphasis on both the adjustment to death and loss, and the underlying phenomenological, humanistic and current social considerations. P, 290 or graduate standing.

558.* Violence and Youth (3) Explores the etiology of youth violence from developmental and socio-cultural perspectives, the influence of societal factors such as media, guns, and gangs on violence among youth. P, 101 and 381, 290. (Identical with SOC 558 and F 558).

559.* Adult Development and Aging (3) Change and continuity in cognition, personality, and adjustment during adulthood, with emphasis on aging processes and late life. P, 290 or 101 and two courses in gerontology or human development; or graduate standing. (Identical with GERO 559).

560.* Advanced Social Psychology (3) Social psychology, with emphasis on theory and method. P, 290. Open only to psychology majors and individual studies majors with a psychology subject area.

561.* Social Cognition (3) [Rpt./6 units] Analysis of social phenomenon from a cognitive perspective; perception, memory, thought, and language concerning self, others, and social situations. P, 290, 325, 360 or consent of instructor.

562.* Mental Health Law & Policy (3) [Rpt./3] Theory, research, and practice in law and mental health interactions and in the delivery of mental health services. P, upper-division standing or honors student.
563a-563b. Forensic Assessment: Intervention and Treatment (3-3) Theory, research, and practice in the assessment and treatment of, and intervention with, persons involved with the legal process who have clinical problems. F, consent of the instructor.

564. Methods for Psychosocial Research (3) 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) (Identical with SP H 567, which is home).

568. Stress Perception (3) (Identical with SP H 568, which is home).

571a-571b. Speech Perception (3) (Identical with SP H 567, which is home).

575. Motor Control (2) (Identical with ARCH 576b, which is home).

576. Environmental Cognition (3) [Rpt./1] Recent advances in the area of environmental cognition, with an emphasis on cognitive aspects of environmental psychology.

576a-576b. Psychology, Law and Social Policy (3) Critical review of theory, methods, and research in the psychology, law, and social policy interface. P, 360, 6 units of a social science, or graduate standing.

578. Sleep and Sleep Disorders (3) Topics include sleep-wake rhythms, sleep deprivation, dreams, and the diagnosis and treatment of sleep disorders. P, 290, 302.

579. Issues in Rural Health (3) (Identical with NURS 579, which is home).

580. Clinical Neuropsychology (3) (Identical with NURS 696d, which is home).

581. Psychopathology (3) In-depth study of current theoretical and research formulations in psychological disorders, various approaches to behavior change. P, 290, 381.

582. Advanced Psychopathology (3) [Rpt./1] Advanced survey of current theory and research in symptoms, causes, and treatment of the major psychological disorders.

583. Biological Bases of Psychopathology (3) Etiology and treatment of major psychological disorders with emphasis on behavioral genetics, imaging, psychopharmacology, and animal models of schizophrenia, affective disorders and anxiety disorders. P, 101, 230, 290, 302, 381 or graduate standing.

584. Advanced Health Psychology (3) [Rpt./1] Current research and theory concerning psychological contributions to health maintenance, illness prevention and treatment, and the organization of health services.

585. Contemporary Issues in Psychology (3) [Rpt/[1] Variable content (consult schedule): major topical problems in psychological research, theory, and applications. P, 200 and 6 units of upper-division psychology. Open only to psychology majors and IDS majors with a psychology subject area.

586. Ethical Issues in Psychology (3) 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. P, upper-division standing or honors student.

589. History of Psychology (3) 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, 290 and 6 upper-division units in psychology.


597. Workshop a. Statistical Models for Psychological Research (3) CR, 507a-507b. Open to majors only.

598. Advanced Research (3) CR, 507a-507b. Open to majors only.


600. Program Evaluation (1-3) [Rpt./6 units] P, graduate standing. Consent of the instructor is required.

621. Clinical Assessment Methods (3) Theory and practice in interview techniques and cognitive and personality assessment. Open to majors only.

625a-625b. Psychosocial Interventions (4-4) a. Introduction to psychotherapy and psychotherapy research. Principles of behavior therapy, marital and family therapy. 625: Issues of therapy integration and factors common to all treatments. P, graduate standing.

694. Practicum a. Clinical Interviewing and Assessment (1-3) [Rpt./1] Open to clinical psychology students only.

695. Colloquium a. Motor Control (2) (Identical with PSIO 695a, which is home).

696. Seminar f. Linguistic Investigations and Applications (3) [Rpt./3] (Identical with LING 696f, which is home).

Public Administration and Policy, School of (PA)
McCllelland Hall, Room 405
Phone: (520) 621-7965, (520) 621-3634
FAX: (520) 621-4171
WWW: http://www.bpa.arizona.edu

PhD: Keith Provan, kprovan@bpa.arizona.edu

MPA: Rhonda Trautman, rtrautman@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

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) Course focuses on understanding and analyzing interactions, effectiveness, and complexities of organization structures.

503. Politics and the Policy Process (3)
Various theories of how public policy is formulated.

504. Public and Policy Economics (3)
Applications of economics to the analysis of public policy and planning problems. (Identical with PLAN 504).

505. Methods for Policy Analysis and Program Evaluation (3) Techniques for analyzing the effects of public policies and programs. P, MKTG 552 or permission of instructor.

506. Bureaucracy, Politics and Policy (3) (Identical with POL 506, which is home).


511. Management of Long Term Care Facilities and Programs (3) Problems and principles of management of facilities and community-based programs providing health and social services to the chronically impaired.

513. Government and the Nonprofit Sector (3) In the past 20 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 Planning and Management (3) 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 permission of instructor. (Identical with GEOG 514 and PLAN 514).


520. Analysis of Health Systems (3) 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) 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. P, 522. (Identical with PLAN 523).

524. Management of Long Term Care Facilities and Programs (3) Problems and principles of management of facilities and community-based programs providing health and social services to the chronically impaired.

525. Comparative Management in Health Administration (3) 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, 522.

526. Health Economics (3) 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, 522, ECON 500, or permission of instructor. (Identical with ECON 526).

527. * Aging and Public Policy (3) Policy framework for administration of programs, plans, priorities, and legislation related to the needs of the aging in modern society. (Identical with GERO 527 and PLAN 527).


530. Aging and Social Sciences (3) (Identical with GERO 530, which is home).

531. International Management (3) (Identical with MAP 535, which is home).


541. Deviance and Social Control (3) (Identical with SOC 541, which is home).


557. * Law of the Elderly (3) (Identical with GERO 557, which is home).

573. * Government and Economic Well-being (3) (Identical with POL 573, which is home).

581. Environmental Policy (3) (Identical with POL 581, which is home).

593. Internship (1-6)

595. Colloquium g. Public Policy (3) [Rpt./2] (Identical with POL 595g, which is home)

596. Colloquium i. Management and Policy for Ecological Sustainability (3) [Rpt.] (Identical with POL 596i, which is home).

Public Health (OSHPHL)
Arizona Health Sciences Center, Room 1115
Phone: (520) 626-3200
FAX: (520) 626-3206
WWW: http://www.ahsc.arizona.edu/publith/100.htm

Application Questions:
Alison Pearson, (520) 626-3208, apearson@u.arizona.edu
Advising Questions:
Sheila Parker, (520) 626-3200, parkers@u.arizona.edu

Degrees Offered: M.P.H.
Carlos C. (Kent) Campbell, Interim Director

Professors: James E. Dalen (Internal Medicine), Sandra Ferkeh (Nursing), Bill Johnson (Health Administration and Policy, ASU), Ron Pust (Family and Community Medicine), Ted Tong (Pharmacy Practice and Pharmacology and Toxicology), Ronald Vogel (Public Administration and Policy and Economics), Anthony Vuturo (Arizona Prevention Center, Emeritus)

Associate Professors: Patricia Moore (Nursing, ASU), John Sciacca (Health, Physical Education, Exercise Science and Nutrition, NAU), Douglas Taren (Family and Community Medicine)

Assistant Professor: Scott Leischow (Family and Community Medicine)

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 AzGPPH is to prepare public health professionals to assume leadership roles in the identification of community health problems, and in the planning, implementation and evaluation of programs and policies essential for the promotion of health and alleviation of illness and disease. The AzGPPH is designed to meet the particular needs of the Southwestern United States, with emphasis on rural and urban medically-underserved populations including Hispanics, Native Americans, and other ethnic minority populations.
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, inter-agency program. At The University of Arizona, there are nine program concentration areas for the M.P.H. degree: community health, program concentration areas for the University of Arizona, there are nine university, inter-agency program. The degree is established as an inter-university, inter-agency program. At The University of Arizona, there are nine university, inter-agency program.

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 listed below:

1. Social and Behavioral Basis of Public Health (PHU/FCM 577) (3)
2. Basic Principles of Epidemiology (PHU/FCM 596A) (3)
3. Biostatistics in Public Health (PHU/FCM 576) (3)
4. Health Administration and Policy (PHU/FCM 574) (3)
5. Environmental and Occupational Health (PHU/FCM 575) (3)

Occupational Safety and Health (OSH)
1435 N. Fremont Ave., Room 111
(520) 882-5855

Clinical Assistant Professors: Clifton D. Crutchfield (Family and Community Medicine), Mark D. Van Ert (Family and Community Medicine)

587. * Advanced Industrial and Environmental Health (3) An in-depth coverage of the professional practice of occupational and environmental health. Contaminant behavior and assessment are emphasized. A comprehensive environmental health assessment of an industrial site is required. P. 486. (Identical with C E 587 and PCOL 587).

502. Environmental Monitoring and Analysis (2-4) Introduction to air sampling instruments and strategies, quality control, and statistical analysis, with emphasis on instrument selection and calibration. P. 586. (Identical with PCOL 502).

510. * Physical Exposures (3) Recognition, evaluation, and control of physical exposures, including radiation, noise, vibration, and heat stress. Student is required to recognize potential exposures, use correct instrumentation to collect and evaluate data, and develop controls. 2R, 3L. P. 486. (Identical with PCOL 510).

533. * Industrial Toxicology and Chemical Exposures (2-4) Principles of Toxicology related to industry; dose response; mechanisms of toxicity; hazard evaluation principles; toxicology of major classes of industrial compounds. P. 486.

584. Fundamentals of Industrial and Environmental Health (3) For a description of course topics see 486. Graduate-level requirements include a comprehensive paper detailing hazards associated with a particular health hazard. (Identical with C E 584 and PCOL 584).

585. Industrial Ventilation (3) Design and evaluation of ventilation systems used for environmental control. Emphasis is on local exhaust system design and evaluation. The importance of ventilation in indoor air quality is also addressed. Five laboratory exercises and course design project. (Identical with PCOL 585).

587. * Advanced Industrial and Environmental Health (3) For a description of course topics see 487. Graduate-level requirements include participation in an industrial hygiene assessment of a plant and completion of a formal report describing the results of the survey. P. 486. (Identical with C E 587 and PCOL 587).

Public Health (PHL)
500. Research (3-12) [Rpt./2] (Identical with F CM 500, which is home).

502. Organization Theory and Behavioral Relations (3) (Identical with MAP 502, which is home).

511. Health Care Systems (3) (Identical with PHSC 511, which is home).

513. Pharmaceutical Economics (3) (Identical with PHSC 513, which is home).

525. * Topics in Latino Health (3) (Identical with MAS 525, which is home).

527. Psychology of Sport and Exercise (3) (Identical with PSIO 527, which is home).

530. Methods in Nursing Research (3) (Identical with NURS 530, which is home).

548. Perspectives in Geriatrics (2) (Identical with PHSC 548, which is home).

553. Toxicology and Chemical Exposures (2-4) (Identical with OSH 553, which is home).

560. Issues and Trends in Public Health (3) (Identical with F CM 570, which is home).

571. International Comparison of Health Care Systems (3) (Identical with F CM 571, which is home).

572. Population Dynamics and Family Planning (3) (Identical with F CM 572, which is home).

573. Health Issues of Women and Children (3) (Identical with F CM 573, which is home).

574. Health Administration and Policy (3) (Identical with F CM 574, which is home).

575. Environmental and Occupational Health (3) (Identical with F CM 575, which is home).

576. Biostatistics in Public Health (3) (Identical with F CM 576, which is home).

577. Social and Behavioral Basis of Public Health (3) (Identical with F CM 577, which is home).

578. Public Health Nutrition (3) (Identical with F CM 578, which is home).

579. Issues in Rural Health (3) (Identical with NURS 579, which is home).

580. Community Based Research Methodology (3) (Identical with FCM 580, which is home).

581. Introduction to Community Health (3) (Identical with FCM 581, which is home).

587. Poverty and Health (3) (Identical with NURS 587, which is home).

589. Clinical Pharmacotherapy of Mental Disorders (2) (Identical with PHSC 589, which is home).

593. Internship
a. Basic Principles of Epidemiology (3) [Rpt./1] (Identical with EPI 596a, which is home).

b. Occupational Disease (1-2) [Rpt./4 units] (Identical with FCM 596g, which is home).

c. Prevention and Control of Disease (1) [Rpt./4 units] Consult department before enrolling. (Identical with FCM 596b, which is home).

i. Seminar for Clinical Educators (4) (Identical with FCM 596i, which is home).

j. Health Policy: Leadership and Current Issues (2-3) (Identical with FCM 596j, which is home).

n. Practice of Community-Oriented Medicine in Rural Areas (2) (Identical with F CM 596n, which is home).

International Nutrition (2-3) (Identical with F CM 596n, which is home).

m. Managed Health Care (3) [Rpt.] (Identical with FCM 596p, which is home).

n. AIDS, Cancer, Nutrition Immunity (1) (Identical with FCM 596s, which is home).

Tropical Disease Problems (2) (Identical with FCM 596t, which is home).

v. Alcohol, Drugs: Biology to Treatment (3) (Identical with FCM 596v, which is home).

w. Diet and Disease Prevention (2) (Identical with FCM 596w, which is home).

602a-602b. Biotoxicology (3-1) (Identical with PCOL 602a-602b, which is home).

603. Public Health Science (3) (Identical with NURS 603, which is home).
Remote Sensing and Spatial Analysis (REM)

1955 E. Sixth St., Suite 205
Phone: (520) 621-7896
FAX: (520) 621-3816

Graduate Interdisciplinary Program in Remote Sensing and Spatial Analysis

Application Questions:
Carmen Ortiz-Henley, (520) 621-7896

Degrees Offered: Ph.D. minor only

Professors: Charles F. Hutchinson (Arid Lands Resource Sciences), Chair, Victor R. Baker (Geosciences), Robert E. Dickinson (Atmospheric Sciences), Alfredo R. Huete (Soil and Water Science), Donald E. Myers (Mathematics), John W. Olsen (Anthropology), 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. Tittle (Geosciences)

Associate Professors: Charles E. Glass (Mining and Geological Engineering), Stuart E. Marsh (Arid Lands Resource Sciences), Robert A. Schowengerdt (Electrical and Computer Engineering, Arid Lands Resource Sciences)

Assistant Professors: Curtis J. Thome (Optical Sciences)

Remote sensing and spatial analysis concerns the collection of information related in some way to the Earth's natural resources or environment. Data are primarily collected by satellite and aircraft systems in conjunction with localized ground-based surveys and measurements. 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 with majors in disciplines within Agriculture, Business and Public Administration, Engineering and Mines, Arts and Sciences, Arid Lands, Resource Sciences, and Optical Sciences. Emphases are available in applied remote sensing or in remote sensing techniques.

Students electing the emphasis in applied remote sensing are required to complete at least 12 graduate units including GEG 330 (without graduate credit and described in the General Catalog only) and 10 graduate units. The program must include OPTI 550 and ECE 531 and either GEG 330, G EN 507 or WS M 520. The remaining units may be selected from WS M 522, GEG 583, or G EN 580. The program selected must be approved in advance by the Committee.

Students electing the emphasis in techniques of remote sensing must complete 12 graduate units including OPTI 550 and ECE 531. The remaining units may be selected from OPTI 524, 539, 558, 559; ATMO 656a-656b.

Students are urged 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 1995-96 A multidisciplinary course delineating the physical basis of electromagnetic remote sensing, the concepts of information extraction, and applications pertinent to earth systems science. (Identical with ATMO 590, G EN 590, GEG 590, HWR 590, MNE 590, OPTI 590, RNR 590, SW 590)

696. Seminar
- Remote Sensing (1) II

Renewable Natural Resources, School of (RNR/L AR/RA M/WS M/WFSC)

Biological Sciences East, Room 325
Phone: (520) 621-7255
FAX: (520) 621-8801
WWW: http://www.snr.arizona.edu

Assistant Professors: Larry D. Howery, Spencer R. Titley

Associate Professors: Charles E. Glass (Mining and Geological Engineering), Stuart E. Marsh (Arid Lands Resource Sciences), Robert A. Schowengerdt (Electrical and Computer Engineering, Arid Lands Resource Sciences)

Assistant Professors: Curtis J. Thome (Optical Sciences)

Remote sensing and spatial analysis concerns the collection of information related in some way to the Earth's natural resources or environment. Data are primarily collected by satellite and aircraft systems in conjunction with localized ground-based surveys and measurements. 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 with majors in disciplines within Agriculture, Business and Public Administration, Engineering and Mines, Arts and Sciences, Arid Lands, Resource Sciences, and Optical Sciences. Emphases are available in applied remote sensing or in remote sensing techniques.

Students electing the emphasis in applied remote sensing are required to complete at least 12 graduate units including GEG 330 (without graduate credit and described in the General Catalog only) and 10 graduate units. The program must include OPTI 550 and ECE 531 and either GEG 330, G EN 507 or WS M 520. The remaining units may be selected from WS M 522, GEG 583, or G EN 507.

Students electing the emphasis in techniques of remote sensing must complete 12 graduate units including OPTI 550 and ECE 531. The remaining units may be selected from OPTI 524, 539, 558, 559; ATMO 656a-656b.

Students are urged 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 1995-96 A multidisciplinary course delineating the physical basis of electromagnetic remote sensing, the concepts of information extraction, and applications pertinent to earth systems science. (Identical with ATMO 590, G EN 590, GEG 590, HWR 590, MNE 590, OPTI 590, RNR 590, SW 590)

696. Seminar
- Remote Sensing (1) II
The School of Renewable Natural Resources is concerned with the management and conservation of natural ecosystems with emphasis on the desert, range, 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 area 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; 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 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.

The school also offers a program leading to the Master of Landscape Architecture degree. For information concerning this degree see chapter IV: Requirements for Master's Degrees elsewhere in this Catalog.

Master of Landscape Architecture (M.L.A.): emphasizes studies related to the planning, design, and management of landscape resources. Areas of specialization include sustainable landscape design, planning, policy, and computer technology as applied to natural resources of arid and semi-arid lands landscape history, theory and criticism; natural resources; tourism and recreation. The M.L.A. degree is offered as both First and Second (advanced) Professional degrees.

Range Management: Concentrations are available in range management, rangeland science, and dryland forestry. Applicants are expected to have completed an undergraduate major in range 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 rangeland and forest resource 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.

Renewable Natural Resources Studies: Graduate work in this major provides training and research opportunities in natural resources with an emphasis on natural resource management and policy decision-making in the context of technical elements and economic, legal, political, and social factors. This interdisciplinary program is appropriate for continuing students and mid-career professionals interested in broadening their expertise in natural resource policy, administration, planning, management, and ecology. An option in Advanced Resource Technology emphasizes the application of geographical information systems (GIS), remote sensing, and modeling and simulation of natural resources management and analysis. Students working toward the M.S. degree shall complete at least 36 units including a thesis for which 6 units may be earned.

Watershed Hydrology and Management: Concentrations are available in watershed hydrology and watershed management. Applicants should normally have completed an undergraduate major in a natural resources area with strong training in the 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.

Landscape Architecture (L AR)

500. The Profession of Landscape Architecture (1) An examination of principles and practices of the profession. Course includes a brief history of the profession as well as famous practitioners and projects. P, senior or graduate standing.

507. The American Landscape (3) (Identical with GEOG 507, which is home).

510. Design Studio I (4) 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. Field trips.


520a-520b. Plant Materials and Design (2-2) Native and selected exotic plant materials frequently used in landscape design and revegetation in the Southwest. Influence of site conditions and requirements on selection of plant materials. Theoretical basis for planting design process, functional use of plants in landscapes, and design planting plans for various sites. 520a is not prerequisite to 520b.

531a-531b. Computer Applications in Design (2-1) Two- and three-dimensional computer-aided design and video techniques for solving landscape architectural-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) 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) 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.


551. Site Engineering (4) 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. Field trips: P, 510.


574. Field Methods in Environmental Psychology (3) (Identical with PSYC 574, which is home).
596. Seminar
   u. Interdisciplinary Environment-Behavior-Design (3) [Rpt./1] (Identical with PSYC 596u, which is home).

597. Workshop
   i. *Community Design for Non-Designers (3) (Identical with ARCH 597i, which is home).

610. Landscape Planning Studio (4) Theories and models in landscape planning; planning issues and methods; case studies; one major studio planning project. Field trips. P, 511.

611. Interdisciplinary Studio (4) Complex landscape design and planning problems within an interdisciplinary area. Field trips. P, 610.

612. Social Dimensions in Landscape Architecture (2) Social and behavioral factors that influence the planning/design process; project goals and objectives; evaluation of planning/design alternatives; and evaluation of completed projects and plans.

631. Computer Applications in Planning (3) 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. P, 531.

660. Professional Practice (2) 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. P, 611.

694. Practicum
   a. Landscape Architecture Teaching (1-2)
   b. Landscape Architecture Professional Experiences (4) [Rpt.] P, 511. Limited to L AR majors, or by approval of L AR faculty.

695. Colloquium
   d. Landscape Architecture Research (2)
   e. Research Design (3) P, 695d.

696. Seminar
   a. Landscape Architecture (1) [Rpt.]

**Range Management (RA M)**

536. * Grazing Ecology and Management (3) 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.

546. * Range Vegetation Improvement (3) Rangeland habitat manipulation through vegetation control and establishment including mechanical, chemical, and burning treatments. Revegetation techniques for rangeland and drastically disturbed semiarid lands. 2R, 3L, P, MCB 181, ECOL 182, SWES 200.


570. Functional Ecology of Arid Land Plants (2) 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. Field trips.

587. Rangeland Management Plan (2) 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, 456.

593. Colloquium
   a. Rangeland Policy (3) [Rpt.]
   c. Diet Selection of Free-ranging Ruminants (2)

696. Seminar
   a. Rangeland Management (1) [Rpt.]

**Renewable Natural Resources (RNR)**

506. * Conservation Biology (3-4) (Identical with ECOL 506, which is home).

516. Geographic Information Systems for Geography and Regional Development (3) (Identical with GEOG 516, which is home).

517. * Geographic Information Systems for Natural Resources (3) 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. (Identical with GEOG 517 and SWES 517).

