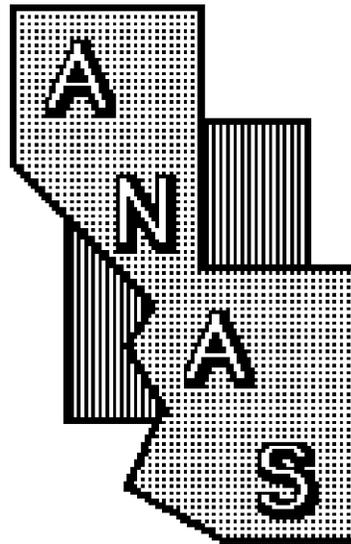


PROCEEDINGS
OF THE
ARIZONA-NEVADA
ACADEMY OF SCIENCE



FIFTY FIFTH ANNUAL MEETING

April 9, 2011

Glendale Community College,
Glendale, AZ

TABLE OF CONTENTS

ABBREVIATED SCHEDULE AND ACTIVITY LOCATIONS	2
SUMMARY OF SECTION MEETINGS.....	3
SPONSORS	4
LUNCHEON SPEAKER.....	5
BIOLOGY/PSYCHOLOGY SESSION	6
GEOLOGY SESSION	12
GEOGRAPHY SESSION.....	17
HYDROLOGY	21
MATHEMATICS SESSION	47
POSTER SESSION	29
ACADEMY BUSINESS AND ANNUAL REPORTS	38
OFFICERS 2010-2011.....	38
COMMITTEE ROSTER	39
BUD ELLIS SCHOLARSHIP	40
OUTSTANDING TEACHER AWARD	40
OUTSTANDING SERVICE AWARD	41
FELLOWS REPORT	41
MEMBERSHIP REPORT	42
NECROLOGY REPORT.....	42
SCIENCE OLYMPIAD/SCIENCE BOWL REPORT.....	42
TREASURER'S REPORT	44

ABBREVIATED SCHEDULE AND ACTIVITY LOCATIONS

Friday, April 8

Board of Governors meeting from 6:00-9:00 PM

Glendale, AZ

Saturday, April 9

All section meetings on Saturday will take place in the Business building (B) on the campus of Glendale Community College, Glendale, AZ. The luncheon and awards program will take place in the Student Union building (SU104).

7:00-8:30 AM	Registration: Lobby
8:00-10:00	Paper Sessions: See section schedule
10:00-10:30	Coffee Break and Poster Session: Student Union Room SU 104
10:00-11:30	Paper Sessions: See section schedule
11:30-1:30	Annual ANAS Awards Luncheon and Annual Business Meeting: Student Union Room SU104
1:45: 2:00	Paper Sessions: See section schedule

SUMMARY OF SECTION MEETINGS

Section	Time	Room
Biology/Psychology	8:30	202
Geography	8:40	203
Geology	9:00	205
Hydrology	8:00	206
Mathematics	8:30	207
Poster Session	10:00	Student Union

All rooms are in the Business building (B)

SPONSORS

The Academy would like to thank the following sponsors for their generous contributions to the annual meeting.



NEW COLLEGE OF INTERDISCIPLINARY ARTS AND SCIENCES
ARIZONA STATE UNIVERSITY AT THE WEST CAMPUS



"MyLab" and "Mastering" give educators the ability to move each student toward the moment that matters most in learning: the moment of true understanding. MyLab and Mastering flex to the unique needs of each student and can be easily customized to your specific course goals and content. The result? Inspired students, higher success rates, and better retention.

Learn more about how instructors and students are successfully using these Pearson Education products in their courses at <http://elearning.pearsonhighered.com/index.shtml>.

LUNCHEON SPEAKER

DR. BRIAN SULLIVAN

**“IMPACTS OF URBANIZATION AND GRAZING ON HERPETOFAUNAL
COMMUNITIES OF THE SONORAN DESERT: SEPARATING MYTHS FROM
REALITIES”**

Dr. Sullivan is Professor of Herpetology at ASU West. He earned an under graduate degree at the University of California, Berkeley and a Ph.D. at Arizona State University. He was a Postdoctoral Associate at the University of Texas, Austin and served as the Editor of the *Journal of Herpetology* from 2000 through 2005.

He is interested in the evolutionary biology of vertebrates; more specifically, his research is focused on the behavior, ecology, conservation, and systematics of amphibians and reptiles of arid regions, especially the southwestern United States.

He has authored over 100 articles, book reviews, technical reports, and book chapters, including many coauthored with students and colleagues in the Phoenix area.

BIOLOGY/PSYCHOLOGY SESSION

SESSION: 8:30

ROOM: 202

Chairperson: Robert Bowker

**8:30-8:45 *TRANSCRIPTIONAL REGULATION OF THE ANTI-AGING GENE
KLOTHO BY 1,25-DIHYDROXYVITAMIN D₃**

Ryan E. Forster¹, G. Kerr Whitfield², Carol A. Haussler², Ichiro Kaneko², Peter W. Jurutka^{2,3} and Mark R. Haussler (¹Arizona State University, Tempe, AZ, ²University of Arizona College of Medicine-Phoenix, AZ, ³Arizona State University, Glendale, AZ)

The Klotho gene (*kl*) encodes a kidney protein (Kl) that suppresses age-related phenotypes as a coreceptor for FGF23. The action of FGF23, as mediated via Kl/FGFR, is to prevent hyperphosphatemia that could arise after the action of 1,25-dihydroxyvitamin D₃ (1,25D), which stimulates both calcium and phosphate absorption in the intestine and reabsorption at the kidney. The 1,25D hormone acts through the vitamin D receptor (VDR) to activate the production of FGF-23, which then downregulates the phosphate transporters NPT2a and NPT2c to decrease kidney phosphate reabsorption. This is in opposition to 1,25D action to promote kidney phosphate reabsorption, which is then attenuated by FGF23 to close the endocrine loop. We hypothesized that 1,25D, acting through the vitamin D receptor (VDR), also directly regulates *kl*. Quantitative real time PCR using total RNA from three kidney cell lines (HK-2, IMCD3 and mpkDCT) revealed a 1.5-4.5-fold 1,25D/VDR-dependent upregulation of *kl*. Oligonucleotides corresponding to candidate mouse and human vitamin D responsive elements (VDREs) were tested in gel mobility shift assays. Several VDREs in the mouse and human promoter region that exhibited potent VDR/RXR binding also demonstrated the ability to mediate transcriptional activation in response to 1,25D when cloned into a pLuc-MCS luciferase reporter vector. Western blot analysis raises important questions about how each of the three known forms of Kl protein is regulated to influence aging. Our results suggest that 1,25D not only regulates bone mineral homeostasis but also ameliorates certain aging related phenotypes via direct upregulation of *kl*.

**8:45-9:00 *DIRECT REGULATION OF FGF23 BY VITAMIN D RESPONSIVE
ELEMENTS TO MAINTAIN PHOSPHATE HOMEOSTASIS**

Rimpi K. Saini¹, G. Kerr Whitfield², Carol A. Haussler², Peter W. Jurutka^{2,3} and Mark R. Haussler² (¹Arizona State University, Tempe, AZ, ²University of Arizona College of Medicine-Phoenix, AZ, ³Arizona State University, Glendale, AZ)

Fibroblast growth factor 23 (FGF23) is a circulating phosphaturic hormone synthesized in osteocytes that corrects hyperphosphatemic states by stimulating renal phosphate excretion via the fibroblast growth factor receptor-1 and its klotho coreceptor. FGF23 null mice are unable to correct the severe hyperphosphatemia and ectopic calcification that results from calcium and phosphate intestinal absorption and renal reabsorption that are simulated by 1,25-dihydroxyvitamin D (1,25D). FGF23 synthesis is activated by the 1,25D bound vitamin D receptor (VDR), resulting in FGF23-directed suppression of the phosphate transporters NaPi-IIa and NaPi-IIc, decreasing renal phosphate reabsorption and resulting in urinary phosphate excretion. Although 1,25D is believed to modulate FGF23 via an indirect (secondary mechanism), we hypothesize that FGF23 production is augmented by direct binding of the 1,25D/VDR complex to vitamin D responsive element(s) (VDREs) in the promoter region of FGF23. Bioinformatic analysis identified four putative VDREs both 3' and 5' of the FGF23 transcription start site. Oligonucleotides containing these VDREs were analyzed in gel shift mobility assays to assess VDR binding potential; all VDREs tested revealed varying binding affinities to VDR. The VDREs were cloned into a pLuc-MCS luciferase reporter vector and tested for transcriptional activation capabilities in response to 1,25D in three different cell lines. The results indicate that one or more of these putative VDREs may mediate direct transcriptional activation of the FGF23 gene when bound by a 1,25D liganded VDR complex.

9:00-9:15 DEVELOPING A LUMINOMETER SYSTEM WITH CONTINUOUS EXTRACELLULAR MANIPULATION

Jordan Roberts, Stephanie Yu, Francisco J. Solis and Pamela A. Marshall, (Arizona State University, Phoenix, AZ)

We are interested in analyzing intracellular responses to extracellular calcium fluxes using the model organism *Saccharomyces cerevisiae*, or budding yeast. After an extracellular pulse of calcium, we know that the calcium gets into the cells through a plasma membrane transporter and then the yeast sequesters the calcium in the vacuole, roughly equivalent to the human lysosome. We seek to determine the additional parameters contributing to calcium homeostasis in this yeast. We use transformed yeast cells (*S. cerevisiae*) expressing the calcium indicating photoprotein aequorin, and measuring the resulting light output as a measure of the amount of cytoplasmic calcium. Most luminometers can only quantify cellular responses to a single calcium pulse and we wish to develop methods to study multiple pulses. Once we have identified these cellular responses, we wish to mathematically model them using a series of differential equations, such as in Marshall et al., Discrete and Dynamical Systems B, v12 p439. We have been successful at developing the equations for a single pulse of calcium; however, the apparatus we have been using was not capable of more complicated extracellular calcium manipulations. Our team sought to design and construct an apparatus capable of continuously manipulating the extracellular calcium concentration around transformed yeast cells (*S.*

cerevisiae) expressing the calcium indicating photoprotein aequorin, and measuring the resulting light output. We will describe the process of construction (including proposed alternatives to the materials that were used), and the pitfalls of its production, such as having to fashion some components by hand. We will also discuss future applications of this custom luminometer device and will demonstrate some sample data taken with the device.