519. * Cartographic Modeling for Natural Resources (3) Computer techniques for analyzing, modeling, and displaying geographic information. Development of spatially oriented problem design and the use of logic applied to the use of GIS programs. Emphasis on applications in land resources management and planning. P, 417 or 517 or GEOG 481 or 581. (Identical with GEOG 519).

520. * Advanced Geographic Information Systems (3) Examines various areas of advanced GIS applications such as dynamic segmentation, surface modeling, spatial statistics, and network modeling. The use of high-performance workstations will be emphasized. 2R, 3L, P. 419. (Identical with GEOG 520).

522. * Photointerpretation (2) Reading and interpretation of aerial photographs; natural resource inventory from aerial photographs; remote sensing techniques. 1R, 3L.

527. Artificial Intelligence in Resource Management (3) 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 will be derived from current applications using various techniques to address management problems. P, computer programming skills.


538. Fire Ecology (3) Ecological role and use of prescribed fire in forest and range ecosystems; fire history; concepts and specific fire effects on vegetation, wildlife, soils, and watersheds. P, basic ecology course, 316 or RA M 382.

546. Principles of Research (3) Philosophy of science and the principles of conducting research, including formulation of problems, problem analysis, study plans, and preparation of manuscripts for publication.

555. Advanced Applied Plant Ecology (3) Discussion of advanced topics in plant ecology, with emphasis on applied ecology of terrestrial ecosystems. P, basic ecology and statistics.

575. Economics of Natural Resource Policy (3) (Identical with AREC 575, which is home).

576. Advanced Natural Resource Economics (3) (Identical with AREC 576, which is home).

578. * Global Change (3) (Identical with GEOS 478, which is home).

580. * Natural Resources Policy and Administration (3) Resource policy formation; ethics of resource use; administration and organization for resource management; analysis of present policy and trends. P, 200.

581. * Environmental Policy (3) (Identical with POL 481, which is home).

583. * Geographic Applications of Remote Sensing (3) (Identical with GEOG 483, which is home).

586a-586b. * Natural Resources Management and Economics (3-3) Introduction to decision-making techniques in natural resources management, including planning, GIS, modeling, applied economics, and systems analysis techniques. 2R, 3L, P, AREC 375, RNR 271, 384.

589a-589b. * Advanced Environmental Interpretation (2-2) Advanced training and experience in communication of natural history and environmental principles to the public. Students must be available for some weekend field work. 589a is part of a two-semester sequence. Credit and grade for 589a will be awarded only upon completion of 589b. Field trips. P, 12 units in biology or renewable natural resources.

590. * Remote Sensing for the Study of Planet Earth (3) (Identical with REM 590, which is home).

595. Colloquium
   b. Public Natural Resource Management (2)
   c. Human Dimensions in Renewable Natural Resources (3)
   e. Heritage Resources Planning and Management (2)
Watershed Management (WS M)

506. * Applied Hydraulics (3) (Identical with ABE 506, which is home).

508. * Wildland Fire Management (3)
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.


526. * Soil and Water Conservation Engineering (3) (Identical with ABE 526, which is home).

531. Dryland Forest Management (3)
Utilization and management of forest resources in dry environments; biophysical and socioeconomic issues related to the development of forest commodities and amenities. P, 6 units of upper-division WS M.

532. Agroforestry (3) 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) Hydrologic principles as applied to arid and semi-arid ecosystems with water management applications in dryland resource management. For non-majors only. P, MATH 160 or 263, SWES 201.


562. * Watershed Management (4) Evaluating hydrologic impacts of management activities on watersheds to include silviculture, range, mining, and recreation use. 3R, 3L, P, 460 or one course in hydrology.

563. * Plant-Water Relations (3) (Identical with PL S 563, which is home).

564. * Introduction to Dendrochronology (4) (Identical with GEOS 564, which is home).


569. Spatial Analysis for Hydrology and Watershed Management (2) 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 the ramifications. 1R, 3L, P, RNR 417/517. (Identical with HWR 560).

577. Advanced Topics in the Economics of Environmental Regulation (3) (Identical with AREC 577, which is home).

595. Colloquium
a. Dendrochronology: Physical Applications (3) (Identical with GEOS 595e).
b. Dendrochronology: Biological Applications (3) (Identical with GEOS 595d).
c. Dendrochronology: Chronometric Applications (3) (Identical with GEOS 595g).

597. Workshop
a. *Dendrochronology (1-4) 3L or 6 L. Field trips. (Identical with GEOS 597c).


605. Watershed Modeling (3) Distributed modeling of hydrological and sedimentation processes at the watershed scale; emphasis on current concepts and applications. P, 560 and computer programming.

696. Seminar
a. Watershed Management (1-2) [Rpt.]
Russian and Slavic Languages (RUSS)
Modern Languages, Room 340
Phone: (520) 621-7341
FAX: (520) 626-4007
WWW: http://russian.arizona.edu

501a-501b. Russian Stylistics (3-3) Designed to improve the student's practical mastery and understanding of Russian at a higher and more sophisticated level. P, 301b.

505a-505b.* Survey of Russian Literature (3-3) Historical survey of Russian literature from the earliest times to the Soviet period; designed to acquaint students with literary terminology and facilitate comprehension of lectures in Russian. P, 301b or 303b.

507a-507b. Advanced Russian Conversation (3-3) Emphasis is on political, economic, and business Russian. P, 407b.

510. Theory and Methods (3) Provides broad theoretical, critical, and bibliographical introduction to the field of Russian/Slavistics.

531. Russian Phonology and Morphology (3) Synchronic study of the phonology and morphology of modern Russian. P, 301b or 303b.

532. Russian Syntax and Semantics (3) Introduction to theories and issues of syntax, semantics, and pragmatics in Russian. Problems in text analysis will also be covered. P, 3 years of Russian language.

533. History of the Russian Language (3) Diachronic study of the Russian language from Indo-European up to the modern period. P, 301b or 305b.

585. Linguistic and Computer-Assisted Approaches to Literature (3) [Rpt./6 units] Designed with GER 385, which is home.

587. Testing and Evaluation in Foreign/Second Language Programs (3) [Rpt. with GER 387, which is home].


686. Russian Drama (3) Examination of the major dramatic works of 19th and 20th century Russian playwrights. P, 405b.

693. Internship
a. Business Internship Graduate Level (3) P, 4 years of college level Russian or equivalent.
b. Business Internship level III (3)

d. Russian Literature: 18th Century (3) [Rpt./12 units]
e. Russian Literature: 19th Century (3) [Rpt./12 units]

School Psychology
(See Special Education and Rehabilitation)

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@ccit.arizona.edu

Advising Questions: Mary Wildner-Bassett, German Studies, (520) 621-1799, wildbass@ccit.arizona.edu

Degrees Offered: Ph.D.

Professors: Robert Ariew (French and Italian), Richard Demers (Linguistics), Kenneth Ian Forster (Psychology), Roseann Duenas Gonzalez (English), Kenneth Goodman (Language, Reading and Culture), Yetta M. Goodman (Language, Reading and Culture), Jane Hill (Anthropology), D. Terence Langendoen (Linguistics), Adrienne Lehrer (Linguistics), Judy Nichols Mitchell (Language, Reading and Culture), Luis C. Moll (Language, Reading and Culture), Susan Philips (Anthropology), Frank Pialorsi (English), Hamdi Qafisheh (Near Eastern Studies), Richard Ruiz (Language, Reading and Culture), Muriel Saville-Troike (English), Renate A. Schultz (German Studies), Rudolph C. Troike (English)

Associate Professors: H. Douglas Adamson (English), Chair, Shirin Antia (Special Education and Rehabilitation), Andrew Bars (Linguistics), Kimberley A. Jones (East Asian Studies), Donna M. Johnson (English), Teresa L. McCarty (Language, Reading and Culture), Samuel J. Supalla (Special Education and Rehabilitation), Mary Wildner-Bassett (German Studies), William J. Wilson (Near Eastern Studies), Ofelia Zepeda (Linguistics)

Assistant Professors: Dalila Ayoun (French and Italian), Lynn Carbon (Spanish and Portuguese), Todd V.
Fletcher (Special Education and Rehabilitation), Simin Karimi (Linguistics), Feng-Hsi Liu (East Asian Studies), Cecile M. McKee (Linguistics), Mary Montalbetti (Spanish and Portuguese), Janet Lee Nicol (Psychology), Tsuyoshi Ono (East Asian Studies), Sini Prosper Sanou (French and Italian), Cynthia White (Classics), Mary Ann 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 book which is relevant; 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://w3.arizona.edu/SOC/

Application Questions:
Bonnie Thompson,
SOCGRAD@arizona.edu

Advising Questions:
Doug McAdam, (520) 621-3889,
DMCADAM@u.arizona.edu

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


Associate Professors: James T. Borhek (Emeritus), Courtney B. Cleland (Emeritus), Susan Gonzalez-Baker (Public Administration and Policy), Patricia L. MacCorquodale, Jerry L.L. Miller (Emeritus), Cathryn K. Morrill, Michael Polakowski (Public Administration and Policy), Kathleen S. Schwartzman, James W. Shockey

Assistant Professors: Sun-Ki Chai, Elisabeth S. Clemens, Donald S. Grant, Alfonso Morales, James Ranger-Moore, Marc Schneiberg, Sarah Soule, Yvonne Zylan

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees. Most fields of sociology are represented in the department, with special concentrations in the areas of crime and deviance, culture, gender, organizations, social psychology, stratification, 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 (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 42 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 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 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) Theory and research on the modern world-system.

508. Sociology of Culture (3) Theory and research on the nature of cultural systems, cultural production and consumption, and strategies of interpretative analysis. P, consult with department before enrolling.

509. Objects and Methods of Cultural Analysis (3) From content analysis to statistical analysis, means of gathering and analyzing data on cultural objects.

510. Political Sociology (3) Basic approaches in political sociology, with emphasis on the relationship of economic and political processes.

511. Rational Choice Sociology (3) 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) 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) 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 well recent and classical empirical works in the area. P, admission to graduate program or departmental approval.

520. Communication and the Legal Process (3) (Identical with COMM 520, which is home).

521. Social Policy (3) (Identical with PA 521, which is home).

524. Organization Ecology (3) Survey of theory and research in organization ecology, focusing on the organizational population as the level of analysis. Topics include population boundaries, selection vs. adaptation, evolutionary dynamics.

525. Organization Theory (3) Basic review of classical and contemporary approaches to the study of complex organizations; formation, development, and internal processes.

527. Social Networks (3) 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) 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) 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, 530, or consult department before enrolling.

533. Social Relations, Groups, and Networks (3) 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, 530, or consult department before enrolling.

535. Advanced Topics in Social Psychology (3) [Rpt.] An in-depth study of one area of theory and research in social psychology. Topics vary. P, 530 or consent of instructor.

540. Theories of Crime and Public Policy (3) (Identical with PA 540, which is home).

541. Deviance and Social Control (3) Theory and research on the origins of various forms of deviant behavior, and on the consequences of efforts to control them. P, 201, 341 or 342. (Identical with PA 541).

542. Criminology (3) A comprehensive review of classic and contemporary approaches to crime, its nature, causes and consequences.

543. White Collar and Organizational Crime (3) (Identical with PA 543, which is home).

545. Law and Society (3) [Rpt.] Comprehensive survey of major theoretical perspectives, methodologies, and empirical works on the origins, operations, development, and social consequences of legal and quasi-legal institutions.

551. Stratification and Class (3) 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.] In-depth study of one contemporary area of research in stratification. Topics will vary.

556. Gender Issues in Organizational Behavior (3) (Identical with MAP 556, which is home).

557. Gender and Labor (3) 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, or undergraduate major in one of these three fields.

558. Gender Identities and Interactions (3) Examination of the interface of gender, race, class, and ethnicity in the context of social structures and institutions. Focuses upon identities and social interaction as keys to understanding how gender inequality is created, perpetuated, or altered in families, schools, peer groups, work settings, and cultural symbols. P, 3 graduate credits in sociology, social psychology or women's studies. (Identical with W 558).

559. Sociology of Gender and the State (3) Gender and construction of state institutions, social policy development, ideas and practices of citizenship. States, families, and markets, naturalist and paternalist origins of welfare states, race and gender in contemporary social policy. Gender and political interests. (Identical with W 559).

560. Race and Ethnicity (3) 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) An introduction to basic quantitative methods for professional sociologists, including computer, mathematical, and statistical concepts.

570a-570b. Social Statistics (3-3) 570a: Probability, distributions, estimation and hypothesis testing. 570b: Ordinary least squares regression, generalized least squares regression, structural equation models (path analysis and non-recursive systems).


576. Field and Observational Methods (3) 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 departmental approval. (Identical with COMM 576).

577. Experimental Methods (3) 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, 575 or consult department before enrolling.

580. Population Studies (3) 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) The logic 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)

596. Seminar
   a. Advanced Problems in Research (1-3) [Rpt.]

599. Seminar
   b. Graduate Teaching (3)
   c. Teaching Practicum (1)
   e. Social Organization (3) [Rpt/6 units] P, completion of first-year graduate program curriculum in sociology. [Note: This is a two-semester course beginning in fall that receives a "K" grade at end of first semester.]
### Soil, Water and Environmental Science (SWES)

Shantz Building, Room 429  
Phone: (520) 621-1646  
Fax: (520) 621-1647  
WWW: [http://ag.arizona.edu/SWES/](http://ag.arizona.edu/SWES/)

**Application Questions:**  
Judith Ellwanger, (520) 621-1646,  
ellwanger@ag.arizona.edu

**Advising Questions:**  
Mark L. Brusseau, (520) 621-1646,  
wso@ag.arizona.edu

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

**Professors:**  

**Associate Professors:**  
Mark L. Brusseau, Robert J. Frye, David M. Hendricks, Allan D. Matthias; Raina Miller

**Assistant Professors:**  
Joan E. Curry, Thomas L. Thompson

The department offers opportunities for study toward the Master of Science and Doctor of Philosophy degrees with a major in soil and water science. Areas of emphasis are available in 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; and soil mineralogy. 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 required which includes 3 of the following courses: SWES 511, 525, 531, 570, or 602.

### Outstanding Students

Outstanding students with undergraduate preparation in physical sciences, biological sciences, earth sciences, and engineering will be considered for admission.

**501.** Management of Arid Lands and Salt-Affected Soils (3) Principles and practices of soil, water, and crop management under arid and semiarid conditions; the use of diagnostic procedures for evaluating soils and waters, reclamation, and economics of irrigation project development. 2R, 3L. Field trips. P, 200, 201.

**504.** Irrigation Principles and Management (3) (Identical with ABE 504, which is home)

**505.** Environmental, Soil and Water Chemistry Laboratory (3) Principles and methods of the chemical analysis of soils, water, and biological materials with emphasis on illustrating important soil and environmental concepts and processes. 1R, 6L. P, CHEM 322, 323; PHYS 102.

**517.** Geographic Information Systems for Natural Resources (3) (Identical with RNR 417, which is home)

**520.** Environmental Physics (3) 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.


**526.** Environmental Microbiology Laboratory (2) Basic techniques for isolation and characterization of environmental soil and water microflora including methods for enumeration and measurement of physiological activity. P, 425. (Identical with MIC 526).

**530.** Environmental Monitoring (2) Theory and application of environmental measures to the sampling and monitoring of groundwater, soil, surface water, and near-surface atmospheric systems. 1R, 3L. P, HWR 450 or SWES 411 or equivalent.

**531.** Soil Morphology, Classification and Interpretations (3) Theory and practice of describing characteristics of soils; principles of soil classification and classification systems; making soil interpretations for selected land uses. 2R, 3L. Field trips. P, 200, 201.

**540.** Biodegradation of Pollutants in Soil and Groundwater (3) 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, 425. (Identical with MIC 540).

**541.** Soil Genesis (3) Physical and chemical processes and mineralogy of weathering and soil formation; quantitative pedology; the soil as part of the ecosystem. Field trips. P, GEOS 101 and CHEM 103b. (Identical with GEOS 541).

**544.** Applied Environmental Law (3) 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.


**550.** Anticipating the Future: Focus on Environment (3) Techniques and approaches to understand 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. P, upper-division standing.

**553.** Remote Sensing of the Environment (3) 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. 2R, 3L. Field trips. P, 330 or PHYS 102b.

**561.** Soil and Water Conservation (3) Consideration of major world soil and water conservation problems and solutions; principles of soil and water degradation by erosion, ground water overdrift, chemical transport in surface and ground water, and their effects on world food production and environmental problems. 2R, 3L. Field trips. P, 200.

**564.** Environmental Chemistry (3) 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, 400b.

**565.** Contaminant Transport in Porous Media (3) 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, 570 or HWR 518 or 531.

**566.** Soil and Groundwater Restoration (3) Methods for remediation of contaminated soil and groundwater; factors influencing efficacy of remediation systems. Emphasis on scientific basis of restoration.

**570.** Soil Physics (3) 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. 2R, 3L. P, 200, PHYS 103. CR, MATH 125a.

**573.** Monitoring Biosphere Processes (3) Global-scale interactions of soils with their plant cover and climate. The spatial distribu-
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, 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 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) 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-century through eighteenth-century Spanish literature; (2) nineteenth and twentieth-century Spanish literature; (3) Pre-Columbian through eighteenth-century Spanish American literature; (4) 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 (3) 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) 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 when topic varies] Representative topics include the development of lyric verse; Mester de Clerencia, art of the Juglar; the Romancero; the development of prose; renaissance and baroque prose or verse; Cervantes; Golden Age drama; picaresque novel.


521. Topics in Eighteenth, Nineteenth and Twentieth-Century Spanish Literature (3) [Rpt./3 when topic varies] Representative topics include Spanish romanticism; nineteenth century realist and naturalist Spanish prose; the generation of '88; 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 from the Pre-Columbian Period to Independence (3) 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 from the Pre-Columbian Period to Independence (3) [Rpt./3 when topic varies] 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 when topic varies] 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 when topic varies] 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 when topic varies] 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 when topic varies] 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) Focuses principally on descriptive linguistic analyses of Chicano language phenomena examined in sociolinguistic and psycholinguistic context. Analyses will include phonological and phonetic levels, although the primary emphasis will be on morphosyntactic and lexical realizations. Macro-sociolinguistic topics of languages in contact/conflict, language shift, language choice/preference, and language attitudes as well as specific linguistic behaviors associated with Chicano bilingualism will also be treated in depth. P, 340. (Identical with LING 574 and MAS 574).

580. Introduction to Hispanic Linguistics (3) May be taken up to four times and will rotate between the following four topics. Introduction to Hispanic Sociolinguistics: Current sociolinguistic perspective on the Spanish Language. Introduction to Spanish in the Americas: Diachronic and synchronic perspectives on the evolution and development of the Spanish-American Dialectology. Introduction to Spanish Phonology: Theoretical perspectives on major issues of Spanish phonology. Introduction to Spanish Morpho-Syntax: Current theoretical perspective on major issues of Spanish Morpho-Syntax.

581. Topics in Second Language Theories and Applications (3) May be taken up to four times and will rotate between the following four topics. Theories of Second Language Acquisition: Analysis of the current theories of second language acquisition including theories from linguistics, psychology and education; Curriculum and Materials Development: Development of curriculae and materials that reflect the impact of current research in the field of second language acquisition; 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. 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) May be taken up to four times and will rotate between the following four topics. Morphological Theory: Theoretical perspectives on the major morphosyntactic and morphophonological issues of Spanish Morphology. Linguistic Perspectives on Mexican American Spanish and Analyses of (socio)linguistic phenomena encountered in the Spanish of the Southwest, History of the Spanish Language: Diachronic and synchronic perspectives on the evolution and development of vernacular Spanish. 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) (Identical with GER 507, which is home).

696. Seminar a. Spanish Peninsular Literature (3) [Rpt./3] b. Spanish American Literature (3) [Rpt./3] c. Mexican and Mexican American Literature (3) [Rpt./3] d. Hispanic Linguistics (3) [Rpt./3]

**Portuguese (PORT)**

501.* Luso-Brazilian Literature to 1900 (3) Overview of literary periods and introduction to the 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, 325 or the equivalent.


514.* Teaching of Modern Languages (3) (Identical with TTE 514, which is home).

530.* Brazilian Civilization (3) 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, 325 or the equivalent. (Identical with LA S 530).

531.* Civilization in the Portuguese-Speaking World (3) 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, 325 or the equivalent (Identical with LA S 531).

501.* Luso-Brazilian Literature to 1900 (3) Overview of literary periods and introduction to the 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, 325 or the equivalent.


514.* Teaching of Modern Languages (3) (Identical with TTE 514, which is home).

530.* Brazilian Civilization (3) 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, 325 or the equivalent. (Identical with LA S 530).

531.* Civilization in the Portuguese-Speaking World (3) 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, 325 or the equivalent (Identical with LA S 531).
549. * Brazilian Literature in Film (3) Presentation of the masterpieces of Brazilian literature and the great films based upon them. P, 325 or the equivalent. (Identical with LA S 549).


Special Education and Rehabilitation (SER)

Education Building, Room 412
Phone: (520) 621-7822
FAX: (520) 621-3821
WWW: http://www.ed.arizona.edu/departments/ser/serinfo.html

Application Questions: Randa Gamal, (520) 621-9724
Advising Questions: Randa Gamal, (520) 621-9724

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

Concentrations: behavior disorders, bilingual learning disabilities, deaf and hard of hearing, early childhood preschool, gifted and talented, interstellar, learning disabilities, orientation and mobility, rehabilitation counseling, school psychology, severe profound and visually impared.


Associate Professors: Jane N. Erin, Head, Shirin D. Antia, S. Mae Smith, Samuel J. Supalla, John Umbreit

Assistant Professors: Todd Fletcher, Elba Reyes

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 psychologists; 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, rehabilitation psychology, and teacher education in the areas of deaf/hard-of-hearing, early childhood, emotional/behavioral disorders, gifted and talented, bilingual special education, learning disabilities, mental retardation and severe/multiple disabilities and visually impaired. Rehabilitation psychology students pursue a Doctor of Philosophy degree and must meet admission and course study requirements specific to that degree.

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 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) 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, 400.

501a. * Assessment and Instruction for Students with Early Reading and Spelling Difficulties (3) 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.

502. * Behavior Principles and Disability (3) Use of behavior principles to positively support individuals with disabilities, especially those with moderate and severe disabilities. 3R, 1L, P, 400.

503. * The Special Services in the Schools (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.

504. * Cultural and Linguistic Diversity in Exceptional Learners (3) 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.

505. * Introduction to Learning Disabilities (3) Theories and history of programs for individuals with learning disabilities—definition, characteristics, etiology. Degree candidates must complete 500 prior to taking 505.


508. Teaching Elementary Students with Learning Disabilities (3) 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, 405/505 or permission of department: CR, 593.

510. * Introduction to Mental Retardation and Severe Disabilities (3) 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, 400 or CR.