**9:15-9:30 DEVELOPMENT OF A NOVEL DIAGNOSTIC ASSAY FOR
ALZHEIMER'S DISEASE**

Crista Procopio, Kristin Penunuri, Lee Nowak and Jon Valla (SOLS ASU Tempe Campus, Barrow Neurological Institute, and Arizona Alzheimer's Consortium)

Previous studies have shown that mitochondrial deficits, such as decreased Complex IV activity, may be relatively specific to Alzheimer's disease (AD), in both brain and peripheral tissues including blood platelets. However, existing modes of measuring Complex IV (cytochrome oxidase; CO) activity are time-consuming and highly variable; thus, our goal was to create an assay for CO activity that was reliable and could be widely performed via an easily-accessible tissue like blood platelets. We have thus applied our standard CO histochemical method to platelets maintained in suspension. Potassium cyanide co-incubation was used to test specificity of staining and to model the dynamic range of possible CO activity deficiencies. Stained platelets were centrifuged in specialized tubes such that densitometric imaging could be used for measurement. This optical densitometry applied to stained platelets centrifuged into a defined space was a reliable measure of CO enzyme activity. Our assay yielded high inter-rater reliability, repeatability, and a typical dose-response curve under cyanide inhibition. We continue to optimize anti-coagulation and buffer conditions toward further increasing reliability and ease of performance. The new assay has entered into clinical trials to determine specificity and sensitivity in AD and control patients. Given its ease of performance, low equipment demands, and low cost, this new assay could fill a significant need by providing pre-symptomatic diagnosis or broad-based population screening.

**9:30-9:45 *USING *CHLAMYDOMONAS REINHARDTII* IC78 AS A MODEL FOR
CILINARY DYSFUNCTION AND ITS TREATMENT**

Marion Dame (Glendale Community College, Glendale, AZ)

I am the mother of a 12-year old girl with a rare genetic disorder called Kartagener's syndrome (KS). Kartagener's is a primary ciliary dyskinesia and its hallmark feature is that its patients present with situs inversus, more commonly called reverse organs. The defect originates in a gene for DNAI1, or axonemal dynein, intermediate chain 1. DNAI1 is involved in attachment of

the outer dynein arms (ODA) to the ciliary axoneme. Without ODA, cilia cannot generate the bending forces required for mucociliary clearance and a host of other physiological functions. My daughter's daily struggle with KS has led me to my current interest in *Chlamydomonas reinhardtii*. Genetic mapping of *Chlamydomonas* has identified more than 200 mutations on 17 linkage groups with 125 different mutant loci which lead to flagellar dysfunction and assembly issues. *Chlamydomonas* IC78 is of special interest to me as it is thought to be a DNAI1 ortholog. This gene produces the 78,000 Mr intermediate chain of *Chlamydomonas* ODA. IC78 *Chlamydomonas* mutants exhibit missing ODA as do KS patients with DNAI1 mutations. My research question is to ask whether IC78 motility deficient mutants can be rescued by the transfection of wild-type DNA, and whether flagella assembly and function can be restored. The findings of my research will hopefully lead to a better understanding of ciliary dyskinesia and ultimately to better treatments and cures for patients like my daughter.

9:45-10:00 ACTION RESEARCH: UNIVERSITY OF ARIZONA HISPANIC ALUMNI CLUB

Patty Gámez, and Laura Gail Lunsford (University of Arizona, Tucson, AZ)

This action research project evaluated the extent to which the University of Arizona Hispanic Alumni Club (UAHA) helps Hispanic students attain their college degree. UAHA members (N = 174), who were either freshmen, sophomores and seniors, completed a survey to assess the resources provided by the program. There were three sections of the survey: evaluation of resources, evaluation of perceived needs as a student, and a demographics section. The first section had 21 Likert questions with a 1 - 5 response scale where 1 indicated "Strongly Disagree" and 5 indicated "Strongly Agree." The second section asked respondents to rank 6 items in order of importance to their college success. These items included factors such as academic advising, tutoring career advising/development, socializing, being involved on campus and other. The mean response was 4.02, indicating above average agreement that the program provided useful and helpful resources. The use of the resources made available by this program varied by class with freshmen using these resources the most (N = 87) and seniors using them the least (N = 43). Academic advising was ranked first by 18 students, while being involved on campus (N=18) and socializing (N=16) were ranked the lowest. One of the main goals of the program is to provide academic encouragement and support by providing tutoring services to its members. However, tutoring is the resource that is used the least by students (N=12).

10:00-10:30 COFFEE BREAK/POSTER SESSION: STUDENT UNION

10:30-10:45 DEVELOPMENT OF THE ARIZONA COLLEGE MENTORING INVENTORY

Laura Gail Lunsford (University of Arizona South, Sierra Vista, AZ)

The Arizona College Mentoring Inventory (ACMI) will fill a gap in the literature by providing an assessment tool to help students develop important developmental relationships. The conceptual framework draws on identity development, relationship attachment styles, and personality. Prior work suggests mentoring factors were not reliable for underrepresented minority students. Thus, the inclusion of a social desirability scale to measure impression management may be warranted. The ACMI will assess developmental needs that may be met by mentoring relationships. Part of the inventory may be piloted this spring. Focus groups will be held with undergraduates to refine ACMI items. The ACMI will then be administered online. Test-retest reliability will be assessed as well as convergent and divergent validity. The ACMI will be designed to provide results to students and to program administrators to facilitate student placement in appropriate developmental relationships.

10:45-11:00 HOW DO YEAST COMPENSATE FOR LOSS OF VACUOLE FUNCTION?

Nick Netzel, Jillian Wisby Guintchev and Pamela A. Marshall (Arizona State University, Phoenix, AZ)

The human lysosome and the equivalent vacuole of *S. cerevisiae* are the cellular waste deposit and recycling centers; however these organelles have additional functions including ion homeostasis. A large group of mutants in *Saccharomyces cerevisiae* that have malfunctioning or missing vacuoles has been isolated; however, in the laboratory, these cell strains can grow on rich media (YPD) in a similar fashion to wild type cells. We have been comparing wild type cells to total loss of vacuolar function mutants, *vps33* and *vps41*, studying changes in gene expression, using RNA gene expression microarray technology, and metabolic flux, using Biolog phenotype microarray plates, to determine how cells manage the loss of vacuolar function in these mutants. Cells lacking either *VPS33* or *VPS41* did upregulate several genes in common including: YLR243w, an essential gene of unknown function; several genes implicated in responses to stress, and several genes functioning in the secretory pathway, but no subunits of the proteasome. Biolog phenotype analysis determined that cells lacking *VPS33* or *VPS41* do not exhibit metabolic gain-of-function phenotypes to compensate for lack of vacuolar function. Instead Biolog analysis showed that the deletion mutants demonstrated lost phenotypes and sensitivities to chemicals, specific to each strain. We conclude that under rich media conditions, yeast use their vacuole more to regulate stress and ion response than as a site of degradation and turnover and do not utilize changes in metabolic flux to compensate for loss of the vacuole.

**11:00:11:15 BUILDING ARIZONA’S SCIENTISTS BY EMPOWERING TEACHERS
TO DEMAND STUDENT MOTIVATION**

Theodore G. Manno (Arizona Western College, Yuma, AZ)

Countries like China, Japan, and India now far surpass the USA in science aptitude. Student achievement is particularly low in Arizona, with many districts exhibiting an AIMS pass rate of $\leq 40\%$. Although studies indicate that most people blame poor parenting and socioeconomics for low student achievement, many schools diametrically oppose the academic philosophies of our successful foreign competitors and demand teaching techniques or philosophies that undermine teacher discretion, fractionalize learning targets while ignoring overarching concepts, and effectively decrease student ownership of learning. Of particular concern are (1) programs for English language learners which instruct vocabulary and grammar *uber alles*, thereby removing inspiring scientific experiences, and (2) practices of “social promotion” and “no failure”, which appear to set high standards but may actually be concessions to demanding parents or required appearances of student achievement. Herein, I present a vision for public science education that integrates a strong component of student responsibility, while recruiting people that show promising science and instructional skills to teach. I outline a proposal that includes limiting constraints imposed on teachers like pre-packaged lesson plans, lack of materials, and mastadon class sizes. Next, I show how student achievement will be increased by improving the societal status of teachers and attracting people that are competent in science and instruction to enter or stay in teaching. Finally, I show how shifting from a focus of teacher failure to student responsibility will truly leave no child behind in science education.