512. Teaching Learning Disabled Adolescents (3) Intervention alternatives for teaching the learning disabled adolescent at the secondary level. Emphasis on current intervention methods and practices. 400/500.

513. Educating Students with Mental Retardation and Severe Disabilities (3) Methods of developing age-appropriate, functional, and inclusive programming: community-based instruction, and integrative source delivery for students who have moderate-to-severe retardation and other physical, sensory, and behavior disorders.

515. * Physical and Multiple Disabilities (3) [Rpt./1] Physical and multiple impairments, etiology, intervention practices, adaptations, transferring and handling skills, and integration into typical environments. Field trips.

517. Behavior Modification and Theory in Schools (3) Application of behavior principles and techniques to promote learning and social development of school-related behavior. 3R, 3L, P, ED P 510 or equivalent or permission of instructor.

518. Nonoral Communication (3) [Rpt./3] Techniques for assessment and intervention of alternative 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) Anatomy and physiology of the eye; implications of visual disorders including visual field losses; introduction to optics; use of optical and nonoptical aids in classroom settings.
clinical and functional low vision assessments, including assessing children with multiple impairments; and report writing. P, 521.

521.* Introduction to Visual Impairments and Deaf-Blindness (3) An overview of educational services for the student with visual impairments and multiple sensory impairments. An emphasis is placed on the psychosocial, educational, and ethical issues related to these students. P, 370b or department permission. Must be taken in sequence.

522a. Orientation and Mobility for Teachers of Individuals with Visual Impairments I (3) 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.

523a. Tactile Communication (3) Fundamentals of Braille reading and writing, methods of teaching Braille and preparation of materials.

524. Methods of Teaching the Visually Handicapped (3) Curriculum development and adaptation in various educational programs; adaptation of classroom materials and procedures for use with blind and partially sighted children and youth; emphasis on methods of teaching academic and nonacademic skills and on educating students with nonhandicapped peers. P, 521; CR, 593.

525.* Strategies of Vocational Development and Supported Employment (3) 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, 400.

526. Principles and Assessment of O & M (3) In-depth study of the principles supporting orientation and mobility instruction; assessment instruments and strategies specific to O & M. P, 522a, 520 or equivalent from other universities.

527. Advanced O & M Practice and Procedures (4) Preparing 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. 2R, 8L. P, 522a, 520 or equivalent from other universities.

529.* Education and Rehabilitation of Deaf and Hard of Hearing Individuals (3) 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.

530. School Psychology (3) Roles of the school psychologist; implementing programs in the public schools; legal and ethical issues in school psychology. 2R, 3L. P, consent of instructor.

531a-531b. * American Sign Language (4-4) Designed to develop intermediate ASL conversational skills in a variety of settings, topics, and functions. P, 370b or department permission. Must be taken in sequence.


533a-533b-533c-533d.* Special Topics in Deaf Studies (3-3-3-3) 533a: Introduction to the structure of ASL; 533b: Languages and cultures of deaf communities; 533c: History of the deaf community; 533d: ASL literature and film. Classes will be offered on a rotating basis in a 2-3-4-4 sequence; however, courses need not be taken in sequence. P, 431b or permission of department.

534. Language Development for the Exceptional Child (3) 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) 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, 507.

536. Teaching Bilingual Exceptional Learners (2) Instructional interventions and program development for exceptional students from culturally and linguistically diverse backgrounds. Emphasis on current intervention methods and practices. P, 508.


539a-539b-539c.* Special Topics in Sign Language Studies (3-3-3) Classes will be offered on a rotating basis in the following sequence: 539a: ASL Acquisition and Bilingualism; 539b: Signed Language Policy, Planning, and Intervention; 539c: Methods and Materials of ASL/ESL Instruction. Courses need not be taken in sequence. P, 431b or permission of department.

540.* Education of Gifted Children (3) Issues in education of the gifted; discussion of definitions, characteristics, development, screening, identification, curriculum, teaching strategies, and program development. P, 400.

541. Teaching the Gifted: Questioning Strategies (3) 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, 440/540.

542. Teaching the Gifted: Productive Thinking Models (3) Mastery of skills involved in developing productive thinking abilities in gifted children by using teaching-learning models developed by Parnes, Williams, Taylor, Guiford, Renzulli, and Trefinger at all grade levels and in all-content areas. P, 440/540.

543. Teaching the Gifted: Hierarchical Models (3) 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, 440/540.

544a-544b-544c.* ASL Discourse Processes (3-6/3-6/3-6) 544a: Intensive ASL. 544b: Introduction to Interpreting. 544c: Classroom instruction in ASL. Courses need not be taken in sequence. P, 431b or permission of department.

550.* Introduction to Emotional or Behavioral Disorders (3) Issues in education of the emotionally or behaviorally disordered: discussion of history, current issues, definitions, characteristics, and theoretical perspectives. P, 400.

551. Teaching Children with Emotional or Behavioral Disorders (3) Assessment techniques, academic and behavioral intervention strategies, and classroom management with emotionally or behaviorally disordered children and youth.

555.* Rehabilitation and Aging (3) Emphasis on aging from the viewpoint of the aging person and those working with the aged.

559. Testing of Minorities (3) Current theoretical, social, and practical issues in the use of norm-referenced tests with individuals from minority colleges.

560.* Introduction to Early Childhood Special Education (3) Focus 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, 400.


562. Methods of Assessment for Preschool Children with Disabilities (3) Norm-referenced and criterion-referenced instruments for screening, diagnosis, and assessment of infants, toddlers, and preschool children will be reviewed. Emphasis will be placed on teacher involvement in the assessment process. P, 400/500, 575.

563. Client Assessment in Rehabilitation (3) Exploration of the world of work; critical review of vocational choice theories; experiences in the use and interpretation of individual assessment techniques. P, 565 or CR; ED P 458. Open to majors only.
586. Psychosocial Assessment of the Deaf Person (3) Selection, administration, and interpretation of various psychosocial evaluation instruments used with deaf persons. P. 674a, ED P 673.

587. Field Experience in Intellectual Assessment in Education (3) Supervised field experience in the administration, scoring, and interpretation of various intellectual assessment devices. 674a: Wechsler Adult Intelligence Scale. 674b: Intellectual assessment techniques. 1R, 3L. Open to majors only. Credit allowed for 674a or 674b, but not for both. P. 673 or CR.

588. Theoretical Foundations of Intelligence (3) Various theories and models of human ability and their implications for intellectual assessment.

673. Prevention of Addictions (3) 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.

674. Medical Aspects of Disability (3) Etiology, therapy, and prognosis of the major disabilities, including drug and alcohol; assessment of physical capacities and limitations; typical restorative techniques. Open to majors only.

675. Psychosocial and Cultural Aspects of Disability (3) Exploration of the psychological, sociological, and cultural aspects of disability; analysis of somatopsychology, psychosomatics, and social psychology.

676. Principles and Practices of Vocational Evaluation (3) Understanding work skills and labor market conditions; process of vocational evaluation of rehabilitation clients; collecting and synthesizing evaluation data and writing meaningful reports.

677. Counseling Theories and Practices in Rehabilitation Settings (3) Professional rehabilitation counseling practices with varied ethnic, age disability, and dependency populations. 3R, 1L. Open to majors only.

678. Problems of Drug Abuse (3) Rpt/1 Survey course for teachers, counselors, and agency workers concerned with drug abuse; examination of community, cultural, and educational approaches to drug use and abuse.

679. Vocational Planning and Placement (3) 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. 563, 565, 580 or CR.
Speech and Hearing Sciences (SPH)

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) 621-6725, peaches@ccit.arizona.edu

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

Professors: Audrey L. Holland, Head, Kathryn A. Bayles, Daniel R. Boone (Emeritus), Richard F. Curlee, Theodore J. Glattke, Thomas J. Hixon, William R. Hodson (Emeritus), Noel D. Matkin, Ralph L. Shelton
Associate Professors: LouAnn Gerken, Jeannette D. Hoit, Yingrong Qi, Linda Swisher
Assistant Professors: Julie M. Barkmeier
Director of the Speech-Language Clinics: Anthony B. DeFeo
Director of the Hearing Clinics: James Dean

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in speech and hearing sciences.

A minimum of 24 undergraduate units in speech and hearing sciences is required for admission without deficiencies. Such coursework must include 6 units in normal communication development and processes, 6 in speech-language pathology, and 6 in audiology. Applicants must complete departmental application forms and submit three letters of recommendation. Scores on the aptitude test of the Graduate Record Examination are required of all applicants to graduate programs. Doctoral applicants must also submit a sample of their scholarly writing.

The Master of Science program requires the completion of 36 units of coursework plus any additional coursework assigned as deficiencies. Submission of a thesis as a part of the program is optional.

The Doctor of Philosophy degree is designed to provide tools, knowledge, and experience in research and not to provide specialization in clinical pursuits.

500. Introduction to Quantitative Methods and Research in Speech and Hearing Sciences (2) Study of measurement and research design and their application in research and professional practice.

501. Professional Issues in Speech-Language Pathology and Audiology (1) Professional practice issues including certification, licensure, supervision, quality control, ethics, federal and state legislation.

502. Principles of Neuroanatomy (4) (Identical with CBA 502, which is home).

510. Counseling Techniques in Communication Disorders (3) Introduction to counseling the communication handicapped and their families.

541. * Language Acquisition (3) 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. 330. (Identical with LING 541 and PSYC 541)

552. Language Disorders in School Age Children (2) 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. 441 or 541.

553. Developmental Language Impairments (3) Topics include: language and nonlanguage characteristics and clinical management of children with developmental language impairment, acquired aphasia, bilingualism, and auditory disorders.

555. Developmental Language Disorders (2) Preschool-level. Competency-based approach (treatment, assessment, and evaluation) to autism, specific language impairment, and mental retardation with attention to children learning English as a second language. Case study focus. P. 441 or 541.


558. * Clinical Studies: Speech-Language Pathology (1-3) [Rpt./9 units] Under supervision, students carry out prescribed intervention programs and conduct evaluation of children and adults. Students participate in weekly staffings and clinical problem-solving. Open to majors only. P. 451, 471 or CR.

559. * Clinical Studies: Audiology (1-3) [Rpt./9 units] 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. Open to majors only. P. 483 or CR.

560R. * Speech and Hearing Science Instrumentation (2) Consideration of some common and specific instruments and methods employed in speech and hearing laboratories and clinics. P. 260, 280 CR.

560L. * Speech and Hearing Science Instrumentation Laboratory (1) P. CR, 460R.

562. Psychophysical Acoustics (3) 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. 280, 460.

563. Microcomputer Applications (2) Basic understanding of microcomputer operations and multiple functions; emphasis on computer literacy, administrative clinical applications, and hands-on instruction.

567. Experimental Phonetics: Physiology (3) 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. 260. (Identical with PSYC 567).

568. * Speech Perception (3) General overview of the field of speech perception. Topics include: role of contextual factor 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. 260. (Identical with PSYC 450).

570R. Evaluation Process (2) Study of principles, methods, and selected procedures involved in the assessment of individuals with communication disorders; attention to skills in interviewing and preparation of reports. P. 470, 471, 483; CR or subsequent registration in 570L. (for majors).

570L. Laboratory in Evaluation Process (1) Open to majors only. P. 570R or CR.


571L. * Laboratory in Articulation Disorders (1) Open to senior majors only. P. 471R or CR.


574. Cleft Palate, Other Craniofacial Disorders, and Communication (2) Communication disorders associated with cleft palate and other craniofacial defects. Speech assessment, evaluation, and treatment; survey of dental and surgical services. P. 471R/L or 571R/L.


580. Community and Industrial Audiology (2) Hearing conservation in industry, schools, and the community; auditory and non-auditory effects of noise, noise assessment, control, and protective procedures.


583. Principles of Audiology (3) Basic principles and techniques of audiological testing, etiologies of hearing impairment, and intervention strategies. P, 280 or graduate standing.

584. Audiolingual Rehabilitation: Adults (3) Speech reading; auditory training; problems encountered with amplification units; social, psychological, educational, speech, and language difficulties encountered by the hearing handicapped. P, 280, 483.


586. Audiolingual Habilitation: Children (3) Amplification, room acoustics, auditory and visual processing, evaluation and remedial programming for children with mild to moderate hearing impairment. P, 483 or 589.


595. Colloquium 
   a. Current Problems in Speech and Hearing Sciences (1) [Rpt./5]
   b. Seminar 
      a. Experimental Phonetics (1-3) [Rpt./2 or 9 units]
      b. Clinical Audiology (1-3) [Rpt./2 or 9 units]
      c. Hearing Physiology and Psychophysics (1-3) [Rpt./2 or 9 units]
      d. Language and Language Disorders (1-3) [Rpt./2 or 9 units]
      e. Speech Pathology (1-3) [Rpt./2 or 9 units]

600. Research Methods in Communication Sciences and Disorders (3) Design and execution of descriptive and experimental research in communication sciences and disorders.


659. 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 specialties. Open to majors only. P 589 or CR.


665R. Aerodynamic Evaluation and Management of the Speech Mechanism (2) 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, 260, 460R/L, 567.


695. Colloquium 
   a. Motor Control (2) [Rpt./8 units] (Identical with PSIO 693a, which is home).

696. Seminar 
   a. Experimental Phonetics (1-3) [Rpt./9 units]
   b. Clinical Audiology (1-3) [Rpt./9 units]
   c. Hearing Physiology and Psychophysics (1-3) [Rpt./9 units]
   d. Language and Language Disorders (1-3) [Rpt./9 units]
   e. Speech Pathology (1-3) [Rpt./9 units]

Statistics (See Mathematics)

Systems and Industrial Engineering (SIE)
Old Engineering Building, Room 111
Phone: (520) 621-6551
FAX: (520) 621-6555
WWW: http://www.sie.arizona.edu

Application Questions: Graduate Secretary, (520) 626-4644, celia@sie.arizona.edu
Advising Questions: Julie Higle, (520) 621-6551, julie@sie.arizona.edu

Degrees Offered: M.S., Ph.D.
Professors: Pitu B. Mirchandani, Head, Ronald G. Askin, A. Terry Bahill, Lucien Duckstein, William R. Ferrell, Marcel F. Neuts, John S. Ramberg, Donald G. Schultz (Emeritus), Suvrajeet Sen, Soroosh Sorooshian, Ferenc Szidarovszky, A. Wayne Wymore (Emeritus), Sidney J. Yakowitz

Associate Professors: Robert L. Baker (Emeritus), Duane L. Dietrich, Jeffrey B. Goldberg, Julia L. Higle, Fei-Yue Wang

Assistant Professors: Frank W. Ciarallo, Emmanuel Fernandez, Larry Head, Sanjay Jagdale

Instructor: John R. Lyon
Adjunct Professor: Walter Arnell
Adjunct Associate Professor: Sandra Newsome
Adjunct Assistant Professor: William Thompson

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 2½ 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. 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.

506. Quality Engineering (3) Methods for quality planning, improvement, and control with applications in manufacturing and service, emphasizing both on-line and off-line methods. Topics include modern quality philosophies and methods, control charts, process capability studies, loss functions, and acceptance sampling. 2ES, 1ED. P, 330R, 330L.

507. Advanced Quality Engineering (3) Advanced techniques for statistical quality assurance, including multivariate control charting, principal components analysis, and control charts, inspection errors, and select papers from the recent literature. P, 530.
508. * Reliability Engineering (3) Time-to-failure, failure-rate, and reliability determination for early, useful, and wear-out lives; equipment reliability predictions; spare parts provisioning; reliability growth; reliability allocation. Credit for this course or a ME 472. P, 330 or a ME 474, MATH 223. 1.5ES, 1.5ED.


511. * Human Interaction with Computers and Software (4) The interaction of technical requirements with the characteristics of computer users and programmers as they affect the design of software, and the physical and cognitive interfaces between people and computers. 1ES, 3ED.

513. Environmental Risk Analysis (3) (Identical with HWR 513, which is home).

518. Reliability Testing (3) Mean-time-between-failure and reliability confidence bounds; sequential testing; sampling; accelerated, sudden-death, and suspended items; nonparametric, and Bayesian testing. Credit for this course or A ME 575. P, 408, 530.


521a-521b. Systems Modeling and Simulation (3-3) (Identical with MIS 521a-521b, which is home).

522. * Engineering Decision Making Under Uncertainty (3) 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, 330R, 330L or equivalent.


528. Maintainability Engineering (3) Complex systems reliability; maintainability engineering; reliability and availability of maintained systems; operational readiness; system effectiveness; maintainability demonstration. Credit for this course or A ME 577, but not for both. P, 408, 530.


532. Statistical Models in Engineering (3) Statistical distributions applicable in engineering, with emphasis on quality and reliability problems. Topics include model selection, parameter estimation, and approximations for large-scale systems. P, 330.

536. Experiment Design and Regression (3) Planning and designing experiments with an emphasis on factorial layouts and response surface methodology. Also, includes analysis of experimental and observational data with multiple linear regression and analysis of variance. P, 330.

537. Advanced Experiment Design (3) Robust product and process design through planned experiments, emphasizing the integration of loss functions, parameter design and tolerance design. P, 330.


541. Dynamic Programming (3) 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, 321, 340.

542. * System Design Projects (3) Practical application of engineering knowledge by student teams to actual system design problems in industry or business. Development of report writing and oral presentation skills. 3ED. P, 431.


545. * Nonlinear Programming (3) 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, 340.

546. Algorithms, Graphs and Networks (3) 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. Credit is allowed for this course or MIS 546. P, 340.

550. Theory of Linear Systems (3) 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, 350.

551. Modeling Physiological Systems (3) Development and validation of models, sensitivity analyses, and applications of systems engineering techniques to physiological systems.


554. Concurrent Engineering and System Design (3) 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, teamworking, project management, ISO 9000 and documentation.

558. Fuzzy Sets in Systems Analysis and Decision Making (3) 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) Quantitative 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, 540 or 544.


573. * Concepts in Information and Communication Systems (3) Modeling and analysis of information and communication, systems/networks for applications in telecommunications, systems and computer communication networks. Topics selected from the following:
signal representation, sampling, coding and error detection, modulation, OSI network architecture, network protocols, delay models of performance, routing and flow control. 3ES. P. 321. 340.

574. Decision Support Systems (3) Building, testing and evaluating expert systems, computer systems that emulate the 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.

575. Computational Methods for Games, Decisions, and Artificial Intelligence (3) 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. 1.5ES. 1.5ED.


583. Computer Integrated Manufacturing Systems (3) 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) 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) 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. 350, or equivalent.


608. Selected Topics in Reliability (3) In-depth analysis of selected advanced topics in reliability engineering from the recent archival literature. Project required. P. 530, A ME 577.


625. Advanced Queuing Theory (3) Study of complex queuing models of engineering interest. Emphasis on algorithmic methods for the study of such models. P. 525.

631. Digital Systems Simulation (3) Emphasis on current research problems including random variate generation, modeling, language development, and statistical analysis of output. P. 431 or MIS 521a or 521b.

640. Topics of Optimization (3) [Rpt./2] Convexity, optimality conditions, duality, and topics related to the instructor's research interests; e.g., stochastic programming, nonsmooth optimization, interior point methods. P. 544 or 540.

645. Large-Scale Optimization (3) Decomposition-coordination algorithms for large-scale mathematical programming. Methods include generalized Benders decomposition, recourse and price directive methods, subgradient optimization, and descent methods of nondifferentiable optimization. Application of these methods to stochastic programming will be emphasized. P. 544.

646. Integer and Combinatorial Optimization (3) Modeling and solving problems where the decisions form a discrete set. Topics include model development, branch and bound methods, cutting plane methods, relaxations, computational complexity, and solving well-structured problems. P. 544.

654. Model-Based System Design (3) 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. 554.


685. Advanced Topics in Robotics and Automation (3) 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. 585.

686. Advanced Manufacturing System Modeling (3) Current topics in design and analysis of manufacturing systems. Topics include serial processing lines, queueing networks and FMS. Student projects. P. 562 or 586.

695. Colloquium
   a. Doctoral (1-3) [Rpt./2] Consult department before enrolling.
   b. Seminar
g. Interstate Conflict Resolution (3) [Rpt.] (Identical with AREC 69g and HWR 696).

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Teaching and Teacher Education (TTE)

Education Building, Room 802
Phone: (520) 621-1286
FAX: (520) 621-7877
WWW: http://www.ed.arizona.edu/departments/tte/tteinfo.htm

Application Questions:
Carolyn Cormier, (520) 621-7821, ccormier@mail.ed.arizona.edu

Advising Questions:
Willis Horak, (520) 621-1948, WJH4aruba.ccit.arizona.edu

Degrees Offered: M.A., M.T., Ed.D., Ph.D.

Specializations and endorsements for the MA: Environmental education, elementary mathematics education, science education, early childhood education, middle-level education, secondary education, and subject matter concentration.


Associate Professors: Ruth A. Beeker, Evelyn M. Carswell (Emerita), Vivian E. Cox, Vivian F. Dutton (Emerita), Paul E. Heckman, Willis J. Horak, Carol F. Larson, Stanley Pogrow, James R. Rankin, D. Paul Robinson, Janice L. Streitmatter, Violet S. Thomas (Emerita)

Assistant Professors: Carol A. Evans, Maria L. Fernandez, Julie L. Wilson

The department offers programs leading to Master of Arts, Doctor of Education, and Doctor of Philosophy degrees with a major in teaching and teacher education. If also offers the Master of Teaching with majors in elementary education and in secondary education. For information concerning these programs, see chapter IV: Requirements for Master's Degrees, in this Catalog.

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. A master's degree (in education or a related discipline) is a
prerequisite for admission to a doctoral program. Beyond these minimal requirements, applicants must meet the specific admission requirements of the majors.

503. Teacher Leadership and School Change (3) 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) Examination of purposes and functions of middle-level and high schools, investigation of trends, issues, and organization of curriculum and programs.

515. Observation and Supervision of Student and Inservice Teachers (3) Research-based strategies to supervise and critique teaching and Inservice Teachers (3) Research-based Education (3) Critical study and evaluation of instructional practices and procedures. Topics based upon 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, 539 or CR, and 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 combatting 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.

542. Middle-Level Curricular Process (3) Examination of procedures for curriculum instructional development, implementation, improvement, and evaluation at the middle-school level. P, 542.

596. Seminar (3) Research on Teacher Education (3) P, 539, 545, EDUC 500. b. Research on Teaching (3) P, 539, 545 and EDUC 500.

793. Internship (3) a. Classroom Research (3) [Rpt/1] P, EDUC 600 or 601. b. Teacher Education Research (3) [Rpt/1] P, EDUC 600 or 601.

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: Gerry 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, Robert A. Keyword (Emeritus), 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 Dox, Douglas Finlayson, Brent Gibbs, Laura McCammon, Nanalee Raphael, Daniel Yurgaitis

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 major 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.


502. * Combat for the Stage (1) [Rpt./1] 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 in relaxation and focus. Open to majors only.

503. * Musical Theatre II (3) 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. Open to majors only. 2L, 2S, P, 205 and audition.

504. * Musical Theatre III (3) Intensive scene study and exploration of the major historical styles and genres of the American musical theatre. 2R, 2S. Open to majors only. P, 403 and audition.

505. * Theatrical Engineering and Management (3) Advanced studies in technical theatre, theatrical engineering, structures, and motion-control systems for the stage. P, 111.

510. * Methods of Teaching Creative Drama (3) Principles and procedures of improvisation, role-playing, creative playwriting techniques, and program development in creative dramas applicable to the elementary and secondary school levels. P, 12 units of theatre arts and education.

514. * Advanced Make-up (2) [Rpt./2] History and practical application of theatrical make-up. Design and construct such items as masks, prosthetic pieces, wigs, and beards. P, 115.


525. * Costume and Scenic Design II (3) Advanced instruction and practice in theatrical costume and scenic design with an emphasis on rendering. P, 225, 229.


530. * Stage Management (3) Principles and techniques of stage management, practical applications, problems and analysis of stage managing. P, 111, 151.

531. * Audience Development (3) Publicity, press releases, sales, advertising, display techniques, subscription procedures. P, 12 units of theatre arts or related arts fields.

532. * Theatre Management (3) Amateur, educational and professional theatre organization and management; theatrical contracts, professional unions and representative organizations. P, 12 units of theatre arts or related arts fields.

541. Scenography (3) The integration of scenery, costume, make-up, light, and sound into a total production design.

542. * Advanced Stage Lighting II (3) An advanced study of lighting design; theoretical (light plots) and practical (light laboratory) projects. P. 420/520.

545. * Dramaturgy (3) The varied roles of the production dramaturg: script analysis, rehearsal process, research, criticism, outreach, interpretation. Major project and short papers. P, one theatre history or criticism (majors) course; others, consent of instructor.
546. Dance Program Administration (3) (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.


550. Literary Resources for Choreography (3) [Rpt./1] (Identical with DNC 550, which is home).


552. * Acting VII (3) [Rpt./1] Audition material, techniques and research into problems of a professional career in the theatre, television, motion pictures and related fields. 2R, 2S, P, 305, 449, audition.

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/combattant. 2R, 2S, P, 402, audition.

555. * Directing I (3) Basic techniques of stage directing including play analysis, director-actor communication, and technical problems of movement, composition, picturization, and blocking. 2R, 2S, P, open to majors only or by permission of instructor.

556. * Directing II (3) 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, 455.

560a-560b. * Writing for Stage and Screen (3-3) Preparation and analysis of short 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 areas of study in immunology/pathology. The program offers an introduction to the study of the history of theatre and drama; introduction to the bibliography of these fields; organization and form of thesis.

565. Advanced Acting I (3) Techniques of stage directing, including play analysis, director-actor communication, director-designer communication, blocking, movement, composition; use of directorial style and the adaptation of directorial philosophies. 2R, 2S, 251 and audition.

566. Advanced Directing II (3) Techniques of analyzing and staging classical texts for a contemporary audience; use of directorial style and the adaptation of directorial philosophies with an emphasis on directing the plays of Shakespeare. 2R, 2S, P, 449, 655.

600. Introduction to Graduate Study of Drama (3) Methods and materials for research in stage and cinema; introduction to the bibliography of these fields; organization and form of thesis.

605. Advanced Voice and Movement for the Actor I (3) [Rpt./1] Advanced study in voice and movement for the actor: relaxation, breathing, physical and vocal freedom, resonance, articulation and improvisation including the Linklater Approach, I.P.A., and Neutral Mask. 6S, P, 401/501. Students may earn a maximum of 9 units in T AR 696, with a maximum of 6 units in any one area.

655. Advanced Directing I (3) Techniques of stage directing, including play analysis, director-actor communication, director-designer communication, blocking, movement, composition; use of directorial style and the adaptation of directorial philosophies. 2R, 2S, 251 and audition.

666. Advanced Directing II (3) Techniques of analyzing and staging classical texts for a contemporary audience; use of directorial style and the adaptation of directorial philosophies with an emphasis on directing the plays of Shakespeare. 2R, 2S, P, 449, 655.

696. Seminar
a. Contemporary Trends (1-3) [Rpt./6 units] p. Special Topics in Acting (1-3) [Rpt./6 units] c. Special Topics in Directing (1-3) [Rpt./6 units] e. Special Topics in Playwriting (3) [Rpt./6 units] f. Performance (1-3) [Rpt./6 units] g. Special Topics in Stage Costume Construction (1-3) [Rpt./6 units] h. Special Topics in Stage Costume Construction (1-3) [Rpt./6 units] i. Design Style (1-3) [Rpt./6 units] l. Special Topics in Costume Design (2-3) [Rpt./6 units] m. Special Topics in Costume Design (2) [Rpt./6 units] P, 401/501. Students may earn a maximum of 9 units in T AR 696, with a maximum of 6 units in any one area.

Toxicology
(See Pharmacology and Toxicology)

Veterinary Science (VSC)
Pharmacy-Microbiology Building, Room 202
Phone: (520) 621-2355
FAX: (520) 621-6366
WWW: http://ag.arizona.edu/VSC/vschome.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 general 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 or a baccalaureate degree at an institution where English is the medium 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; one or more manuscripts 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. 500a: Nervous, muscular, skeletal, immune, hemolympathic, circulatory, and renal systems. 500b: Respiratory, digestive, endocrine, and reproductive systems. 500a is not a prerequisite to 500b. P, ECOL 181, 182; CHEM 243a; MATH 117R/S.


505. *Animal Diseases (3) Survey of selected diseases of domestic animals Includes disease mechanisms, immunology, and infectious agents; husbandry, management, and nutrition.

512. Biological Electron Microscopy (4) (Identical with MCB 512, which is home).


523. *Mechanisms of Disease (4) General pathophysiology of animal and selected human diseases with emphasis on pathogenesis, pathophysiology, and morphologic changes at the macroscopic, microscopic, and molecular levels. Recitation will stress general mechanisms of disease. Laboratory will reinforce recitation and stress recognition of disease in organs and tissues at the gross and microscopic levels. P, 11L. P, 400a-400b, 459 or CR, MIC 205, MIC 419R or equivalent or consent of instructor. (Identical with MIC 523 and PCL 523).

527. *Insect Chemical Ecology (4) (Identical with ENTO 527, which is home).

529. *General Virology (3) (Identical with MIC 529, which is home).


543. *Research Animal Methods (3) Regulations, care, diseases, and techniques involving common laboratory animals used in research and teaching programs. (Identical with ANS 343, BIOG 343, MCB 343).

549. *Diseases of Wildlife (3) Important diseases of wildlife. Disease mechanisms, infectious agents, diagnostic procedures, and post-mortem techniques as well as a survey of selected but generally well-recognized diseases of wildlife. (Identical with WFSC 549).

550L. Medical Mycology Laboratory (2) (Identical with MBIM 550L, which is home).

550R. Medical Mycology (2) (Identical with MBIM 550R, which is home).

552. *Medical-Veterinary Entomology (4) [Rpt/3] (Identical with ENTO 552, which is home).

554. *Host-Microbial Interactions (3) 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. P, 419 and 420, or consent of instructor. (Identical with MIC 554).

556. *Aquaculture (3) (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. Evolution and gross structure of vertebrate organ systems. A vertebrate anatomy and/or systemsatic course is strongly recommended (Identical with ECOL 559).

565. Shrimp Pathology (3) [Rpt./1] Comprehensive lectures and practical laboratory training on the current methods used to diagnose, prevent, and treat the principal diseases of cultured penaeid shrimp. Field trip. P, B.S., M.S. and/or D.V.M. in biological and/or medically oriented fields.

566. *Physiology Laboratory (3) (Identical with ECOL 566, which is home).

568. *Comparative Physiology (3) (Identical with ECOL 568, which is home).

575. *Parasite Immunology (3) An updated understanding and review of host-parasite interactions with emphasis on host immunological mechanisms operative in the control of parasitic infection. (Identical with MBIM 575, MCB 575, and MIC 575).

612. Biological Electron Microscopy (4) (Identical with MCB 612, which is home).

630. Experimental Methods for Research (4) (Identical with MBIM 630, which is home).

649. Fishery-Water Quality and Toxicology (3) (Identical with WFSC 649, which is home).

660. Infectious Disease Epidemiology (3) [Rpt./1] (Identical with EPI 660, which is home).

695. Colloquium

a. Veterinary Laboratory (1-3) [Rpt./9 units]

696. Seminar

a. Research (1) [Rpt./3]

Water Resources

(See Hydrology and Water Resources)
Assistant Professors: Maria Barbosa (Spanish and Portuguese), Elisabeth Clemens (Sociology), Maureen Fitzgerald (History), Kathleen Frank (College of Law), Suzanne Hegedorn (English), Nancy Rose Hunt (History), Katherine Morrissey (History), Amy Newhall (Near Eastern Studies), Ana Ortiz (Anthropology), Jane Rice (German Studies), Beverly Seckinger (Media Arts), Yvonne Zylan (Sociology)

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.

Academic option: Students following this option must complete 12 units of required courses. 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 complete an oral examination evaluating the student's understanding of the theoretical and empirical dimensions of feminist scholarship. Students following the academic option must, in consultation with their advisor, write an extended research paper of 30-50 pages. Students 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.

Special Topics in Women's Studies (3) [Rpt/1] Topics will vary.

Gender and Language in Japan (3) (Identical with JPN 502, which is home).

Theoretical Issues in the Study of Women and Religion (3) (Identical with RELI 525, which is home).

Lesbian/Bisexual Women's Theories/Lives/Activisms (3) Exploration of the relationships between lesbian and bisexual women's lives and activisms, and the theoretical understandings which concurrently arise out of and construct those lives and activisms. P, 3 units of women's studies, preferably 305, or consent of instructor.

Feminist Political Theory (3) (Identical with POL 533, which is home).

History of Feminist Theory (3) 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.

Engendering the Past (3) (Identical with ANTH 540, which is home).

Women and the Body (3) 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 in women's studies.

Women in Islamic History (3) (Identical with HIST 545, which is home).

Health and the Global Economy (3) (Identical with GEOG 546, which is home).

Modern Theories of Cultural Studies (3) (Identical with CCSL 550, which is home).

Contemporary Feminist Theories (3) 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 will be enabled to read, synthesize and critique across the spectrum of feminist theorizing. P, consult the committee before enrolling. (Identical with ENGL 554)

History of Women in Europe (3) (Identical with HIST 555, which is home).

Gender Identities and Interactions (3) (Identical with SOC 558, which is home).

Sociology of Gender and the State (3) (Identical with SOC 559, which is home).

Feminist and IR Theories (3) (Identical with POL 561, which is home).

Women in American Architecture (3) (Identical with ARCH 564, which is home).

Counseling Women (3) (Identical with FS 571, which is home).
581. *Work, Motherhood and Female Identity in America: 1945 to the Present (3) History of women in the U.S. since 1945. Will explore a variety of topics including employment, sexuality, motherhood, abortion, reproductive technologies, and feminism, and explore how changes in these areas have affected diverse groups of women. Prior course work in women's studies or history helpful. P, two women's studies courses or one women's history course (Identical with HIST 581).

583. *Gender and African History (3)
(Identical with HIST 583, which is home).

584. Feminist Research Methodologies (3)
Considers some epistemological assumptions underlying research and theoretical projects of traditional disciplines; explores feminist adaptations and critiques of these assumptions.

585. *Mexicana/Chicana Women’s History (3)
(Identical with MAS 585, which is home).

586. Gender, Difference, and Power (3)
Focuses on gender as it has intersected in varied ways with other cultural distinctions of difference based on class, race, sexual identity, and religion.

596. Seminar
5. *Women and the Literature of Identity in Modern Middle East and North Africa (3)
(Identical with NES 596c, which is home).

r. Research in Women's Studies (3) [Rpt./1]
P, consent of instructor.

w. *Women's Studies (3) [Rpt./2] (Identical with ENGL 596w).

606. Women’s Health in the United States (3)
(Identical with ANTH 606, which is home).

695. Colloquium
b. Feminist Jurisprudence (2) (Identical with Law 695b, which is home).

e. Advanced Studies in the History of Women (3) [Rpt./5] (Identical with HIST 695e).

696. Seminar
n. Comparative Women's History (3) [Rpt./4]
P, consult committee before enrolling.
(Identical with HIST 696n, which is home.)
University Libraries, Research Units and Public Service Units

The University Library

The University Library system contains almost 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 and the Reserve Book Room, 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 Folklore 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

Houses 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 for all customers with email access 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

Houses all the library's non-book materials except microforms and music tapes and records. The Film Department was added in 1988.

Newspapers and Microforms Collection

A depository for federal government maps, houses a fully cataloged collection of nearly 300,000 maps on every subject.

Special Collections

Houses the library's collections of Arizonaiana and Southwestern Americana, special subject collections, rare books, fine printing, manuscripts, and The University of Arizona archives.
Science-Engineering Library
Houses all materials on science and technology; has more than 500,000 volumes, 1,500,000 microforms, and displays current issues of its 4,000-plus periodicals.

Music Library
Maintains the library's collection of approximately 30,000 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 collection 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
Houses musical tapes and manuscript archives of Southwest music and folklore.

Oriental Studies Collection
Houses materials in the Chinese, Japanese, Arabic, Persian, Turkish and other oriental languages, has over 160,000 items.

Architecture Library
Houses a collection with emphasis on the topics of design, architectural history and theory, building technology, desert architecture, and design communications. Includes over 10,000 monograph titles and 300 serial titles.

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, which serves the University Hospital as well as the colleges of Medicine, Nursing and Pharmacy, contains almost 190,000 volumes and receives approximately 3,000 serial titles. The collection includes books, journals, and non-print materials in the health sciences.

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, also are available to serve special research needs.

Research and Public Service Units
The following divisions are a part of, or are affiliated with, the University. Additional information regarding their organization and services may be obtained upon inquiry to the director concerned.

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, scleroderma, inflammatory muscle 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 prosthesis 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 pre-neoplastic 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) development of multidisciplinary education and clinical training programs regarding the elderly that involve University faculty, allied health professionals, scientists, and health administrators. 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.
  3. The AEMRC participates in the M.P.A. and M.P.H. programs at The University of Arizona. Emergency Health Services Information 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, physiology, 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, 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 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; Micrcoroulation 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. It 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; zoos; and 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.

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) (1985) 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 work in high-speed interconnect systems is being extended to on-chip interconnects. Faculty members from Electrical and Computer Engineering and Aerospace and Mechanical Engineering are currently contributing to CEPR projects. The long-term goal of the Center for Electronic Packaging Research is to develop an integrated package and Multichip Module (MCM) design/simulation/manufacturing system. This system will permit tradeoffs between performance, cost, reliability, and manufacturability to be performed in the design phase. The simulation capability will assure first-pass achievement of packaging requirements, rather than require successive iterations. The CEPR is committed to expeditious transfer of basic research results to research sponsors, the electronic packaging community, and the U.S. industry community through reports, publications, workshops, education of students, and cooperative efforts which involve member industry personnel as both researchers and mentors.

The Center for Insect Science (1989) of the Arizona Research Laboratories is a multicumulus, 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 fifteen 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 and 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 healthcare 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 (SWEPHSC) 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 SWEPHSC 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 Neurological Sciences, Memory and Aging (1980) 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 an interdisciplinary research unit devoted to the 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 (1968) was established within the College of Medicine in recognition of the increasingly complicated cultural, social, economic, legal, and ethical influences affecting the institution of medicine in American society. The efforts of this Division focus on expanding and exciting the thinking of medical students and faculty in the area of human values and the role of medicine in contemporary society. The activities of the Division include symposia, seminars, and workshops on such topics as cultural and economic factors in health and disease, ethical issues in medicine, medical jurisprudence, health needs of the elderly, care for the terminally ill, holistic medicine, innovations in medical education, and other current issues. Local and national authorities are invited to participate in these programs from such fields as psychology, law, politics, sociology, anthropology, economics, theology, philosophy, and medicine.

The Engineering Experiment Station (1941) administers the funds of sponsored grants and contracts of the faculty of the College of Engineering and Mines. Using state-appropriated funds, the Station promotes, initiates, and conducts engineering research of potential benefit to the State of Arizona.

The Environmental Research Laboratory (ERL) (1967) conducts research in controlled-environment agriculture (CEA) warm water aquaculture, in sea water crop irrigation, biospherics, environmental control
systems, water quality, and solar heating and cooling. ERL has designed CEA vegetable systems which produce crops in the desert sands of the United States, Mexico, and the Middle East, and it has 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, a private venture of Space Biosphere Ventures, and in global studies of the greenhouse effect.

Flandrau 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. Flandrau. It houses a 50-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 and 25,000 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 undertake research in basic market processes, (2) to promote 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.

KUAZ 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: KUAZ-TV Channel 6; KUAZ-TV Channel 27 (in the Catalina Foothills) and TV Translator K23CK, Duncan, Arizona; KUAZ-AM (1550 kHz); KUAZ-FM (89.1 MHz); and KUAZ-FM (90.5 MHz) with Translator Frequencies, 89.7 MHz in northwest 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: preproduction 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 Ellcott 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 paleocological 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, curriculum 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 internships 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 uncommonly 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 spec-

rometry 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 are 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, and conduct a regular program of planetary, solar, and stellar infrared spectroscopy using the NASA Kuiper Airborne Observatory. The University is continuing to develop a new observatory site on Mt. Graham, northeast of Tucson. The laboratory participates in interdepartmental programs in theoretical astrophysics and in applied mathematics. The laboratory is housed in the Gerard P. Kuiper Space Sciences Building, with additional facilities in the Gould-Simpson Building.

The Mexican American Studies and Research Center (1983) engages in research, publication, public service, and undergraduate and graduate educational activities which enhance the study of the Mexican American experience and related issues. Major objectives of interdisciplinary research and publication include such areas as expressive culture, adaptations of the Mexican-born into U.S. society, educational practices and policies, minority entrepreneurship, and health care behavior and intervention strategies. Special research and service projects are provided through university funds and outside support. Funds of sponsored grants support training of students in a variety of disciplines. The Center disseminates information of concern to the Hispanic community, sponsors lectures and forums and provides assistance to and linkage with the University and the greater Mexican American community, as well as regional, national and international private and public sectors.

The Mineral Museum (1902) is operated by the Department of Geosciences, and housed in the lower level of the Flandrau Science Center. The Museum has more than 13,000 mineral specimens representing more than 1,000 different mineral species. On display is a wide collection of material from around the world, including meteorites, cut gemstones, and mining artifacts from Arizona's past. The Museum operates a series of education programs for both university students and the community at large. The Mineral Museum is open to the public whenever Flandrau Science Center is open.

The National Center for Interpretation Testing, Research, and Policy (1993), is an active research and public service unit whose main mission is to explore from a scholarly, theoretical, and applied perspective the area of interlingual, intercultural communication in a variety of settings: judicial, quasi-judicial, medical, law enforcement, social service, global economic (NAFTA), technical/scientific, mental health, and other public service delivery fields from commercial to private, non-profit enterprises. Its main function is to advance knowledge and to solve real-world interpretation and language service delivery problems for the ever-increasing limited- and non-English speakers in our state, the nation, and in any situation in which interlingual communication occurs. The foci of the Center include: (1) exploring the phenomenon of interpretation through a multidisciplinary approach; (2) assisting agencies in the development of valid language policies (legislative or internal) to meet the needs of limited- and non-English speaking clients; (3) providing services to a variety of users creating valid and reliable bilingual and interpreter testing and training programs; (4) functioning as a clearinghouse for interpretation testing, research, and policy in legal and quasi-legal, medical, mental health, and international trade language service areas; (5) creating an outlet for publications and reference works in the discipline; (6) expanding opportunities for undergraduate and graduate students in direct research activities; and (7) providing faculty a forum for research and teaching.

The Office of Arid Land Studies (1964), administratively located within the College of Agriculture, is active in international studies, natural resources development and management, environmental studies, economic botany, new crop development, water and energy conservation, farming systems research, information services, remote sensing, geographic information systems, publications, and education. Activities are conducted within the framework of the arid environment. The Office provides interdisciplinary project management and works closely with local and campus communities as well as with local, state, federal, and international government agencies.
The Optical Sciences Center (1967) is a graduate center for research in experimental and theoretical optics. 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, optical computing components, diffractive and binary optics, novel optical materials, adaptive optics, nonlinear optics, optical trapping and cooling of atoms, semiconductor and solid state laser physics. Interdisciplinary programs in progress involve Materials Science and Engineering, Mathematics, Astronomy, Chemistry, Electrical and Computer Engineering, Ophthalmology, Physics, Radiology, the Steward Observatory, 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 ultrafast femosecond lasers, a thin film deposition laboratory and a multitude of networked computing facilities.

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.

Science and Mathematics Education Center (1994), located in the Gerard P. Kuiper Space Sciences Building, is the coordinating body for The University of Arizona's campus-wide initiative in support of pre-college science and mathematics education. The Center's role in the science and mathematics education community is to: (1) serve as a liaison between University of Arizona colleges, community schools, and the private sector; (2) facilitate sponsored projects at The University of Arizona by forming innovative alliances, building on experience, and providing information on funding sources; (3) coordinate efforts in both pre-service and in-service teacher preparation at The University of Arizona; (4) advise The University of Arizona Admissions Office and the Arizona Board of Regents on admissions requirements for high-school science and mathematics preparation; (5) evaluate faculty engaged in scholarly work in science and mathematics education through the Center's Science Education Promotion and Tenure Committee; and (6) prepare and disseminate information on The University of Arizona's outreach programs in science and mathematics.

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,
various forms of support for contract-

instructional improvement. SRC provides
who require wordprocessing support;

and their graduate students who are
(SRC). DASL provides support for faculty
units, the Data and Software Laboratory
of study. SBSRI contains two smaller
initiatives to promote work in new areas
The Institute encourages both disciplinary
write small projects designed to involve
addition, funds are available to under-

lead to externally- funded research. In
support for faculty members and aca-
within the College of Social and Behav-
Research Institute (1984)
complimented as exemplary in its
University of Arizona's Center has been
contamination/defect reduction. The
limiting yield, and to prioritize efforts in
defects and the role of specific defects
materials, (3) to understand and develop
tools to generate and study specific defects originating from process equip-
ment, such as oxidation, deposition, dry
tch (plasma, RJE, etc.) and ion implanta-
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's Center has been
complemented 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 Behav-
ioral Sciences. Through a series of regular
competitions, the Institute provides
support for faculty members and aca-
demic professionals undertaking pilot
projects or small-scale studies likely to
lead to externally-funded research. In
addition, funds are available to under-
write small projects designed to involve
undergraduates in the research process.
The Institute encourages both disciplinary
and interdisciplinary 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 wordprocessing 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.