11:30-1:30 LUNCHEON: STUDENT UNION SU 104

GEOLOGY SESSION

SESSION: 9:00

ROOM: 205

Chairperson: Robert McCord

9:00- 9:15 *PALEOECOLOGICAL RECONSTRUCTION OF THE COCONINO SANDSTONE DEPOSITIONAL ENVIRONMENT

Rickey Bartlett (SESES, Northern Arizona University, Flagstaff, AZ)

The Coconino Sandstone is a well-studied formation, which is exposed throughout Northern Arizona. It is an eolian (windblown) sandstone, which was deposited in a huge erg, or dune sea, that stretched across present day Arizona, Colorado, New Mexico, and Utah during the Permian. While the Coconino contains no body fossils it possesses a wealth of trace fossil evidence of various animals, from spiders to large mammal like reptiles, and it has been postulated that fogs from the ocean provided both water for the organisms (as they do in the Namib), and a mechanism for preserving the trace fossils. The Namib Desert has been considered to be a viable analog for the Coconino erg but there are major differences between the two. An attempt is made here to produce a more detailed examination of the suitability of the Namib to explain both the physical and ecological properties of the Coconino depositional environment. The limited area of the Namib, its proximity to water, the lack of a cold offshore current as a fog-producing mechanism for the Coconino erg, together with the size and metabolic requirements of the Coconino fauna, all combine to limit the suitability of the Namib as an analog.

9:15-9:30 WERE EURYPTERIDS PREDATORS ON EARLY VERTEBRATES?

David K. Elliott (SESES, Northern Arizona University, Flagstaff, AZ)

Armored jawless vertebrates (agnathans) are present in the fossil record from the Late Ordovician (450 mya) to the Late Devonian (370 mya). They occur in sediments deposited in a variety of fresh, brackish, and marginal marine environments and are frequently associated with eurypterid arthropods, large marine predators. It has been assumed that the eurypterids preyed on agnathans, and it has even been suggested that their external armor was developed in response to this relationship. Unfortunately physical evidence has been lacking for this idea, although agnathan armor is common in some localities. It has also been suggested that the chelicerae (claws) of eurypterids were not strong enough to penetrate agnathan armor. A recently described agnathan shield from the Early Devonian Water Canyon Formation of northern Utah shows a series of punctures that fit closely the denticles on the claw of *Jaekelopterus*, a eurypterid known

to occur in the coeval Beartooth Butte Formation. In addition a recent functional analysis of the chelicera of the eurypterid *Acutiramus* suggests that *Jaekelopterus* would have been capable of penetrating agnathan armor. Taken together this new information supports the view that eurypterids were predators on early vertebrates.

**9:30-9:45 IDENTITY AND ORIGIN OF NORTH AMERICAN GLYPTODONTS
(LATE BLANCAN LAND MAMMAL AGE)**

David D. Gillette (Museum of Northern Arizona, Flagstaff, AZ), Robert McCord and Gavin McCullough (Arizona Museum of Natural History, Mesa, AZ), Larry Thrasher, (Bureau of Land Management, Safford, AZ), and Richard S. White, Jr. (International Wildlife Museum, Tucson, AZ)

Early Pleistocene glyptodonts of southern Arizona have been assigned to two species: *Glyptotherium texanum* and *Glyptotherium arizonae*. *Glyptotherium texanum* has been considered the least derived and the stratigraphically oldest glyptodont in North America, although some unpublished records appear to indicate still earlier glyptodonts in Mexico. Newly recovered specimens from the 111 Ranch fauna of earliest (Late Blancan) Pleistocene age indicate a greater range in individual size for the population heretofore assigned to *G. texanum*, and overlap in diagnostic characters between the two species as they are presently defined. These new specimens point to their synonymy. *Glyptotherium texanum* Osborn 1903 predates *Glyptotherium arizonae* Gidley 1926. If this hypothesis is correct, the stratigraphic range of *G. texanum* in Arizona extends from early to late Blancan Land Mammal Age. The holotype of *G. texanum* is from roughly correlative strata in western Texas. This postulated revision of the taxonomy of early *Glyptotherium* in North America simplifies comparisons with South American progenitors of this lineage. Late Pliocene glyptodonts in Argentina and Venezuela have recently been recognized as possible ancestors of *Glyptotherium*. *Boreostemma* sp. from Venezuela is a possible candidate for direct ancestry to the glyptodonts that expanded northward into Central America during the early stages of the Great American Biotic Interchange. Nevertheless, precise timing of this expansion northward remains to be resolved.

**9:45-10:00 NEW OBSERVATIONS ON THE THEROPOD AND CERATOPSIDIAN
DINOSAURS FROM THE CAMPANIAN FORT CRITTENDEN
FORMATION, SOUTHERN ARIZONA**

John-Paul Hodnett (Northern Arizona University, Flagstaff, AZ), Ralph E. Molnar (Museum of Northern Arizona, Flagstaff, AZ) and Robert D. McCord (Arizona Museum of Natural History, Mesa, AZ)

The lacustrine shales of the Late Cretaceous (Campanian) Fort Crittenden Formation of the Santa Rita Mountains have long yielded vertebrate fossils. Higher vertebrates such as hadrosaurs, titanosaurs, theropods, and ceratopsians are recorded at the familial level. However, a large, undescribed collection of dinosaur fossils from the Arizona-Sonora Desert Museum may help shed light on the diversity of dinosaurs from this unit. The fauna from the Fort Crittenden Formation is roughly correlative chronologically to the Late Cretaceous southern Laramidia biotas from southern Utah, New Mexico, Texas, and Mexico. Additional fragmentary ceratopsian cranial specimens and a re-examination of a sample of theropod teeth add to our understanding of this fauna. The new specimens of Ceratopsia include isolated teeth, a dentary fragment, a fragmentary squamosal, fragments of the (?) parietal, and other miscellaneous cranial bones found approximately in the same vicinity. The squamosal is elongated proximodistally. A single epoccipital, assumed to be part of the squamosal, is preserved. The epoccipital is triangular in shape, fused to the fragment of squamosal. A suture surface for the parietal is found medially. This anatomical trait, as well as the elongated squamosal, suggests these new specimens belong to a chasmosaurine ceratopsian, perhaps associated with the *Triceratops* or *Pentaceratops* clade. 19 incomplete isolated teeth indicate the presence of non-avian theropods. Most of these teeth may represent tyrannosauroids, although the characteristic interdenticular sulci are absent. A small tooth may represent a dromaeosauroid, and a medially or laterally flexed crown suggests a large allosauroid tetanuran. This theropod assemblage seems to resemble one from Coahuila, Mexico.

10:00-10:30 COFFEE BREAK/POSTER SESSION: STUDENT UNION

**10:30-10:45 THE SECOND RECORD OF A CALCANEUM FOR
CHASMAPORTHETES (MAMMALIA; CARNIVORA; HYAENIDAE);
EVIDENCE FROM THE ST. DAVID FORMATION, SOUTHEASTERN
ARIZONA**

John-Paul Hodnett (Northern Arizona University, Flagstaff, AZ), Richard White (International Wildlife Museum, Tucson, AZ) and Lars Werdelin (Swedish Museum of Natural History, Stockholm, Sweden)

The fossil record of the extinct “hunting hyaena”, *Chasmaporthetes*, is known from the Late Miocene to early Pleistocene of Africa, Eurasia, and North America. However, much of the specimens of *Chasmaporthetes* consist largely of dental and cranial elements with little known or published on the post-cranial skeleton. Of the post-cranial skeleton the specimens and descriptions of the tarsals, particularly the calcaneum, are rare. Until recently, a single example of a calcaneum was known only from the holotype of *Chasmaporthetes borissiaki*, a sub-adult individual originally described in Russian from the Pliocene of Eurasia. A new calcaneum

specimen for *Chasmaporthetes* was recognized from the paleontology collections at the American Museum of Natural History, New York. This specimen, collected from the Blancan NALMA (Late Pliocene) St. David Formation of southern Arizona, is considered here an adult calcaneum of *C. ossifragus*, the first of its kind for the species, and the second specimen of a calcaneum for *Chasmaporthetes* globally. The specimen is more gracile and anteroposteriorly elongated than seen in modern hyenas with some similarities to living felids. However, the width of the posterior expansion for the Achilles tendon is greater than the width of the cuboid facet, a unique trait only seen in derived modern hyenas like *Crocuta crocuta* (spotted hyena), *Hyaena hyaena* (striped hyena), and *Parahyaena brunnea* (brown hyena). The aardwolf (*Proteles cristatus*) is considered a living basal hyena and has a calcaneum that is structurally similar to the living coyote (*Canis latrans*). Structurally the calcaneum of *Chasmaporthetes*, based on the two known calcanii, supports the notion that this hyena was built for greater speed than its living relatives. However, like the living derived hyenas, *Chasmaporthetes* had evolved tarsals for efficient stabilization of the body for orally carrying heavy loads.

10:45-11:00 ARE TORTOISES THERMOMETERS?

Robert D. McCord (Arizona Museum of Natural History, Mesa AZ)

The use of tortoises as indicators of non freezing conditions has a long tradition in vertebrate paleontology. In a broad way this is undoubtedly true. The occurrence of the Eocene tortoise *Hadrianus* on Ellesmere Island at 78° north latitude cannot be doubted as to representing warmer conditions. The difficulty with using tortoises as thermometers lies with understanding, and quantifying, just what the limiting factors for tortoises are. Is it simply minimum temperature? or is it mean minimum temperature, duration of freezes or, in a long lived organism, frequency of frosts over 20 or 50 years? How do other factors, such as thermal inertia, specific variation, or the ability to burrow, complicate tortoises' use as a climate proxy? Reliability and accuracy of tortoises as climatic proxies should begin with the living species of tortoises. In North America this would be the four species in the genus *Gopherus*. Modern ranges should not be trusted as the living taxa may well represent relict populations of their true climatic potential. Rather, actual understanding of the limiting factors should be employed. With less certainty, approximations of minimum conditions may be determined for extinct taxa phylogenetically. With appropriate caution, such an approach may be used for extinct genera, such as *Hesperetudo*.