SBRSI also interfaces with other research
units, including the Southwest Center.

Annually, the Institute sponsors a
competition for the best research
monograph and the best research 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 Behav-
ioral 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 interdis-
ciplinary 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 Research 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.

Steele Memorial Children's Re-
search Center (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 nutri-
tion, behavioral sciences, and develop-
mental biology. The Center's research
programs are closely tied to the educa-
tional 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.

Steele 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 the
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 major 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 (1985), 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-m 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 region, 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 the next generation of giant optical/infrared telescopes. The observatory activities are closely integrated with the

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 sponsors 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 facility 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.

University 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 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 University 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 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, 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 233, 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 RF screenroom/cleanroom available for use. The Welding, Machining, and Metal Stockroom Facilities are located in the Gould-Simpson Building, Room 235, and the machine 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 Arizona's 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 opportunity for study and research for faculty and qualified graduate students. Several of these are located on the University campus, and certain staff members of some of these organizations also hold University staff appointments.

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.

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 at 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 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.

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 University 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 southern California, offices are maintained in both geographic areas.

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 southern California office. The campus Office, headquarters for all alumni activities, houses computerized record files on more than 348,000 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 46 cities throughout the United States and Mexico, 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, video tapes, and films 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.

Awards and Recognition—Each year alumni are honored for outstanding service to the University and/or for outstanding personal achievement.

Publications—The Alumni Office publishes the Arizona Alumnus, the official publication of the Alumni Association. Published two 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 also produces a monthly television show.
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. The foundation is governed by a 33-member volunteer board of directors.

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 1996-97

Officers

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C. Donald Hatfield - Vice Chair and Chair Elect
Kathryn L. Munro - Treasurer
Harold W. Ashton - Secretary
Richard F. Imwalle - President
Gary N. Scrivner - Vice President, Finance and Administration
S. James Manilla - Vice President, Development Operations
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Dee Simpson
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Cherie Walden
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Melvin Zuckerman
Accreditations, Memberships, Administration, and Faculty

Accreditations
Accreditation Board for Engineering and Technology; American Assembly of Collegiate Schools of Business; American Association for Accreditation of Laboratory Animal Care; American Association of Museums; American Chemical Society; American Council on Pharmaceutical Education; American Dietetic Association; American Library Association; American Planning Association; American Psychological Association (graduate program in clinical psychology and graduate program for school psychologists); American Speech-Language-Hearing Association; Association of American Law Schools and American Bar Association; Commission on Rehabilitation Education; Council on Education in Journalism and Mass Communications; Council on Rehabilitation Education; Liaison Committee on Medical Education of the American Medical Association and the Association of American Medical Colleges; National Architectural Accrediting Board; National Association of Schools of Dance; National Association of Schools of Music; National Association of Schools of Public Affairs and Administration; National Association of Schools of Theatre; National Council for Accreditation of Teacher Education; National League for Nursing; North Central Association of Colleges and Schools.

Memberships
Accrediting Council on Education in Journalism and Mass Communication; American Anthropological Association; American Association for Higher Education; American Association for Laboratory Animal Sciences; American Association of Colleges for Teacher Education; American Association of Colleges of Nursing; American Association of University Women; American College Dance Festival Association; American College Theatre Festival Association; American Council of Learned Societies; American Council on Education; American Home Economics Association; American Institute for Iranian Studies; American Institute for Yemeni Studies; American Newspaper Publishers Association; American Political Science Association; American Psychological Association; American Research Center in Egypt; American Research Center in Turkey; American Society for Engineering Education; American Society for Public Administration; American Statistical Association; Argonne Universities Association; Associated Western Universities; Association for Communication Administration; Association for Gerontology in Higher Education; Association for Public Policy and Management; Association for Theatre in Higher Education; Association for University Business and Economic Research; Association of Academic Health Centers; Association of American Colleges; Association of American Geographers; Association of American Medical Colleges; Association of American State Geologists; Association of American University Presses; Association of Collegiate Schools of Architecture; Association of Collegiate Schools of Planning; Association of Research Libraries; Association of Systematics Collections; Association of Universities for Research in Astronomy; Association of University Summer Sessions; Border State Universities Consortium for Latin America; Broadcaster Education Association; Center for Arabic Study Abroad; College Art Association of America; College Entrance Examination Board; Consortium of Western Universities and Colleges; Council for Advancement and Support of Education; Council of Graduate Schools in the United States; Council of United States Universities for Soil and Water Development in Arid and Subhumid Areas; EDUCOM, Interuniversity Communications Council; Inter-University Consortium for Political and Social Research; Eisenhower Consortium; Graduate Management Admissions Council; Institute of International Education; International Museum of
Photography; Latin American Scholarship Program of American Universities; Middle East Studies Association; Mid-America College Art Association; Midwestern Association of Graduate Schools; National Association for Bilingual Education; National Association for Chicano Scholars; National Association of Colleges and Teachers of Agriculture; National Association of College and University Attorneys; National Association of Schools of Art and Design; National Association of State Universities and Land Grant Colleges; National Consortium for Black Professional Development; National Public Radio; National University Continuing Education Association; North American Association of Summer Sessions; Pacific Mountain Network; Public Broadcasting Service; Rocky Mountain Science Council; Society of Architectural Historians; Speech Communication Association; Travel Research Association; United States Institute for Theatre Technology; Universities Council on Water Resources; Universities Research Association; University Corporation for Atmospheric Research; University Film Association; University Resident Theatre Association; University Space Research Association; Western Association of Collegiate Schools of Business; Western Association of Graduate Schools; Western College Association; Western Interstate Commission for Higher Education (WICHE); Western Institute of Nursing.

Arizona Board of Regents

Ex Officio

Fife Symington
Governor of Arizona

Lisa Graham Keegan
State Superintendent of Public Instruction

Appointed

Johnathan Schmitt
June 1997

Art Chapa, J.D.
January 1998

Eddie Basha
January 1998

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

(Date shown is term expiration date)

Administrative Officers

The 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.

(Years of first University appointment in parentheses after each name)

Manuel T. Pacheco (1991) President of the University; Ph.D., 1969, Ohio State University

Henry Koffler (1982) President Emeritus; Ph.D., 1947, University of Wisconsin

John Paul Schafer (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

Celestino Fernandez (1976) Executive Vice President and Provost, Arizona International Campus; Ph.D., 1976, Stanford University

James E. Dalen (1988) Vice President, Health Sciences; M.D., 1961, University of Washington

Michael A. Cusanovich (1969) Vice President, Research and Graduate Studies; Ph.D., 1967, University of California at San Diego

Michael R. Gottfredson (1985) Vice President, Undergraduate Education; Ph.D., 1976, State University of New York at Albany

Eugene G. Sander (1987) Vice Provost, Agriculture; Ph.D., 1965, Cornell University

Ernest T. Smerdon (1988) Vice Provost, Engineering and Mines; Ph.D., 1959, University of Missouri

Holly Martin Smith (1983) Vice Provost, Liberal Arts; Ph.D., 1972, University of Michigan

Sandahl I. Taylor (1992) Vice President, Student Life and Human Resources; Ph.D., 1969, Ohio University

Amelia A. Tynan (1990) Vice Provost, University Information and Technology; M.S., 1974, University of the Philippines

Adela A. Allen (1968) Associate Vice President, Latin American Relations; Ph.D., 1974, The University of Arizona

Janet E. Bingham (1989) Assistant Vice President, Health Sciences Public Affairs; Ph.D., 1977, The University of Arizona

J. Gregory Fahey (1984) Associate Vice President, State Relations; M.A., 1971, Princeton University

Charles A. Geoffrion (1987) Associate Vice President, Research; M.A., 1965, Boston University


Julius Parker (1989) Associate Vice President, Business Affairs; M.P.A., 1973, Shippensburg State University


Susan M. Steele (1976) Associate Vice President, Undergraduate Education; Ph.D., 1973, University of California at San Diego

Graduate College Officers

Michael A. Cusanovich (1969) Vice President, Research and Graduate Studies; Ph.D., 1967, University of California at San Diego

Thomas J. Hixon (1976) Dean of the Graduate College; Ph.D., 1965, University of Iowa

Adela A. Allen (1968) Associate Dean of The Graduate College; Ph.D., 1974, The University of Arizona

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

James E. Dalen (1988), Dean, Medicine; M.D., 1961, University of Washington

Richard A. Eribes (1997), Dean, Architecture; Ph.D., 1977, University of Southern California

Randall H. Groth (1991), Dean, Sierra Vista Campus; Ph.D., 1990, The University of Arizona

Thomas J. Hixon (1976), Dean, Graduate College; Ph.D., 1965, University of Iowa

Eugene H. Levy (1975), Dean, Science; Ph.D., 1971, University of Chicago

Anita D. McDonald (1984), Dean, Extended University and Summer Session; Ph.D., 1983, St. Louis University

Eugene Sander G. (1987), Dean, Agriculture; Ph.D., 1965, Cornell University

Joel Seligman (1995), Dean, Law; J.D., 1974, Harvard University

Maurice J. Sevigny (1991), Dean, Fine Arts; Ph.D., 1977, Ohio State University
Graduate Council

The Graduate Council consists of members 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
Shrin D. Antia, Associate Professor, Special Education and Rehabilitation
Kandy L. Bassett, Professor, Hydrology and Water Resources
David B. Buller, Professor, Communication
Chuan F. Chen, Professor, Aerospace and Mechanical Engineering
Jerry R. Dickey, Associate Professor, Theatre Arts
Edgar A. Dryden, Professor, English
Rose M. Gerber, Associate Professor, Nursing
Thomas J. Hixon, Dean of The Graduate College
Willis J. Horak, Associate Professor, Teaching and Teacher Education
William B. Hubbard, Professor, Planetary Sciences
Christina K. Kennedy, Professor, Plant Pathology
Brian A. Larkins, Professor, Plant Sciences
Noel Matkin, Professor, Speech and Hearing Sciences
Fred S. Matter, Professor, Architecture
Jeanne M. McCarthy, Professor, Special Education and Rehabilitation
Linda D. Mendenhall, Professor, Sociology
David F. O'Brien, Professor, Chemistry
Sudha Ram, Professor, Management Information Systems
Jocelyn S. Reiter, Professor, Music
Jerry W. Rozenblit, Assistant Professor, Electrical and Computer Engineering
Richard L. Shoemaker, Professor, Optical Sciences
Michael A. Shupe, Professor, Physics
Karen L. Smith, Associate Professor, Spanish and Portuguese
Barbara Timmermann, Professor, Pharmacology and Toxicology
Joseph T. Tolliver, Associate Professor, Philosophy

Maria Teresa Velez, Associate Dean of the Graduate College
Mary A. Willie, Assistant Professor, Linguistics

Regents' Professors

Angel, J. Roger P. (1973) Regents' Professor; Ph.D., 1967, Oxford University
Annas, Jule E. (1986-90, 1992) Regents' Professor; Ph.D., 1972, Harvard University
Arnett, W. David (1988) Regents' Professor; Ph.D., 1965, Yale University
Babcock, Barbara A. (1980) Regents' Professor; Ph.D., 1975, University of Chicago
Baker, Victor R. (1981) Regents' Professor; Ph.D., 1971, University of Colorado
Barrett, Harrison H. (1974) Regents' Professor; Ph.D., 1968, Harvard University
Canfield, J. Douglas (1974) Regents' Professor; Ph.D., 1969, University of Florida at Gainesville
Desai, Chandrakant (1981) Regents' Professor; Ph.D., 1968, University of Texas
Dickinson, Robert E. (1990) Regents' Professor; Ph.D., 1966, Massachusetts Institute of Technology
Dobbs, Dan B. (1977) Regents' Professor; L.L.M., 1961, University of Illinois
Goodman, Yetta M. (1975) Regents' Professor; Ph.D., 1967, Wayne State University
Hauspler, Mark R. (1971) Regents' Professor; Ph.D., 1968, University of California at Riverside
Haynes, C. Vance (1974) Regents' Professor; Ph.D., 1965, The University of Arizona
Hildebrand, John G. (1985) Regents' Professor; Ph.D., 1969, Rockefeller University
Hill, Jane H. (1983) Regents' Professor; Ph.D., 1966, University of California at Los Angeles
Hirschi, Travis W. (1981) Regents' Professor; Ph.D., 1968, University of California at Berkeley
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
Hunten, D. M. (1977) Regents' Professor; Ph.D., 1950, McGill University
Kay, Margaret E. (1993) Regents' Professor; M.D., 1974, University of California at San Francisco
Kidwell, Margaret G. (1985) Regents' Professor; Ph.D., 1973, Brown University
Kingery, William D. (1988) Regents' Professor; Ph.D., 1950, Massachusetts Institute of Technology
Lamb, J. Willis (1974) Regents' Professor; L.H.D., 1965, Yale University
Law, John H. (1981) Regents' Professor; Ph.D., 1957, University of Illinois
Momaday, Navarre Scott (1981) Regents' Professor; Ph.D., 1963, Stanford University
Nunamaker Jr., Jay F. (1974) Regents' Professor; Ph.D., 1969, Case Western Reserve University
Oberman, Heiko A. (1984) Regents' Professor; Th.D., 1957, University of Utrecht
Salmon, Sydney E. (1972) Regents' Professor; M.D., 1962, Washington University
Smith, Vernon L. (1975) Regents' Professor; Ph.D., 1953, Harvard University
Strittmatter, Peter A. (1971) Regents' Professor; Ph.D., 1966, St. John's College
Stuart, Douglas G. (1967) Regents' Professor; Ph.D., 1961, University of California at Los Angeles
Bernays, Elizabeth A. (1989-96) Regents' Professor Emerita; Ph.D., 1970, University of London
Grisswold, Ralph E. (1971-95) Regents' Professor Emeritus; Ph.D., 1962, Stanford University
Sonett, Charles P. (1973-92) Regents' Professor Emeritus; Ph.D., 1954, University of California at Los Angeles
Wais, James R. (1980-89) Regents' Professor Emeritus; Ph.D., 1951, University of Toronto
Colescott, Robert H. (1985-95) Regents' Professor Emeritus, Art; M.A., 1952, University of California
Feinberg, Joel (1979-97) Regents' Professor Emeritus, Philosophy; Ph.D., 1957, University of Michigan
Low, Frank J. (1962-96) Regents' Research Professor Emeritus; Ph.D., 1959, Rice University

Faculty of the University

Faculty of the University (Denotes members of the Committee on Graduate Study)

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Abrams, Herbert K. (1968-83), Professor Emeritus; M.D., 1947, Johns Hopkins University
Adam, Rodney D. (1988), Associate Professor; Medicine; Associate Professor; Microbiology and Immunology; M.D., 1981, University of Illinois
Adamcin, Julie C. (1970), Agent; University of Arizona
Adamec, Ludwig Warran (1967), Professor, Near Eastern Studies; Ph.D., 1966, University of California at Los Angeles
Adamowicz, Ludwik (1987), Associate Professor; Chemistry; Ph.D., 1977, Polish Academy of Sciences
Adams, Alison E. (1990), Associate Professor, Molecular and Cellular Biology; Ph.D., 1984, University of Michigan
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Adams, H. Douglas (1987), Associate Professor, English; Ph.D., 1980, Georgetown University
Adickes, H. Wayne (1993), Assistant Professor, Chemistry; Senior Staff Scientist; Ph.D., 1968, Texas Christian University
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Ahmed, Nafees (1994), Assistant Professor, Medicine; M.D., 1984, Aligarh Muslim University
Alcorn, Stanley M. (1963-89), Professor, Accounting; Ph.D., 1983, Columbia University
Allen, Janice R. (1992), Lecturer, Nursing; M.A., 1987, New York University
Allen Jr., Rupert C. (1976), Professor, Philosophy; Ph.D., 1974, University of Virginia
Allen, Ronald E. (1980), Professor, Animal Sciences; Ph.D., 1976, Iowa State University
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Alonso, Ana M. (1991), Associate Professor, Anthropology; Ph.D., 1998, University of Chicago
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Alvarado, Elizabeth C. (1996), Lecturer, English; M.F.A., 1989
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Amobi, Olufunmilayo A. (1996), Assistant Professor, Teaching and Teacher Education; Program Coordinator; Ed.D., 1986, Arizona State University
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Anderson, Waldo K. (1966-86), Professor Emeritus; Art; Ph.D., 1963, University of Minnesota
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Annas, Julia E. (1986-90; 1992), Regents' Professor; Professor, Philosophy; Ph.D., 1972, Harvard University
Anthony, James R. (1952-88), Professor Emeritus; Master's Diploma, 1951, Sorbonne, Universite De Paris
Antia, Shirin D. (1980), Associate Head, Special Education and Rehabilitation; Associate Professor, Special Education and Rehabilitation; Ph.D., 1979, University of Pittsburgh
Ankerman, Paul G. (1992), Assistant Professor, Animal Sciences; Assistant Professor, Cell Biology and Anatomy; Ph.D., 1982, University of Pennsylvania
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Arada, Francisco A. (1993), Assistant Professor, Surgery; M.D., 1983, University of Pennsylvania
Arabyan, Ara (1986), Associate Professor, Aerospace and Mechanical Engineering; Ph.D., 1986, University of Southern California
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Ariew, Robert A. (1987), Head, French and Italian; Professor, French and Italian; Ph.D., 1974, University of Illinois
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Armstrong, Neil R. (1978), Professor, Chemistry; Joint Appointment as Professor of Optical Sciences; Ph.D., 1974, University of New Mexico
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Becker, Stewart (1947-67), Professor Emeritus, Electrical Engineering; Ph.D., 1954, Agricultural and Mechanical College of Texas
Bedford, Felice L. (1988), Associate Professor, Psychology; Ph.D., 1988, University of Pennsylvania
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Bellamy, William T. (1991), Assistant Professor, Pathology; Joint Appointment as Research Assistant Professor of Medicine, Adjunct Assistant Professor, Pharmacology and Toxicology; Investigator, Center for Toxicology; Ph.D., 1988, The University of Arizona
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Bernstein, Alan E. (1982), Professor, History; Ph.D., 1972, Columbia University
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Bottacini, Manfred (1958-81), Professor Emeritus, Mathematics; Ph.D., 1958, State University of Iowa
'Bourque, Don P. (1973), Professor, Biochemistry; Professor, Molecular and Cellular Biology; Ph.D., 1969, Duke University
'Bowden, George T. (1978), Professor Emeritus, Biology; Ph.D., 1972, University of California at Berkeley
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Bradley, Gregory A. (1991), Associate Professor, Research Scientist, Veterinary Science; D.V.M., 1981, Colorado State University
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Bradley, Lucy K. (1994), Assistant Agent, Agriculture and Natural Resources, M.S., 1984, Purdue University
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'Brainerd, Charles J. (1987), Professor, Educational Psychology; Ph.D., 1970, Michigan State University
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Brendel, Klaus (1970-96), Professor Emeritus, Ph.D., 1962, Free University of Berlin
Bressler, Rubin (1970), Professor, Medicine; Joint Appointment as Professor of Pharmacology; M.D., 1957, Duke University
Brettal, Eleanor V. (1962-75), Professor Emerita, Nursing; M.S., 1964, University of Washington
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Briggs, Maurice M. (1967-77), Professor Emeritus, Finance, Insurance, and Real Estate; J.D., 1933, University of Illinois
Brillhart, John David (1967), Professor, Mathematics; Ph.D., 1967, University of California at Berkeley
Brio, Moysey (1986), Associate Professor, Mathematics; Ph.D., 1984, University of California at Los Angeles
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Bronstein, Judith (1989), Associate Professor, Ecology and Evolutionary Biology; Ph.D., 1986, University of Michigan
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Brosota, Bruno (1994), Assistant Professor, Economics; Ph.D., 1994, University of California at San Diego
Brosin, Henry W. (1970-95), Professor Emeritus, Psychiatric; M.D., 1933, University of Wisconsin
Broder, Robert Paul (1969-87), Professor Emeritus, History; M.A., 1949, Harvard University
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Brown, Michael F. (1988), Professor, Chemistry; Joint Appointment as Professor of Biochemistry; Ph.D., 1973, University of California at Santa Cruz
Brown, Robert H. (1990), Professor, Planetary Sciences; Professor, Lunar and Planetary Laboratory; Professor, Astronomy; Ph.D., 1982, University of Hawaii
Brown, William H. (1959-94), Professor Emeritus, Animal Sciences; Ph.D., 1959, University of Maryland
Bruning, Samuel R. (1959-71), Professor Emeritus, Systems Engineering; M.S., 1960, The University of Arizona
Buckalter, George A. (1967-89), Associate Professor Emeritus; History; Ph.D., 1960, University of Texas
'Brucks, Merrie L. (1989), Associate Professor, Marketing; Ph.D., 1984, Carnegie Mellon University
Brussel, Mark L. (1989), Associate Professor, Soil and Water Science; Joint Appointment as Associate Professor Emeritus, Hydrology and Water Resources; Investigator, Center for Toxicology; Ph.D., 1989, University of Florida
Bus-Saba, Wald Y. (1995), Assistant Professor, Finance; Ph.D., 1995, Boston College
Buchheuser, Andrew W. (1938-76), Professor Emeritus, Music; M.M., 1938, The University of Arizona
Budhu, Muniram (1988), Professor, Civil Engineering; Ph.D., 1979, Cambridge University
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Bull, William B. (1968), Professor, Geosciences; Ph.D., 1960, Stanford University
Buller, David B. (1986), Professor, Communication; Ph.D., 1984, Michigan State University
Bunis, William K. (1996), Lecturer, Sociology; Ph.D., 1993, The University of Arizona
Buras, Nathan (1981), Professor, Hydrology and Water Resources; Ph.D., 1962, University of California at Los Angeles
Burd, Gail D. (1985), Associate Professor, Cell Biology and Anatomy; Joint Appointment as Associate Professor of Molecular and Cellular Biology; Associate Professor, International Studies; Ph.D., 1979, University of North Carolina
Burgoon, Herbert M. (1984), Professor, Communication; Joint Appointment as Professor of Family and Community Medicine; Ph.D., 1970, Michigan State University
Burgoon, Judee K. (1984), Professor, Communication; Ed.D., 1974, West Virginia University
Burke, James Joseph (1967-96; 1996), Professor Emeritus, Ph.D., 1972, The University of Arizona
Burke, Michael F. (1967), Associate Professor, Chemistry; Optical Sciences; Ph.D., 1966, Virginia Polytechnic Institute and State University
Burke, Patrick M. (1994), Associate Professor, Psychiatry; Ph.D., 1975, Brown University
Burke, Terence (1982), Associate To The President; Professor, Geography; Ph.D., 1967, University of Birmingham
Burkhard, Ford N. (1976-96), Associate Professor Emeritus, Journalism; Ph.D., 1990, Arizona State University
Burns, Robert A. (1991), Associate Professor, Classics; Ph.D., 1971, University of Iowa
Burns, Robert C. (1947-86), Professor Emeritus, Drama; M.A., 1947, State University of Iowa
Burrows, Adam S. (1986), Professor, Physics; Joint Appointment As Associate Professor of Astronomy; Associate Professor In The Arizona Research Laboratories; Ph.D., 1979, Massachusetts Institute of Technology
Burrows, Benjamin (1968), Professor Emeritus, Medicine; M.D., 1949, Johns Hopkins University
Burt, Janis M. (1985), Associate Professor, Physiology; Joint Appointment As Research Associate Professor of Surgery; Ph.D., 1980, University of California at Irvine
Busch, Frank (1989), Head Coach, Swimming; B.S., 1973, Loyola University of Chicago
Butler, Henry Emerson (1967-82), Professor Emeritus, Educational Foundations and Administration; Ph.D., 1960, University of California at Berkeley
Butler, Robert F. (1974), Professor, Geosciences; Professor In The Arizona Research Laboratories; Ph.D., 1972, Stanford University
Butman, Samuel (1985), Associate Professor, Medicine; M.D., 1976, McGill University
Byerly, Henry Clement (1967-95), Professor Emeritus, Philosophy; Ph.D., 1967, University of Minnesota
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Byrne, David N. (1977), Professor, Entomology; Ph.D., 1976, University of Idaho
Cable Jr., C. Curtis (1966-85), Professor Emeritus, Agricultural and Resource Economics; Ph.D., 1968, University of Minnesota
Caldwell, Craig B. (1994), Professor, Media Arts; Ph.D., 1989, Ohio State University
Caldwell, Roger L. (1967), Special Assistant To The Dean, Agriculture; Professor, Communication; Professor, Soil and Water Science; Ph.D., 1966, The University of Arizona
Call, Reginald L. (1968-89), Associate Professor Emeritus, Electrical and Computer Engineering; Ph.D., 1958, University of Utah
Call, Robert E. (1991), Assistant Agent, Agriculture; M.S., 1985, Utah State University
Calmes, Robert E. (1958-86), Professor Emeritus, Educational Psychology; Ed.D., 1958, University of Denver
Calvert, Paul D. (1988), Professor, Materials Science and Engineering; Ph.D., 1971, Massachusetts Institute of Technology
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Campbell, Carlos C. (1995), Director, Arizona Prevention Center; Professor, Family and Community Medicine; Professor, Clinical Pediatrics; M.D., 1970, Duke University
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Candrea, John M. (1985), Head Coach, Women's Softball; M.Ed., 1980, Arizona State University
Canfield, J. Douglas (1974), Regents' Professor; Professor, English; Ph.D., 1969, University of Florida
Canfield, Louise M. (1987), Associate Professor, Biochemistry; Joint Appointment As Associate Professor Of Family and Community Medicine; Ph.D., 1976, Vanderbilt University
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Cardon, Bartley P. (1946-54; 1954-55; 1980-87), Associate Director, Development for Life Sciences; Dean Emeritus, Ph.D., 1946, University of California
Carleton, Willard T. (1984), Professor, Finance; Ph.D., 1962, University of Minnesota
Carleile, Robert N. (1963-89), Professor Emeritus, Electrical and Computer Engineering; Ph.D., 1963, University of California at Berkeley
Carmody, Raymond F. (1980), Professor, Radiology; M.D., 1969, Indiana University
Carothers, Jo Dale (1990), Assistant Professor, Electrical and Computer Engineering; Ph.D., 1989, University of Texas
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Carruthers, Peter (1986), Professor, Physics; Ph.D., 1961, Cornell University
Carswell, Evelyn M. (1970-83), Associate Professor Emerita, Elementary Education; Ed.D., 1967, The University of Arizona
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Carter, Herbert E. (1971-91), Professor Emeritus, Biochemistry; Ph.D., 1934, University of Illinois
Carter, Katherine J. (1986), Professor, Teaching and Teacher Education; Ph.D., 1980, North Texas State University
Carter, Paul A. (1973-91), Professor Emeritus, History; Ph.D., 1954, Columbia University
Carter, Ruth A. (1993), Director, County Extension; Assistant Agent, Family and Youth Development; M.S., 1983, University of Oregon
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Cellier, Francois E. (1984), Associate Professor, Electrical and Computer Engineering; Ph.D., 1979, Swiss Federal Institute of Technology
Cetas, Thomas C. (1975), Professor, Radiation Oncology; Joint Appointment As Professor of Aerospace and Mechanical Engineering; Professor, Electrical and Computer Engineering; Ph.D., 1970, Iowa State University
Chabot, Aturo M. (1988), Associate Professor; Art; M.F.A., 1981, University of Colorado
Chadd, Bryan K. (1984), Associate Agent, 4-H Youth Development; M.A., 1995, Northern Arizona University
Chai, Sun-Ki (1994), Assistant Professor, Sociology; Ph.D., 1994, Stanford University
Challant, James L. (1972), Professor, Special Education and Rehabilitation; Ed.D., 1965, University of Illinois
Chalfoun, Nader V. (1991), Associate Professor; Architecture; Ph.D., 1989, The University of Arizona
Cole, Jack R. (1957-92; 1994), Professor, Medicinal Chemistry; Professor, Pharmaceutical Sciences; Ph.D., 1957, University of Minnesota