11:00- 11:15 DINOSAUR EGG SHELL FROM THE TERRESTRIAL CRETACEOUS (?CENOMANIAN) OF SOUTHEASTERN ARIZONA

Gavin McCullough and Robert D. McCord (Arizona Museum of Natural History, Mesa, AZ)

Recent investigations of the early Late Cretaceous Turney Ranch Formation within the Bureau of Land Management's Las Cienegas National Conservation Area (LCNCA) in southeastern Arizona have produced relatively abundant vertebrate fossils. Within the LCNCA Turney Ranch strata occur as locally undulating mudstones and sandstones, dramatically tilted so that near-vertical dips are common. Our activities and previous expeditions show that the region supported a diverse fauna including turtles and ornithopod (including possible hadrosaurid), theropod, sauropod, and ankylosaur dinosaurs. Among the newest additions to the collection are apparent dinosaur eggshell fragments, indicating a paleoenvironment suitable for dinosaur nesting. The eggshell fragments are identified as such by thickness, smooth concave aspect, bumpy convex aspect with regularly-spaced pores, and cross-sectional prismatic structure. Prism morphology is in concordance with the broad dinosauroid spherulitic eggshell organization category and more specifically the tubospherulitic morphotype thought to be indicative of sauropod or ornithischian dinosaurs.

11:30-1:30 LUNCHEON: STUDENT UNION SU 104

GEOGRAPHY SESSION

SESSION: 8:40

ROOM: 203

Chairperson: Anthony Brazel, Moderator: Donna Hartz

**8:40-9:00 UNDERSTANDING HYDRO-BIOGEOMORPHOLOGICAL CHANGES
DUE TO THE CENTRAL ARIZONA (CAP) CANAL ON A DESERT
WASH**

Abeer Hamdan (Arizona State University, Tempe, AZ)

The Central Arizona Project (CAP) canal is approximately 541 km (336 miles) long and traverses the state of Arizona from Lake Havasu City to Tucson. The canal truncates several smaller desert washes hampering the natural flow of sediment and water downslope causing water impoundment and sediment accumulation behind the canal. This research aims to answer how the canal affects hydro- biogeomorphological changes on desert washes that are blocked by the canal. The section of the study area was constructed between the years 1986-1987: aerial photographs and GIS were used to quantify landscape changes. The results show that in a 36-year period, vegetation increased by 477% upslope from the canal, whereas vegetation became barren below the canal. Sediment accumulation depths in the channel ranged from 0 - 5.7 cm increasing in depth nearest to the canal boundary. A kriged map of sediment depths shows that no apparent relationship exists between both: sediment accumulation depths and the spatial distribution of vegetation or between sediment accumulation depths and the density of vegetation. The interpolated map illustrates that channel flow direction is maintained when compared to visually estimated flow patterns in 1973. The present-day channel is approximately 13.7 m shorter downslope from its original length observed in 1973

9:00-9:20 DATA MINGE TRAVEL PATTERNS FROM GEO-TAGGED PHOTOS

Xun Li, Paul M. Torrens and Haojie Zhu (Arizona State University, Tempe, AZ)

Recently, the photo sharing websites, like Panoramio.com and Flickr.com provided millions of photos with geographical locations, through which people's digital footprints could be represented as the sequences of their geo-tagged photos. How to discover travel knowledge from these tremendous community-contributed geo-tagged photos becomes an interesting research question for behavioral geographers. In this paper, we present a novel hierarchical regions-of-interest (ROIs) based graph model for discovering travel patterns from geo-tagged photos. In this model, geo-tagged photos are firstly preprocessed to individual points-of-interest (POIs) by removing the visually redundant photos which have been taken at a same place. These individual

POIs are then clustered hierarchically into several groups by using a density-based spatial clustering method, which is called ordering points to identify the clustering structure (OPTICS), at different geographical scales. We further define ROIs as these clusters at different hierarchies. By doing so, each user's travel routes can be represented as the transitions among ROIs. Then, we discover the travel patterns, such as major travel flows and popular travel routes, from geo-tagged photos based on these directed graphs by using an apriori-like algorithm for sequential pattern discovery. To prove the usefulness of our method, we designed an experiment to discover travel patterns in California by using the publicly available geo-tagged photos which we retrieved from Panoramia.com. From this experiment, we successfully explored popular travel regions and discovered interesting travel patterns at different geographical scales in our study area.

9:20-9:40 RECONNAISSANCE VOLCANIC GEOLOGY OF THE BATAMOTE MOUNTAINS, AJO, ARIZONA)

Zack Bowles and Ronald Greeley (Arizona State University, Tempe, AZ)

The Batamote Mountains represent a 14 - 16 million year old eroded shield volcano in the Basin and Range province near Ajo, Arizona. Analysis of Landsat 7 Enhanced Thematic Mapper "Plus" data and field work were conducted to map the geology at 1:24,000 scale. Volcanic deposits and field relations indicate that mid-Tertiary eruptions initially involved mild explosions from at least six vents, evidenced by near-surface intrusive units surrounded by oxidized cinders and spatter deposits. The associated lava flows partly cover the pre-Batamote basement silicic volcanics. At least three subsequent effusive phases emplaced multiple flows from a minimum of six vents on the cinder cone deposits and earlier lava flows. The last volcanic event involved fire-fountains that produced several short, thin, agglutinated flows, forming the steeper summit of the volcano. Extension and normal faulting caused rocks in the central portion of the Batamote Mountains to collapse; subsequent erosion of summit material left the amphitheater morphology seen today.