Colescott, Robert H. (1985-95), Regents' Professor Emeritus, Art; M.A., 1952, University of California


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Coons, Stephen J. (1991), Director, Center for Pharmaceutical Economics; Associate Professor, Pharmacy Practice; Ph.D., 1986, The University of Arizona

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Dahood, Roger (1970), Professor, English; Ph.D., 1970, Stanford University

Daldup, Roger J. (1962-88), Professor Emeritus, Family and Consumer Resources; Ph.D., 1962, University of Missouri

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'Daniel, Terry C. (1969), Professor, Psychology; Professor, Renewable Natural Resources; Ph.D., 1969, University of New Mexico

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Davis, George H. (1970-1990; 1993), Professor, Geosciences; Ph.D., 1971, University of Michigan
Davis, Jack Emory (1949-1978), Professor Emeritus, Romance Languages; Ph.D., 1956, Tulane University
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Davis, Russell G. (1966-91), Professor Emeritus, Atmospheric Sciences; Ph.D., 1963, University of California at Berkeley
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Hall, Jennifer D. (1976), Associate Professor, Molecular and Cellular Biology; Joint Appointment as Associate Professor of Biochemistry; Ph.D., 1973, Yale University
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Huber, Nancy S. (1989), Associate Specialist, Community and Economic Development; Associate Professor, Agriculture Education; Ph.D., 1987, University of Wisconsin

Huber, Roger T. (1974), Head, Agriculture Education; Professor, Entomology; Ph.D., 1969, Purdue University

Huelsman, Lawrence P. (1960-89), Professor Emeritus, Electrical and Computer Engineering; Ph.D., 1960, University of California at Berkeley

Huestis, Douglas W. (1969-93), Professor Emeritus, Pathology; M.D., 1948, McGill University

Huete, Alfredo R. (1984), Professor, Soil and Water Science; Ph.D., 1984, The University of Arizona

Huffman, Donald R. (1967), Regents' Professor, Physics; Ph.D., 1966, University of California at Riverside

Hughes Hallett, Deborah J. (1992), Professor of Mathematics; M.A., 1976, Harvard University

Hughes, Malcolm K. (1980), Director, Tree Ring Laboratory; Professor, Dendrochronology; Joint Appointment as Professor of Watershed Management; Ph.D., 1970, University of Durham

Hull, Herbert M. (1966-85), Professor Emeritus, Watershed Management; Ph.D., 1951, California Institute of Technology

Hull, Robert L. (1964-81), Dean Emeritus, Fine Arts; Dean Emeritus of Music; Ph.D., 1945, Cornell University

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Huston, John E. (1993), Assistant Professor, History; Ph.D., 1995, Yale University

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Hutchinson, Charles F. (1979), Associate Director, Arid Lands Studies; Professor, Arid Lands Studies; Adjunct Professor, Soil and Water Hydrology; Adjunct Professor, Geography and Regional Development; Ph.D., 1978, University of California at Riverside

Hutter, John J. (1976), Professor, Pediatrics; M.D., 1967, State University of New York

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Ker, Alan P. (1996), Assistant Professor, Agricultural and Resource Economics; M.Sc., 1992, University of Guelph
Faculty / 241

`Krausman, Paul R. (1978), Associate Director, Agricultural Experiment Station; Professor, Wildlife and Fisheries Science; Ph.D., 1976, University of Idaho
Kresen, Peter L. (1991), Senior Lecturer, Geosciences; M.S., 1975, The University of Arizona

Krider, E. Philip (1971), Professor, Atmospheric Sciences; Ph.D., 1969, The University of Arizona

Krien, Peter R. (1978), Associate Professor, Geology; Ph.D., 1968, University of Colorado

Krunz, Marwan M. (1997), Assistant Professor, Electrical and Computer Engineering; Ph.D., 1995, Michigan State University

Kruttsch, Philip S. (1964-89), Professor Emeritus, Anatomy; Ph.D., 1953, University of Kansas
Kuehl, Robert O. (1964), Professor, Statistical Support Unit; Ph.D., 1964, North Carolina State College

Lal, Stephen L. (1994), Assistant Professor, Statistics; M.S., 1981, University of Georgia

Lam, Kit Sang (1990), Associate Professor, Medicine; Joint Appointment as Associate Professor of Microbiology and Immunology; Assistant Research Scientist, Cancer Center; M.D., 1984, Stanford University

Lamb, Ursula S. (1974-84), Professor Emerita, History; Ph.D., 1949, University of California at Berkeley

Lamoureux, Christopher G. (1994), Associate Professor, Finance; Ph.D., 1985, Syracuse University

Lan, Richard D. (1990), Associate Professor, Psychiatry; M.D., 1978, University of Illinois

Lang, William A. (1970), Professor, Theatre Arts; Ph.D., 1971, University of Illinois

Langen, Herbert J. (1947-83), Professor Emeritus, Business and Career Education; Ph.D., 1954, State University of Iowa

Langeland, D. Terence (1978), Head, Linguistics; Professor, Linguistics; Ph.D., 1964, Massachusetts Institute of Technology

Langley, Paul C. (1994), Associate Professor, Entomology; Ph.D., 1990, University of Illinois


Lansing, Robert W. (1959-94), Professor Emeritus, Engineering; Ph.D., 1964, The University of Arizona

Larson, Dennis L. (1973), Associate Professor, Agricultural and Biosystems Engineering; Ph.D., 1971, Purdue University

Larson, Douglas F. (1990), Associate Professor, Surgery; Director, Instructional Research and Development; Joint Appointment as Associate Professor of Pharmacology; Ph.D., 1984, The University of Arizona

Larson, Harold P. (1982), Professor, Lunar and Planetary Laboratory; Professor, Planetary Sciences; Ph.D., 1967, Purdue University

Lasse, James F. (1964), Distinguished Professor, Professor, Management Information Systems; D.Ed., 1963, Pennsylvania State University

Laursten, Emmett M. (1962-83), Professor Emeritus, Civil Engineering and Engineering Mechanics; Ph.D., 1958, University of Iowa

Lauver, Philip J. (1971-92), Associate Professor Emeritus of Family and Consumer Resources; Ph.D., 1966, Ohio University

Lauxman, Lisa A. (1991), Coordinator, Curriculum Development; Associate Agent, 4-H Youth Development; M.B.A., 1989, Emporia State University

Law, Shaughn M. (1995), Associate Professor, Philosophy; Ph.D., 1988, University of California at Berkeley

Law, John H. (1981), Director, Center for Insect Sciences; Regents' Professor; Professor, Biochemistry; Professor, Arizona Research Laboratories; Ph.D., 1957, University of Illinois

Lax, Daniela (1988), Assistant Professor, Pediatrics; M.D., 1981, University of Wisconsin

Layton, Jack Malcolm (1967-88), Professor Emeritus, Pathology; M.D., 1943, State University of Iowa

Leadem, Christopher A. (1983), Associate Dean, Student Affairs-Medicine; Associate Professor, Cell Biology and Anatomy; Ph.D., 1981, The University of Arizona

Leal, Daniel (1994), Associate Professor, Russian and Slavic Languages; Ph.D., 1992, University of Virginia

Leavengood, John H. (1971), Coordinator, Health Sciences; B.B.A., 1958, Indiana University

Leavitt, John A. (1960-95), Professor Emeritus, Physics; Ph.D., 1960, Harvard University

Leavitt, Steven W. (1990), Professor, Endocrinology; Ph.D., 1982, The University of Arizona

Lecbou, Albert V. (1991), Associate Professor, Cell Biology and Anatomy; Ph.D., 1988, University of California at Los Angeles

Lee, Jack K. (1952-83), Professor Emeritus, Music; M.A., 1947, Ohio State University
Lehman, Gordon S. (1968), Associate Professor, Water and Waste Management; Ph.D., 1968, The University of Arizona

Lehman, Peter R. (1983), Professor, Media Arts; Ph.D., 1978, University of Wisconsin
Lehrer, Adrienne (1974), Professor, Linguistics; Joint Appointment as Research Social Scientist in Cognitive Science; Ph.D., 1968, University of Rochester

Lehrer, Keith E. (1974), Regents' Professor, Professor, Philosophy; Ph.D., 1969, Brown University

Lei, Kai Y. (1980), Professor, Nutritional Sciences; Ph.D., 1973, Michigan State University

Lei, Polin P. (1985), Associate Librarian; Librarian, Reference; M.L.S., 1982, The University of Arizona

Leichen, Lise H. (1985), Associate Professor, French and Italian; Ph.D., 1982, Stanford University


Leischow, Scott J. (1991), Assistant Professor, Health Education; Assistant Professor, Family and Community Medicine; Ph.D., 1988, University of Maryland

Lemen, Richard J. (1977), Professor, Pediatrics; Joint Appointment as Assistant Professor of Physiology; M.D., 1967, Tulane University

Leonard Jr., Albert (1985), Professor, Classics; Professor, Near Eastern Studies; Ph.D., 1976, University of Chicago

Leonard, John Lander (1966), Lecturer, Mathematics; Ph.D., 1966, University of California at Santa Barbara

Leonard, Robert C. (1964-91), Professor Emeritus, Sociology; Ph.D., 1962, University of Oregon

Leonard, Robert T. (1994), Head, Plant Sciences; Professor, Plant Sciences; Ph.D., 1971, University of Illinois

Leones, Julie P. (1990), Assistant Specialist, Agricultual and Resource Economics; Ph.D., 1990, Cornell University

Leshin, George J. (1963-82), Professor Emeritus, Special Education; Ph.D., 1959, University of Portland

Leslie, Larry (1976), Professor, Higher Education; Ed.D., 1968, University of Oregon

Lesser, Michael P. (1995), Associate Research Scientist, Steward Observatory; Ph.D., 1988, The University of Arizona

Leuton, Robert J. (1956-60, 1967-85), Professor Emeritus, Secondary Education; Ed.D., 1956, University of Missouri

Leung, Janny M. (1991), Associate Professor, Management Information Systems; Ph.D., 1986, Massachusetts Institute of Technology

Levenson, Alan Ira (1969), Professor, Psychiatry; M.D., 1965, Harvard University

Lever, Paul J. A. (1991), Assistant Professor, Mining and Geological Engineering; Ph.D., 1989, University of Rochester

Levermore, Charles D. (1987), Professor, Mathematics; Ph.D., 1982, Clarkson College

Levin, John S. (1993), Associate Professor, Educational Administration and Higher Education; Ed.D., 1989, University of Rochester

Levine, Norman (1978), Professor, Medicine; M.D., 1970, University of Michigan

Levine, Richard B. (1986), Professor, Neurobiology; Joint Appointment as Assistant Professor of Physiology; Ph.D., 1978, State University of New York

Levinson, Daniel O. (1995), Associate Professor, Family and Community Medicine; M.D., 1954, University of Chicago

Levy, Eugene H. (1973), Dean, Faculty of Science; Professor, Lunar and Planetary Laboratory; Professor, Plant Sciences; Professor, Physics; Ph.D., 1971, University of Chicago

Levy, Jerrold E. (1972-95), Professor Emeritus, Anthropology; Ph.D., 1959, University of Chicago

Lewis, John S. (1981), Professor, Lunar and Planetary Laboratory; Professor, Planetary Science; Donald Y., 1968, University of California at San Diego

Libbey, Gary D. (1984), Director, Eller Center for Law; Professor, Economics; Joint Appointment as Professor of Law; Ph.D., 1976, University of Pennsylvania

Lichtenberger, Dennis L. (1976), Head, Chemistry; Professor; Ph.D., 1974, University of Wisconsin

Lieber, James W. (1976), Professor, Astronomy; Astronomer, Steward Observatory; Ph.D., 1976, University of California at Berkeley

Liebler, Daniel C. (1987), Associate Professor, Pharmacology and Toxicology; Investigator, Center for Toxicology; Ph.D., 1984, Vanderbilt University

Lien, Yeong-Hau Howard (1990), Associate Professor, Medicine; Joint Appointment as Associate Professor of Physiology; Associate Professor, Radiology; Ph.D., 1984, University of California at San Francisco

Lightner, Donald V. (1991), Professor, Veterinary Science; Joint Appointment as Adjunct Associate Professor of Renewable Natural Resources; Ph.D., 1971, Colorado State University

Lightner, Elmer S. (1969), Professor, Pediatrics; M.D., 1958, University of Pennsylvania

Lindell, Thomas J. (1970), Associate Professor, Molecular and Cellular Biology; Ph.D., 1969, University of Iowa

Lindsey, Douglas (1973-89), Professor Emeritus, Surgery; M.D., 1949, Yale University

Limpero, Janice K. (1996), Lecturer, English; M.A., 1982, Ball State University

List, Alan F. (1988), Associate Professor, Medicine; Joint Appointment as Assistant Research Scientist in The Arizona Cancer Center; M.D., 1980, University of Pennsylvania

Little, John (1977), Professor, Biochemistry; Joint Appointment as Professor of Molecular and Cellular Biology; Ph.D., 1966, Stanford University

Liu, Feng-Hsi (1991), Assistant Professor, East Asian Studies; Ph.D., 1990, University of California at Los Angeles

Liverman, Diana M. (1995), Director, Latin American Area Center; Associate Professor, Geography and Regional Development; Ph.D., 1983, University of California at Los Angeles

Lockard, W. Kirby (1962-92), Professor Emeritus, Architecture; M.S., 1962, Massachusetts Institute of Technology

Loeb, Robert G. (1996), Associate Professor, Anesthesiology; M.D., 1983, University of Maryland

Logan, Bruce E. (1986), Associate Professor, Chemical Engineering; Investigator, Center for Toxicology; Ph.D., 1986, University of California

Logan, James P. (1968-89), Professor Emeritus; Management and Policy; Ph.D., 1960, Columbia University

Logan, Joy L. (1984), Associate Professor, Medicine; M.D., 1976, The University of Arizona

Lohman, Timothy G. (1964), Professor, Physiology; Ph.D., 1967, University of Wisconsin

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Lomont, John W. (1965-89), Professor Emeritus, Mathematics; Ph.D., 1951, Purdue University

Long, Austin (1968), Professor, Geosciences; Joint Appointment as Professor of Hydrology and Water Resources, Chief Scientist, Isotope Geochemistry; Ph.D., 1966, The University of Arizona

Longacre, William A. (1964), Head, Anthropology; Professor, Anthropology; Ph.D., 1963, University of Chicago


Lopes, Vicente L. (1989), Associate Professor, Water Resources Management; Ph.D., 1987, The University of Arizona

Lopez Jr., Richard L. (1980), Lecturer, Teaching and Teacher Education; D.Ed., 1980, New Mexico State University


Lotz, Sherry L. (1996), Assistant Professor, Family and Consumer Resources; Ph.D., 1995, Kent State University

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Loveland, David (1974), Professor, Mathematics; D.Sc., 1974, University of Natal

Low, Frank J. (1962-96), Regents Research Professor Emeritus; Ph.D., 1959, Rice University

Lowe Jr., Charles H. (1950-94), Professor Emeritus, Ecology and Evolutionary Biology; Curator of Amphibians and Reptiles; Ph.D., 1950, University of California at Los Angeles

Lowe, Melissa G. (1991), Associate Professor, Dance; Diploma, 1973, Professional Children's School

Lu, Jiang Hua (1994), Assistant Professor, Mathematics; Ph.D., 1990, University of California at Berkeley
Luft, Julie A. (1994), Assistant Professor, University of Pittsburgh

Ludovici, Peter P. (1965-83), Professor, University of California at Los Angeles

Lund, Pamela J. (1993), Assistant Professor, Radiology; M.D., 1982, University of Illinois

Lundberg, John G. (1993), Professor, Ecology and Evolutionary Biology; Ph.D., 1970, University of Michigan

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Luprecht, Mark A. (1987), Senior Lecturer, Humanities; Ph.D., 1986, Florida State University

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Lynch, David C. (1984), Associate Head, Materials Science; Professor, Materials Science and Engineering; Sc.D., 1976, Massachusetts Institute of Technology

Lynch, Lillian (1962-81), Associate Professor Emerita, German; M.A., 1951, The University of Arizona

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MacDonald, Donald P. (1978), Director, Honors Center; Associate Professor, Sociology; Adjunct Associate Professor, Educational Administration and Higher Education; Ph.D., 1978, University of Wisconsin

MacDonald, Joel D. (1996), Assistant Professor, Surgery; M.D., 1989, University of North Carolina

Maga, Claire B. (1996), Assistant Librarian; M.L.S., 1993, The University of Arizona

Mack, Julie A. (1989), Associate Professor, Theatre Arts; M.F.A., 1987, Purdue University

MacKenzie, Neil E. (1987), Associate Professor, Pharmaceutical Sciences; Joint Appointment as Associate Professor, Biochemistry; Ph.D., 1979, University of Aberdeen

MacKinnon, William J. (1956-80), Professor Emeritus, Psychology; Ph.D., 1955, University of California at Los Angeles

Madden, Daniel (1976), Associate Professor, Mathematics; Ph.D., 1975, Ohio State University

Maddison, David R. (1992), Assistant Professor, Entomology; Ph.D., 1990, Harvard University

Maddison, Wayne P. (1990), Associate Professor, Ecology and Evolutionary Biology; Ph.D., 1988, Harvard University

Maddock III, Thomas (1977), Professor, Hydrology and Water Resources; Ph.D., 1973, University of Arizona

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Madison, Peter (1963-83), Professor Emeritus, Psychology; Counseling Psychologist Emeritus, Student Counseling Service; Ph.D., 1953, Harvard University

Maggs, Jennifer L. (1996), Assistant Professor, Family and Consumer Resources; Ph.D., 1993, University of Victoria

Mahar, James M. (1958-94), Professor Emeritus, Near Eastern Studies; Ph.D., 1966, Cornell University

Makler, Mark (1974), Professor, Theatre Arts; Ph.D., 1973, University of Michigan

Malcolm, Martin (1988), Professor Emeritus; Physics; Ph.D., 1953, University of Canada

Maier, Robert S. (1988), Associate Professor, Mathematics; Associate Professor, Physics; Ph.D., 1983, Rutgers University

Maker, Carol J. (1981), Professor, Special Education and Rehabilitation; Ph.D., 1978, University of Virginia

Malan, T. Philip (1992), Assistant Professor, Anesthesiology; M.D., 1985, University of Massachusetts

Malik Jr., Joe (1960-89), Professor Emeritus, Russian and Slavic Languages; Ph.D., 1955, University of Pennsylvania

Maloney, John C. (1988), Head, Philosophy; Professor, Philosophy; Ph.D., 1978, Indiana University

Malvick, Allan J. (1965-86), Professor Emeritus, Civil Engineering and Engineering Mechanics; Sc.D., 1961, University of Notre Dame

Manber, Rachel (1994), Assistant Professor, Psychiatry; Assistant Professor, Psychology; Ph.D., 1993, The University of Arizona

Manber, Udi (1987), Professor, Computer Science; Ph.D., 1982, University of Washington

Mangelsdorf, Philip (1964-87), Professor Emeritus, Journalism; M.A., 1964, University of Washington

Manke, Gale E. (1990), Senior Lecturer, Nursing; M.S.N., 1979, Northern Illinois University

Marney, Lawrence D. (1976), Professor, Planning; Ph.D., 1961, Harvard University

'Mannan, Robert W. (1982), Professor, Wildlife and Fisheries Science; Ph.D., 1982, Oregon State University

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Manning, Doris E. (1963-83), Professor Emeritus, Home Economics; Ph.D., 1967, University of Wisconsin

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'Marathay, Arvind S. (1969), Professor, Optical Sciences; Ph.D., 1963, Boston University

Marcellin, Michael W. (1988), Associate Professor, Electrical and Computer Engineering; Ph.D., 1987, Texas A & M University

Marchalonis, John J. (1988), Head, Microbiology and Immunology; Joint Appointment as Professor of Pathology; Professor, Medicine; Ph.D., 1967, Rockefeller University

'Marchello, John A. (1965), Professor, Animal Sciences; Professor, Nutritional Sciences; Ph.D., 1965, Colorado State University

Marcum, Kenneth R. (1995), Associate Professor, Plant Sciences; Ph.D., 1989, University of Hawaii

Marcus, Frank I. (1968), Professor, Medicine; M.D., 1953, Boston University

'Mare, Cornelius J. (1976), Professor, Veterinary Science; Ph.D., 1965, Iowa State University

Marefat, Michael Mahmud (1992), Associate Professor, Electrical and Computer Engineering; Ph.D., 1991, Purdue University

Marietta, Jack D. (1968), Associate Professor, History; Ph.D., 1968, Stanford University

Martin, Mary H. (1976-91), Associate Professor Emerita, Family and Consumer Resources; Ph.D., 1970, University of Wisconsin

Marsh, Ted J. (1970), Chief Psychologist, Counseling and Psychological Services; Director, Counseling and Psychological Services; Joint Appointment as Associate Professor in Psychology; Clinical Lecturer, Psychiatry; Ph.D., 1970, University of North Carolina

'Marsh, Stuart E. (1988), Associate Professor, Arid Lands Studies; Joint Appointment as Associate Professor of Geography and Regional Development; Associate Director, Remote Sensing and Spatial Analysis; Associate Professor, Watershed Management; Ph.D., 1979, Stanford University

Marshall, James R. (1995), Professor, Family and Community Medicine; Associate Director, Cancer Prevention and Control; Ph.D., 1977, University of California at Los Angeles

Marshall, Robert H. (1957-93), Professor Emeritus, Economics; Ph.D., 1957, Ohio State University

Marshall, Thomas H. (1982), Associate Librarian; M.L.S., 1978, University of California at Los Angeles

Marshall, Wesley B. (1968), Associate Professor, Media Arts; M.F.A., 1959, University of Wisconsin

Marston, Sallie (1986), Associate Professor, Geography; Ph.D., 1986, University of Colorado

Martin, Arnold R. (1977), Professor, Molecular Chemistry; Professor, Pharmaceutical Sciences; Ph.D., 1964, University of California at San Francisco

Martin, Edward C. (1992), Associate Specialist, Agricultural and Biosystems Engineering; Ph.D., 1992, Michigan State University
Martin, Hollis K. (1957-83), Associate Professor Emeritus, Management; M.S., 1960, The University of Arizona
Martin, John W. (1977-89), Professor Emeritus, Spanish and Portuguese; M.A., 1956, University of Washington
Martin, Paul S. (1957-89), Professor Emeritus, Geosciences; Ph.D., 1956, University of Michigan
Martin, S. S. (1983), Professor Emeritus, Range Management; Ph.D., 1964, The University of Arizona
Martin, William E. (1961-89), Professor Emeritus, Agricultural and Resource Economics; Ph.D., 1961, University of California at Berkeley
Martinez, Fernando (1991), Director, Respiratory Sciences; Associate Professor, Pediatrics; Joint Appointment as Research Scientist in Respiratory Sciences; M.D., 1975, University of Rome
Martinez, Jesse D. (1991), Assistant Professor, Radiation Oncology; Ph.D., 1987, University of Nevada
Martinez, John J, Assistant Librarian; M.A., 1995, The University of Arizona
Martinez, Oscar (1988), Acting Director, Latin America Area Center; Professor, History; Ph.D., 1975, University of California at Los Angeles
Martino, Steven D. (1988), Assistant Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
May, Cynthia F. (1993), Assistant Professor, Psychology; Ph.D., 1995, Duke University
May, Kathleen A., Associate Professor, Nursing; D.N.Sc., 1985, University of California
McCabe, Kevin A. (1996), Associate Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
McCarter, Fred S. (1967), Professor, Architecture; Adjunct Professor, Director, Graduate Programs; Planning; M.Arch., 1967, University of Oregon
McCary, Mary M. (1993), Associate Professor, Educational Psychology; Ph.D., 1981, Michigan State University
McCaughey, William F. (1951-92), Professor Emeritus, Nutritional Sciences; Ph.D., 1951, The University of Arizona
McClaran, Paul F. (1986), Associate Professor, Range Management; Ph.D., 1986, University of California at Berkeley
McCloskey, William B. (1991), Assistant Professor, Psychology; Ph.D., 1986, University of Michigan
McCloskey, William B. (1991), Assistant Professor, Psychology; Ph.D., 1986, University of Michigan
McCormick Jr., Floyd (1967-89), Head, Emeritus, Agriculture Education; Professor Emeritus, Agriculture Education; Ph.D., 1964, Ohio State University
McCoy, Leahm (1954-78), Professor Emerita, Economics; Ph.D., 1937, University of Wisconsin-Madison
McCracken, Betty Jo (1969-86), Associate Professor Emerita, Nursing; M.S., 1959, University of Colorado
McCravey, James C. (1968), Associate Professor, Economics; Ph.D., 1969, University of Colorado
McElroy, D. Keith (1977), Associate Professor, Art; Ph.D., 1977, University of Michigan
McElroy, John H. (1970), Professor, English; Ph.D., 1966, Duke University
McEwen, Marylyn M. (1990), Senior Lecturer, Nursing; B.S.N., 1976, The University of Arizona
McMahan, Thomas R. Jr. (1961), Associate Professor, English; M.A., 1967, The University of Arizona
McNamara, Kevin A. (1996), Angle Professor Emeritus, Agriculture Education; Ph.D., 1984, University of Michigan
McNally, John D. (1963), Professor Emeritus, Agriculture Education; Ph.D., 1984, University of Michigan
McQuaid, John J., Professor, Medicine; M.D., 1970, University of California at Los Angeles
McRae, Murray W. (1969), Associate Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
McRae, William C. (1969), Associate Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
McRae, William C. (1969), Associate Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
McRae, William C. (1969), Associate Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
McRae, William C. (1969), Associate Professor Emeritus, Molecular Pharmaceutical Sciences; Ph.D., 1984, Arizona State University
McGinnis, Reginald J. (1995), Assistant Professor, French and Italian; Ph.D., 1990, Stanford University
McGovern, Kathy A. (1993), Assistant Professor, Radiation Oncology; Ph.D., 1983, University of Florida
McGrew, Bruce E. (1966), Professor, Art; M.F.A., 1964, The University of Arizona
McGuire, Thomas R. (1986), Associate Research Anthropologist; Adjunct Associate Research Professor, Anthropology; Ph.D., 1979, The University of Arizona
Melfi, Lyle H. (1965-85), Professor Emeritus, Accounting; Ph.D., 1966, Harvard University
McIntyre Jr., Laurence (1966), Professor, Physics; Ph.D., 1965, University of Wisconsin
Mcke, Cecile M. (1993), Assistant Professor, Linguistics; Ph.D., 1988, University of Connecticut
McKelvie, Douglas H. (1974-89), Associate Professor Emeritus, Pathology; Ph.D., 1968, University of California at Davis
McKnight, Brian E. (1990), Head, East Asian Studies; Professor, East Asian Studies; Ph.D., 1988, University of Arizona
McLaughlin, Carrol M. (1981), Professor, Neurology; Associate Professor, Cell Biology and Anatomy; M.M. 1984, The University of Arizona
McLaughlin, Steven P. (1987), Associate Professor, Arid Lands Studies; Joint Appointment as Adjunct Assistant Professor of Plant Sciences; Ph.D., 1978, The University of Arizona
McMahon, Ellen E. (1990), Assistant Professor, Art; M.S., 1983, The University of Arizona
McMillan, Theodora Mantz (1970-91), Professor Emeritus, Pharmacology and Toxicology; Research Scientist, Arizona Research Laboratories; M.S., 1981, The University of Arizona
Mead, Albert R. (1946-81), Professor Emeritus, Ecology and Evolutionary Biology; Ph.D., 1942, Cornell University
McLer, Lyle H. (1965-85), Professor Emeritus, English; B.Lit., 1951, Dalhousie University
McLer, Terry H. (1985-91), Professor Emeritus, Pathology; Ph.D., 1968, University of Arizona
Medina Jr., Marcello (1980), Associate Professor, Language, Reading and Culture; Ph.D., 1980, The University of Arizona
Medina, Peter Ernest (1969), Professor, English; Ph.D., 1970, University of Wisconsin
Meek, Paula M. (1996), Assistant Professor, Nursing; Ph.D., 1993, The University of Arizona
Meek, Phillip R. (1967), Professor Emeritus, History; Ph.D., 1967, University of New Mexico
Mellor, Robert S. (1962-93), Associate Professor Emeritus, Ecology and Evolutionary Biology; Ph.D., 1962, Colorado State University
Melnik, Amelia (1960-89), Professor Emerita, Language, Reading and Culture; Ed.D., 1960, Columbia University
Melosh, Henry J. (1982), Professor Emeritus, Lunar and Planetary Laboratory; Professor, Planetary Sciences; Professor, Geosciences; Ph.D., 1973, California Institute of Technology
Mencke, Reed A. (1968), Associate Director, University Learning Center; Ph.D., 1968, Iowa State University
Mendelson, Neil Harland (1969), Professor Emeritus, Molecular and Cellular Biology; Joint Appointment as Adjunct Professor of Nutritional Sciences; Ph.D., 1964, Indiana University
Mendez, Miguel M. (1982), Professor, Spanish and Portuguese; Joint Appointment as Research Humanist in The Mexican American Studies and Research Center
Mercado, Rodney M. (1960-94), Associate Professor Emeritus, Music; M.M., 1953, University of Southern California
Merging, John V. (1962-75), Professor Emeritus, History; Ph.D., 1960, University of Missouri
Merk, Patricia A. (1993), Acting Director, County Extension; Assistant Agent, Family and Youth Development; M.S., 1981, Indiana University
Merkle, Carrie J. (1993), Assistant Professor, Nursing; Research Assistant Professor, Physiology; Ph.D., 1990, Arizona State University
Merritt, Curtis B. (1949-80), Associate Dean Emeritus, Graduate College; Professor, Educational Psychology; Ph.D., 1950, University of Michigan
Metcalf, Darrel S. (1958-82), Dean Emeritus, Agronomy; Ph.D., 1950, Iowa State College
Meyer, Michael C. (1973-96), Professor Emeritus, History; Ph.D., 1953, University of New Mexico
Meystre, Pierre (1986), Professor, Optical Sciences; Joint Appointment as Professor of Physics; Ph.D., 1974, Ecole Polytechnique
Mino, Ronald C. (1973), Associate Professor, East Asian Studies; Ph.D., 1969, University of California at Berkeley
Michod, Richard E. (1978), Professor, Ecology and Evolutionary Biology; M.A., 1978, University of Georgia
Miesfeld, Roger L. (1987), Associate Professor, Biochemistry; Joint Appointment as Associate Professor of Molecular and Cellular Biology; Ph.D., 1983, State University of New York
Mihalik, Edward J. (1972), Investment Officer; B.S., 1928, Wayne State University
Mikel, Terry H. (1978-81; 1984), Agent, Agriculture; M.S., 1981, The University of Arizona
Miklosky, Haaren A. (1966-86), Professor Emeritus, Civil Engineering and Engineering Mechanics; Eng.D., 1950, Yale University
Miller III, Walter B. (1993), Senior Lecturer, Chemistry; Ph.D., 1968, Harvard University
Miller, Donna M. (1959-89), Professor Emeritus, Exercise and Sport Sciences; Ph.D., 1960, University of Southern California
Miller, Glen M. (1987), Associate Professor, Agriculture Education; Ed.D., 1986, Mississippi State University
Miller, Jane R. (1987), Professor, English; M.A., 1975, California State University
Miller, Jerry L. (1962-92), Associate Professor Emeritus, Sociology; Ph.D., 1959, Florida State University
Miller, Joseph M. (1991), Associate Professor, Ophthalmology; Joint Appointment as Associate Professor of Optical Sciences; M.D., 1986, Northeastern Ohio University
Miller, Nico J. (1980), Professor, English; Ph.D., 1987, Harvard University
Miller, Raina M. (1991), Associate Professor, Soil and Water Science; Investigator, Center for Toxicology; Ph.D., 1988, Rutgers University
Miller, Thomas P. (1968), Associate Professor, English; Director, Undergraduate Composition Programs; Ph.D., 1984, University of Texas
Miller, Thomas P. (1980), Professor, Medicine; Research Scientist, Cancer Center; M.D., 1972, University of Illinois
Miller, Virginia June (1967-84), Associate Professor Emerita, Nursing; M.A., 1952, University of Chicago
Mills, Walter B. (1968), Professor Emeritus, General Biology; Ph.D., 1967, The University of Arizona
Mills, Barbara J. (1991), Associate Professor, Anthropology; Ph.D., 1989, University of New Mexico
Mills, John A. (1961-66; 1974-95), Associate Professor Emeritus, English; Ph.D., 1961, Indiana University
Mills, Joseph L. (1994), Associate Professor, Surgery; M.D., 1981, Georgetown University
Mills, Lillian F. (1997), Assistant Professor, Accounting; Ph.D., 1996, University of Michigan
Milo, Ronald D. (1962-95), Professor Emeritus, Philosophy; Ph.D., 1962, University of Washington
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Mirchandani, Piru B. (1990), Head, Systems and Industrial Engineering; Professor, Systems and Industrial Engineering; Joint Appointment as Professor of Electrical and Computer Engineering; D.Sc., 1975, Massachusetts Institute of Technology
Misaghi, Iraj J. (1978), Associate Professor, Plant Pathology; Ph.D., 1969, University of California at Davis
Mishler II, William T. (1997), Head, Political Science; Professor, Political Science; Ph.D., 1973, Duke University
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Morris, Thomas M. (1959-82), Professor Emeritus, Metallurgical Engineering; Ph.D., 1950, University of Missouri
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Sanders, Linda W. (1990), Professor, Architecture; M.Arch., 1973, University of Florida
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Stark, Royal W. (1971-72), Professor, Physics; Professor, Arizona Research Laboratories; Ph.D., 1962, Case Institute of Technology

Stauss, Joseph H. (1972-80; 1988), Chair, Cell Biology and Anatomy; Ph.D., 1979, University of California at Los Angeles

Steinberg, Marc W. (1976), Professor, Anthropology; Joint Appointment as Professor of Family and Community Medicine; Ph.D., 1976, University of California at Los Angeles

Steinle, Cornelius (1957-89), Professor Emeritus, Chemistry; Ph.D., 1956, University of California at Los Angeles

Steere, Peter L. (1990), Assistant Librarian; M.L.S., 1987, The University of Arizona

Steidl, Robert J. (1996), Assistant Professor, Renewable Natural Resources; Ph.D., 1994, Oregon State University

Stein, Daniel L. (1987), Head, Physics; Professor, Physics; Ph.D., 1979, Princeton University

Steinbrenner, Arthur H. (1956-83), Professor Emeritus, Secondary Education; Professor Emeritus, Mathematics; Ph.D., 1955, Columbia University

Steinert, Victoria E. (1977), Agent, Home Economics; M.S., 1983, The University of Arizona

Steinmetz, Matthias (1997), Assistant Professor, Astronomy; Assistant Astronomer, Steward Observatory; Ph.D., 1993, Technical University Munich

Sterling, Charles R. (1983), Head, Veterinary Science; Professor, Veterinary Science; Ph.D., 1971, Wayne State University

Stern, Lawrence Z. (1970), Professor, Medicine; M.D., 1965, Columbia University

Sternberg, Ben K. (1986), Head, Mining and Geological Engineering; Professor, Mining and Geological Engineering; Ph.D., 1977, University of Wisconsin

Stevenson, Frederick W. (1971), Professor, Mathematics; Ph.D., 1966, University of Colorado

Stewart, Harry E. (1946-76), Professor Emeritus, Electrical Engineering; M.S., 1939, University of Michigan

Stewart, James C. (1995), Instructor, Military Science Tactics; B.S., 1990, United States Military Academy

Still, David W. (1994), Assistant Research Scientist, Yuma Agricultural Center; Ph.D., 1989, Texas A and M University

Stiner, Mary C. (1994), Assistant Professor, Anthropology; Ph.D., 1990, University of New Mexico

Stern, William A. (1976), Professor, Anthropology; Joint Appointment as Professor of Family and Community Medicine; Ph.D., 1969, University of Wisconsin

Stith, Lee S. (1955-83), Professor Emeritus, Plant Sciences; Ph.D., 1955, Iowa State College

Stitt, Jerry L. (1996), Head Coach, Men's Baseball; Ed.D., 1993, The University of Arizona

Stockton, Charles W. (1970), Professor, Dendrochronology; Joint Appointment as Professor of Arid Lands Studies; Ph.D., 1971, The University of Arizona

Stoddard, Mari J. (1992), Associate Librarian; Librarian, Head of Educational Services; M.L.S., 1984, University of California at Berkeley

Stoffle, Carla J. (1991), Dean, Libraries; Librarian; Professor, Library Science; M.L.S., 1969, University of Kentucky

Stoffle, Richard W. (1994), Associate Research Anthropologist; Ph.D., 1972, University of Kentucky
Stokes, Marsden B. (1963-80), Professor Emeritus, Educational Foundations and Administration; Ph.D., 1959, University of Minnesota
Stokes, Marvin A. (1967-83; 1984-89), Professor Emeritus, Dendrochronology; M.S., 1965, The University of Arizona
Stone, H. Reynolds (1965-95), Associate Professor Emeritus, Spanish and Portuguese; Ph.D., 1965, University of North Carolina
Stoner Jr., John O. (1967), Professor, Physics; Ph.D., 1964, Princeton University
Stott, Gerald H. (1960-83), Professor Emeritus, Animal Sciences; Ph.D., 1956, University of Wisconsin
Strack, David H. (1972-89), Professor Emeritus, Exercise and Sport Sciences; Ph.D., 1961, Case Institute of Technology
Stratton, Leslie S. (1988), Assistant Professor, Economics; Ph.D., 1989, Massachusetts Institute of Technology
Strausfeld, Nicholas J. (1987), Professor, Neurobiology; Professor, Ecology and Evolutionary Biology; Professor, Cell Biology and Anatomy; Adjunct Professor, Art; Ph.D., 1968, University of London
Streitmatter, Janice L. (1980), Associate Dean, Education; Associate Professor, Educational Psychology; Ph.D., 1978, The University of Arizona
Strickland, Robin N. (1979), Associate Professor, Electrical and Computer Engineering; Associate Professor, Optical Sciences; Ph.D., 1978, University of Sheffield
Strittmatter, Peter A. (1971), Regents' Professor, Astronomy; Director, Steward Observatory; Astronomer, Steward Observatory; Ph.D., 1966, St. John's College
Stroehlein, Jack L. (1962-89), Professor Emeritus, Soil and Water Science; Ph.D., 1962, University of Wisconsin
Strom, Robert G. (1963), Professor, Lunar and Planetary Laboratory; Joint Appointment as Professor of Planetary Sciences; M.S., 1937, Stanford University
Strong, John W. (1984), Rosenstiel Distinguished Professor, Law; J.D., 1962, University of Illinois
Stuart, Douglas G. (1967), Regents' Professor, Professor, Physiology; Ph.D., 1961, University of California at Los Angeles
Stuart, Marta E. (1992), Associate Agent, Family and Youth Development; M.A., 1989, San Jose State University
Stubbseldie, Thomas M. (1959-83), Professor Emeritus, Agricultural and Resource Economics; Ph.D., 1956, Texas A and M University
Sturmian, Janet L. (1995), Assistant Professor, Music; Ph.D., 1987, Columbia University
Suay, Jose R. (1993), Assistant Professor, Finance; Ph.D., 1993, University of Utah
Subramaniam, Banumathi (1996), Assistant Research Scientist, SIROW; Ph.D., 1993, Duke University
Sugnet, Christopher L. (1988), Associate Librarian; M.L.S., 1974, State University of New York at Geneseo
Sullivan, John B. (1984), Associate Dean, Clinical Affairs; Associate Professor, Surgery; Joint Appointment as Adjunct Assistant Professor of Pharmacology and Toxicology; M.D., 1974, University of Alabama
Sullivan, Lawrence M. (1973), Associate Specialist, 4-H Youth Development; Joint Appointment as Associate Specialist in, Renewable Natural Resources; M.S., 1967, The University of Arizona
Sullivan, Michael Patrick (1968), Professor, Political Science; Ph.D., 1968, University of Oregon
Summers, George W. (1966-88), Professor Emeritus, Management and Policy; M.A., 1950, University of Colorado
Sundareshan, Malur K. (1993), Professor, Electrical and Computer Engineering; Ph.D., 1973, Indian Institute of Science
'Supalla, Samuel J. (1989), Associate Professor, Special Education and Rehabilitation; Ph.D., 1990, University of Illinois
Surwit, Earl A. (1991), Clinical Associate Professor, Surgery; Professor, Clinical Obstetrics and Gynecology; M.D., 1973, Georgetown University
Sutherland, R. Warren (1973), Professor, Music; M.S., 1960, University of Wisconsin
Sutherland, Ronald A. (1982), Lecturer, Exercise and Sport Sciences; M.S., 1983, University of Rhode Island
Svob, Robert S. (1942-44; 1946-83), Dean Emeritus, Students; Professor Emeritus; M.A., 1950, The University of Arizona
Swain, Donna E. (1987-96); (1996), Senior Lecturer, Humanities; Ph.D., 1978, The University of Arizona
Swalin, Richard A. (1984-94), Professor Emeritus, Materials Science and Engineering; Ph.D., 1954, University of Minnesota
Swanson, Gerald J. (1970), Associate Professor, Economics; Ph.D., 1972, University of Illinois
Swetnam, Thomas W. (1988), Associate Professor, Dendrochronology; Joint Appointment as Associate Professor of Watershed Management; Ph.D., 1987, The University of Arizona
Swindle, Timothy D. (1986), Associate Professor, Lunar and Planetary Laboratory; Associate Professor, Planetary Sciences; Ph.D., 1986, Washington University
Swisher, Linda (1977), Associate Professor, Speech and Hearing Sciences; Ph.D., 1966, McGill University
Sypherd, Paul S. (1993), Senior Vice President, Academic Affairs and Provost; Professor, and Cellular Biology; Professor, Biochemistry; Professor, Microbiology and Immunology; Ph.D., 1963, Yale University
Szidarovszky, Ferenc (1990), Professor, Systems and Industrial Engineering; Ph.D., 1977, K. Marx University
Szilagyi, Miklos N. (1982), Professor, Electrical and Computer Engineering; D.Sc., 1979, Hungarian Academy of Sciences
Tabashnik, Bruce E. (1996), Head, Entomology; Professor, Entomology; Ph.D., 1981, Stanford University
Tabli, Laura (1988), Associate Professor, History; Ph.D., 1987, Rutgers University
Tabor, Michael (1992), Head, Applied Mathematics; Professor, Mathematics; Professor, Applied Mathematics; D.Sc., 1990, Bristol University
Taatel, Raymond (1991), Professor, Medicine; Professor, Pathology; Research Scientist, Cancer Center; M.D., 1973, Northwestern University
Taleb, Mohamed A. (1996), Assistant Librarian; M.L.S., 1988, The University of Arizona
Tallman, Karen D. (1985), Associate Librarian; M.S.L.S., 1978, Florida State University
Tanner, Clara Lee (1928-75), Professor Emerita, Anthropology; M.A., 1928, The University of Arizona
Tansik, David A. (1969), Associate Professor, Management and Policy; Ph.D., 1970, Northwestern University
'Tao, Jing-Shen (1976), Professor, East Asian Studies; Ph.D., 1967, Indiana University
Taren, Douglas L. (1992), Associate Professor, Family and Community Medicine; Ph.D., 1986, Cornell University
Tash, Jerry C. (1958-86), Associate Professor Emeritus, Wildlife and Fisheries Science; Ph.D., 1964, University of Kansas
Tatum, Charles M. (1987), Dean, Humanities; Professor, Spanish and Portuguese; Ph.D., 1971, University of New Mexico
Tatum, Roy A. (1955-89), Assistant Professor Emeritus, Exercise and Sport Sciences; M.Ed., 1949, University of Missouri
Taylor, Angela R. (1993), Associate Professor, Family and Consumer Resources; Ph.D., 1984, University of Illinois
Taylor, B. Brooks (1969-94), Professor Emeritus, Plant Sciences; Ph.D., 1967, Rutgers University
Taylor, Charles W. (1988), Associate Professor, Medicine; Research Associate, Cancer Center; M.D., 1982, University of Oklahoma Medical School
Taylor, Christopher J. (1992), Senior Lecturer, Psychology; Ph.D., 1968, Ohio University
Taylor, John L. (1991), Dean, Education; Professor, Teaching and Teacher Education; Ph.D., 1976, Stanford University
Taylor, Kathryn C. (1991), Assistant Professor, Plant Sciences; Ph.D., 1987, University of Florida
Taylor, Lester D. (1972), Professor, Economics; Joint Appointment as Professor of Agricultural and Resource Economics; Ph.D., 1963, Harvard University
Taylor, Martin F. (1991), Assistant Professor, Entomology; Ph.D., 1987, University of Queensland
Taylor, Shirley H. (1974), Specialist, 4-H Youth Development; Ph.D., 1979, The University of Arizona
Teague, Lynn S. (1982), Curator, Archaeology; Joint Appointment as Adjunct Lecturer of Anthropology; M.A., 1974, The University of Arizona
Tellman, Jennalyn W. (1990), Assistant Librarian; M.S., 1971, Simmons College
Tellman, Stephen G. (1965), Lecturer, Mathematics; Ph.D., 1960, University of Washington
Warrick, Arthur Will (1967), Professor, Soil and Water Science; Ph.D., 1967, Iowa State University

Wassertone, Marvin (1986), Associate Professor, Geography and Regional Development; Joint Appointment as Associate Professor of Hydrology and Water Resources; Ph.D., 1983, Rutgers University

Watts, Susan E. (1983), Agent, 4-H Youth Development; M.S., 1993, The University of Arizona


Wdowiak, Catherine R. (1994), Assistant Professor, Naval Science; M.S., 1988, Troy State University

**Wearing, John P. (1974), Professor, English; J.D., 1968, New York University**

Wearing, Michael C. (1987), Professor, English; M.F.A., 1993, The University of Arizona

Wearing, Martin (1986), Associate Professor, English; Ph.D., 1987, Catholic University of America

Wearing, Willard S. (1969), Professor, English; Ph.D., 1978, Johns Hopkins University

Wearing, William A. (1987), Professor, Political Science; Ph.D., 1990, The University of Chicago

Wearing, William A. (1992), Professor, Political Science; Ph.D., 1990, The University of Chicago

Watts, John E. (1984), Specialist, Soil and Water Science; Research Scientist, Soil and Water Science; Ph.D., 1982, The University of Arizona

White, Donald (1958 -83), Executive Vice President Emeritus; B.A., 1962, The University of Arizona

White, Donald (1958 -83), Professor, English; J.D., 1968, New York University

White, Donald (1958 -83), Professor, English; Ph.D., 1987, Johns Hopkins University


Whiting, Allen S. (1982), Regents' Professor; Professor, Political Science; Ph.D., 1952, Columbia University

Whiting, Frank M. (1965), Professor, Animal Sciences; Ph.D., 1971, The University of Arizona

Whitfield, Stacie G. (1989), Associate Professor, Art; Ph.D., 1986, University of California at Los Angeles

Widajja, Indra (1994), Assistant Professor, Electrical and Computer Engineering; Ph.D., 1992, University of Toronto

Wierenga, Peter J. (1988), Head, Soil and Water Science; Professor, Soil and Water Science; Investigator, Center for Toxicology; Ph.D., 1968, University of California at Davis

Wiersma, Frank (1957-89), Professor Emeritus, Agriculture Engineering; Ph.D., 1966, Oklahoma State University

Wigley, David E. (1985), Professor, Chemistry; Ph.D., 1983, Purdue University

Wilcox, Mark A. (1992), Assistant Agent, Agriculture; M.S., 1991, Arizona State University

Wiggin, Carol C. (1986), Director, Southwest Studies Center; Editor, Journal of the Southwest; Ph.D., 1986, University of Notre Dame

Wildner-Bassett, Mary E. (1986), Associate Professor, German; Ph.D., 1983, Ruhr University

Wilford, Benjamin S. (1992), Assistant Professor, Pediatrics; M.D., 1985, New Jersey Medical School

Wilhelm, Mari S. (1982), Associate Professor, Family and Consumer Resources; Ph.D., 1982, Michigan State University

Wilkin, Donovan C. (1980), Associate Professor, Renewable Natural Resources; Ph.D., 1971, University of California at Irvine

Wilkins, David E. (1990), Associate Professor, Political Science; Ph.D., 1990, University of North Carolina at Chapel Hill

Wilkinson, Richard H. (1988), Senior Lecturer, Humanities; Ph.D., 1986, University of Minnesota

Willard, Thomas S. (1978), Associate Professor, English; Ph.D., 1978, University of Toronto

Willerton, John P. (1988), Associate Professor, Political Science; Ph.D., 1985, University of Michigan

Williams Jr., Robert A. (1987), Professor, Law; Joint Appointment as Professor of American Indian Studies; J.D., 1990, Harvard University

Williams, David A. (1993), Associate Professor, Communication; Ph.D., 1971, University of Utah

Williams, David G. (1995), Assistant Professor, Range Management; Ph.D., 1992, Washington State University
Williams, Edward J. (1968), Professor, Political Science; Ph.D., 1966, Johns Hopkins University

Williams, Frank R. (1977), Specialist, Home Economics; Th.D., 1973, Boston University

Williams, Jacqueline A. (1995), Assistant Professor, Marketing; Ph.D., 1995, Florida State University

Williams, Jane W. (1988), Associate Professor, Art; Ph.D., 1987, University of California at Los Angeles

Williams, Jean Marie (1969), Professor, Psychology; Ph.D., 1975, Florida State University

Williams, John G. (1992), Director, Nuclear Reactor Laboratory; Professor, Nuclear and Energy Engineering; Ph.D., 1971, London University

Williams, Karen Ann (1983), Team Leader, Social Sciences; M.A.L.S., 1982, University of Michigan

Williams, Linda F. (1995), Associate Librarian; Librarian, Head of Technical Services; M.L.S., 1973, University of Michigan

Williams, Michael L. (1992), Assistant Professor, Dance; B.M., 1978, University of Kentucky

Williams, Stuart K. (1990), Chair, Biomedical Engineering; Ph.D., 1986, University of Arizona

Wills, Carol L. (1984), Associate Agent, Home Economics; Acting Director, County Extension; M.S., 1969, Arizona State University

Wills, Elizabeth (1996), Assistant Professor, Arizona Research Laboratories; Ph.D., 1989, The University of Arizona


Wilson, Clifton E. (1961-88), Professor Emeritus, Political Science; Ph.D., 1964, University of Minnesota

Wilson, Fraser A. W. (1996), Assistant Professor, Psychology; Ph.D., 1985, Oxford University

Wilson, Jean M. (1990), Assistant Professor, Cell Biology and Anatomy; Ph.D., 1985, University of California at Davis

Wilson, John M. (1974), Professor, Dance; Joint Appointment as Professor of International Studies; Ph.D., 1968, University of Wisconsin

Wilson, Paul N. (1982), Professor, Agricultural and Resource Economics; Ph.D., 1982, University of Minnesota

Wilson, William J. (1965), Associate Professor, Near Eastern Studies; Ph.D., 1965, University of Utah

Wilson-Sanders, Susan E. (1980), Director, University Animal Care; Veterinary Specialist, University Animal Care; Adjunct Professor, Veterinary Science; Research Lecturer, Internal Medicine; M.S., 1976, Texas A and M University

Wimmer, Gayle E. (1977), Professor, Art; M.F.A., 1971, Tyler School of Art

Winans, S. Sherwood (1964), Agent, Agriculture; Director, County Extension; M.Ed., 1971, Colorado State University

Winfree, Arthur T. (1986), Regents' Professor, Professor, Ecology and Evolutionary Biology; Ph.D., 1970, Princeton University

Wing, William H. (1974), Professor, Physics; Professor, Optical Sciences; Professor, Arizona Research Laboratories; Joint Appointment as Professor of International Studies; Ph.D., 1968, University of Michigan

Winklow, Diane J. (1980), Associate Professor, Theatre Arts; M.F.A., 1977, University of California

Winerling, Joy J. (1995), Assistant Professor, Nutritional Sciences; Adjunct Assistant Professor, Arizona Research Laboratories; Ph.D., 1990, The University of Arizona

Wirsching, Paul H. (1970), Professor, Aerospace and Mechanical Engineering; Ph.D., 1970, University of New Mexico

Wise, Mark E. (1984), Associate Professor, Animal Sciences; Joint Appointment as Assistant Professor of Physiology; Ph.D., 1982, University of Nebraska

Wissner, Helen J. (1939-74), Extension Agent Emeritus; B.S., 1933, Michigan State University

Witte, Charles L. (1969), Professor, Surgery; M.D., 1960, New York University

Witte, Marlys H. (1970), Professor, Surgery; M.D., 1960, New York University

Wittig, Monique M. (1990), Professor, French and Italian; Ph.D., 1986, Sorbonne, Universite De Paris

Witulski, Arthur F. (1989), Associate Professor, Electrical and Computer Engineering; Ph.D., 1988, University of Colorado

Wojtkowski, Maciej P. (1984), Associate Professor, Mathematics; Ph.D., 1978, Moscow State University

Wolfe, William L. (1969-95), Professor Emeritus, Optical Sciences; M.S.E., 1966, University of Michigan

Wolfson, Catherine L. (1974), Associate Librarian; Librarian, Reference; M.A., 1973, University of Missouri

Woloshin, David J. (1957-83), Professor Emeritus, German; Ph.D., 1968, The University of Arizona

Wood, Bruce (1967), Associate Professor, Mathematics; Ph.D., 1967, Lehigh University

Woodard, Dudley B. (1983), Head, Educational Administration and Higher Education; Professor, Educational Administration and Higher Education; Ph.D., 1969, Ohio University

Wooders, John C. (1991), Assistant Professor, Economics; Ph.D., 1991, Cornell University

Woods, Theodore L. (1967-88), Associate Professor, Economics; Ph.D., 1967, University of Southern California

Woods, Alexander H. (1964-86), Associate Professor Emeritus, Internal Medicine; M.D., 1952, Johns Hopkins University

Woods, Rex A. (1988), Associate Professor, Music; J.D., 1988, Arizona State University

Woodson, Drexel G. (1990), Assistant Research Anthropologist; Ph.D., 1990, University of Chicago

Woolf, Neville J. (1974), Professor, Astronomy; Astronomer, Steward Observatory; Ph.D., 1959, Manchester University

Woolfenden, James M. (1974), Professor, Radiology; M.D., 1968, University of Washington

Worthen, Thomas D. (1965), Associate Professor, Classics; Ph.D., 1968, University of Washington

Wortman, Robert H. (1976), Associate Professor, Civil Engineering and Engineering Mechanics; Adjunct Associate Professor, Planning; Ph.D., 1970, University of Illinois Urbana Campus

Wrenn, Robert L. (1962), Faculty Associate; Professor, Psychology; Ph.D., 1962, Ohio State University

Wright, Arthur L. (1975), Associate Professor, Mathematics; Associate Professor, Computer Engineering; Ph.D., 1974, University of California at Irvine

Wright, Ewan M. (1989), Associate Professor, Optical Sciences; Joint Appointment as Assistant Professor, Physics; Ph.D., 1983, Heriot-Watt University

Wright, Glenn C. (1992), Assistant Research Scientist, Agricultural Experiment Station; Ph.D., 1991, Utah State University

Wright, J. Edward (1992), Assistant Professor, Near Eastern Studies; Joint Appointment as Assistant Professor, Judaic Studies; Ph.D., 1991, Brandeis University

Wright, Ron (1995), Assistant Professor, Communication; Ph.D., 1993, University of Pennsylvania

Wright, Stephen H. (1982), Professor, Physiology; Investigator, Center for Toxicology; Ph.D., 1978, University of California at Irvine

Wright, William H. (1986), Head Coach, Men's Tennis; J.D., 1963, University of Denver

Wyant, James C. (1974), Professor, Optical Sciences; Joint Appointment as Professor, Electrical and Computer Engineering; Ph.D., 1968, University of Rochester

Wyganski, Israel J. (1986), Professor, Aerospace and Mechanical Engineering; Ph.D., 1964, McGill University

Wymore, A. Wayne (1957-87), Professor Emeritus, Systems and Industrial Engineering; Ph.D., 1956, University of Wisconsin

Wynn, M. Karen (1990), Associate Professor, Psychology; Joint Appointment as Research Social Scientist, Social and Behavioral Sciences Research Institute; Ph.D., 1990, Massachusetts Institute of Technology

Wysocki, Vicki H. (1996), Associate Professor, Chemistry; Ph.D., 1987, Purdue University
Xin, Xue (1991), Assistant Professor, Mathematics; Ph.D., 1990, New York University

Xiong, Zhongguo (1991), Assistant Professor, Plant Pathology; Ph.D., 1988, Kansas State University

Yakowitz, Sidney J. (1966), Professor, Systems and Industrial Engineering; Ph.D., 1967, Arizona State University

Yalkowsky, Samuel H. (1982), Professor, Pharmaceutical Sciences; Ph.D., 1969, University of Michigan College of Pharmacy

Yall, Irving (1957-83), Professor Emeritus, Microbiology; Ph.D., 1953, Purdue University

Yamamura, Henry I. (1975), Professor, Economics; Ph.D., 1971, Institute of International University

Yamamura, Henry I. (1975), Professor, Economics; Ph.D., 1971, Institute of International University

Yamamura, Henry I. (1975), Professor, Economics; Ph.D., 1971, Institute of International University

Yamamura, Henry I. (1975), Professor, Economics; Ph.D., 1971, Institute of International University

Yamamura, Henry I. (1975), Professor, Economics; Ph.D., 1971, Institute of International University

Young, Paul J. (1992), Assistant Research Scientist; Ph.D., 1988, University of Alberta

Young, Carlton J. (1995), Assistant Professor, Surgery; M.D., 1987, Johns Hopkins University

Young, Deborah J. (1982), Director, County Extension; Agent, Agriculture; Ph.D., 1982, The University of Arizona

Young, Emily H. (1993), Assistant Professor, Geography and Regional Development; Ph.D., 1996, University of Texas

Young, Erick T. (1988), Associate Astronomer, Steward Observatory; Ph.D., 1978, State University of New York

Young, David E. (1986), Associate Professor, Medicine; M.D., 1977, University of Florida

Yool, Stephen R. (1995), Assistant Professor, Geography and Regional Development; Adjunct Assistant Professor, Planning; Ph.D., 1985, University of California at Santa Barbara

Zandt, George (1997), Professor, Geosciences; Ph.D., 1978, Massachusetts Institute of Technology

Zapotocky, Joseph A. (1953-82), Professor Emeritus, Pharmaceutical Sciences; Ph.D., 1948, Ohio State University

Zehnder, Joseph A. (1988), Associate Professor, Atmospheric Sciences; Ph.D., 1986, University of Chicago

Zeigler, Bernard P. (1985), Professor, Electrical and Computer Engineering; Ph.D., 1968, University of Michigan

Zelinski, Brian J. (1987), Associate Professor, Materials Science; Ph.D., 1987, Massachusetts Institute of Technology

Zemel, Rich S. (1996), Assistant Professor, Psychology; Ph.D., 1994, University of Toronto

Zepeda, Ofelia (1986), Associate Professor, Linguistics; B.A., 1977, The University of Arizona

Zhu, Jian-Kang (1996), Assistant Professor, Plant Sciences; Ph.D., 1993, Purdue University

Ziegler, Charles D. (1967-91), Lecturer Emeritus, Wildlife and Fisheries Science; M.S., 1954, Oregon State College

Ziolkowski, Richard W. (1990), Professor, Chemistry; Associate Professor, Astronomy; Ph.D., 1984, University of California at Berkeley

Zreda, Marek G. (1994), Assistant Professor, Hydrology and Water Resources; Investigator, Center for Toxicology; Ph.D., 1994, New Mexico Institute of Mining and Technology

Zabe, Ervin H. (1977-96; 1996), Professor Emeritus; Ph.D., 1973, Clark University

Zukoski III, Charles F. (1969-94), Professor Emeritus, Surgery; M.D., 1951, Harvard University

Ziurys, Lucy M. (1996), Associate Professor, Chemistry; Associate Professor, Astronomy; Ph.D., 1984, University of California at Berkeley

Ziurys, Lucy M. (1996), Associate Professor, Chemistry; Associate Professor, Astronomy; Ph.D., 1984, University of California at Berkeley

Zwieg, Bella (1987), Senior Lecturer, Humanities; Ph.D., 1982, Stanford University

Zwinger, Lynda M. (1984), Associate Professor, English; Ph.D., 1984, State University of New York at Buffalo

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

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Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara

Zwolinski, Malcolm J. (1978), Associate Professor, English; Ph.D., 1976, University of California at Santa Barbara
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<tr>
<th>Building Name</th>
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<tbody>
<tr>
<td>Central Refrig. Plant</td>
<td>174</td>
</tr>
<tr>
<td>Chemistry &amp; Bio. Sci Class/Lab</td>
<td>113</td>
</tr>
<tr>
<td>Chemistry, Old</td>
<td>41</td>
</tr>
<tr>
<td>Cherry Avenue Parking Garage</td>
<td>115</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>72</td>
</tr>
<tr>
<td>Clinical Resources Unit</td>
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<td>Cochise Hall</td>
<td>31</td>
</tr>
<tr>
<td>Cocenino Hall</td>
<td>5</td>
</tr>
<tr>
<td>Communication/Speech</td>
<td>25</td>
</tr>
<tr>
<td>Computer Center (CCIT)</td>
<td>73</td>
</tr>
<tr>
<td>Comstock, AHSC</td>
<td>559</td>
</tr>
<tr>
<td>Controller's Office</td>
<td>153</td>
</tr>
<tr>
<td>Corleone Apartments</td>
<td>435</td>
</tr>
<tr>
<td>Coronado Hall</td>
<td>65</td>
</tr>
<tr>
<td>Crown Hall (Music)</td>
<td>4</td>
</tr>
<tr>
<td>Cultural Affairs</td>
<td>158</td>
</tr>
<tr>
<td>Day Hall</td>
<td>205</td>
</tr>
<tr>
<td>Dean of Students</td>
<td>21</td>
</tr>
<tr>
<td>Development Office</td>
<td>109</td>
</tr>
<tr>
<td>Disability Related Rcs.</td>
<td>64</td>
</tr>
<tr>
<td>Douglass</td>
<td>28</td>
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<td>E - East Stadium</td>
<td>61</td>
</tr>
<tr>
<td>Economics Building</td>
<td>23</td>
</tr>
<tr>
<td>Engineering, Mines, College of</td>
<td>72</td>
</tr>
<tr>
<td>Engineering Building</td>
<td>20</td>
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THE UNIVERSITY OF ARIZONA®
Campus Parking Map
1997-1998

LEGEND:
- Zone 1
- Flex Lot Permit Parking
- Lot Specific Permit Parking
- Construction
- Visitor Parking Lot
- Gated Area 1
- Gated Area 2
- Gated Area 3
- Motorcycle Parking
- Closed to traffic (M-F 7-4)
- Restricted Area
For Copies of Other University Catalogs:

General Catalog
Write: ASUA Bookstore

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