9:40-10:00 ESTIMATING AGRICULTURAL WATER CONSUMPTION OVER AN ARID REGION USING REMOTE SENSING

Shai_Kaplan_(Arizona State University, Tempe, AZ)

Irrigated agriculture around Phoenix metropolitan area is the biggest user of fresh water (~60%), the most valuable resource in an arid environment. The main objective of this research is to quantify water consumption by agriculture using remote sensing. Specifically, estimate the seasonal evapo-transpiration as an indicator for water consumption and compare the spatio-

temporal water consumption between drought and wet years. Quantifying ET over large areas is important to understand water cycle, climate dynamics and ecological processes. Understanding these can influence water resources planning and water regulations, especially in arid regions. First, an object oriented approach is used to identify active agricultural fields. Second, daily evapo-transpiration was obtained by applying elements of the METRIC and ReSET energy balance models to a set of Landsat images. Finally, interpolation technique is used to estimate the seasonal evapo-transpiration. Preliminary results indicate daily ET ranges from less than 2 mm/day over bare soil and inactive agriculture to over 15mm/day over active agricultural fields.

10:00-10:30 COFFEE BREAK/POSTER SESSION: STUDENT UNION

10:30-10:50 DEFINING THE NORTH AMERICAN MONSOON USING CLIMATOLOGICAL ISENTROPIC ANALYSIS

Matthew B. Pace, Kimberly DeBiasse and Randall S. Cerveny (Arizona State University, Tempe, AZ)

Forecasting precipitation across the southwestern United States during the North American Monsoon (NAM) has been a long standing topic of research. While numerous studies have focused on synoptic scale analysis using constant pressure charts, only a few and dated studies have examined forecasting precipitation during the NAM using isentropic analysis. Within this research, the use of isentropic analysis, as a synoptic climatology forecast tool, was examined to determine its ability to forecast precipitation within Arizona during the NAM. Arizona climate division rainfall data were used to determine the ten most extreme driest and wettest monsoon seasons for Arizona, from the time period of 1959 through 2009. For these top events, average isentropic (300K-315K) and mixing ratio maps were created for analysis. Those years with below normal precipitation, the isentropic trough is shifted eastward and orientated along a southwest to northeast axis. Subsequently, moisture is shifted east of Arizona resulting in below normal precipitation. During years with above normal precipitation, a broader and deeper isentropic trough is present across the entire southwestern United States, with a north to south axis of orientation. This shift and orientation results in an influx of deep monsoonal moisture into Arizona from the south resulting in above normal precipitation. It appears as if the orientation and depth of the isentropic trough during the NAM can accurately represent uplift/flow of moisture resulting in enhanced or decreased precipitation across Arizona.

10:50-11:10 EFFECTS OF ACCLIMATION ON ATHLETIC PERFORMANCE

Kimberly DeBiasse (Arizona State University, Tempe, AZ)

While there are many elements to consider when determining one's risk of heat or cold stress, acclimation could prove to be an important factor to consider. Individuals that are participating in less strenuous activities, while being at a lower risk, will still feel the impacts of acclimation to a strenuous climate. To evaluate acclimation in strenuous conditions finishing times from six different marathon races were collected: the New York City Marathon (New York City, New York), Equinox Marathon (Fairbanks, Alaska), California International Marathon (Sacramento, California), LIVESTRONG Austin Marathon (Austin, Texas), Cincinnati Flying Pig Marathon (Cincinnati, Ohio), and the Ocala Marathon (Ocala, Florida). Additionally, various meteorological variables were collected for each race day and the five days leading up to the race. These values were tested against the finishing times for the local runners, participants that are from the race state, and visitors, those from another geographic location. Local acclimation is evaluated by comparing finishing times of local runners to the change in weather conditions between the race days conditions and the days leading up to the race. The visitors will be tested in a similar manor, but their times may be negatively or positively affected depending on how demanding their training conditions were.

11:10-11:30 SPATIAL AND CLIMATE VARIABILITY OF HEAT RELATED ILLNESS AND DEATH

Donna A. Hartz (Arizona State University, Tempe, AZ)

The detrimental health impacts of heat waves and excessive heat are well known. In the face of likely regional climate changes, and rapidly growing urban and elderly populations—both of which are associated with increased vulnerability to heat—cities worldwide are seeking to better understand localized triggers of heat related illness and deaths. Precise and effective warning systems would reduce heat related illness (HRI) and heat related mortality (HRM), but need to be locally adapted to take into account local conditions and vulnerabilities. Despite lack of uniformity in data and methodology in studies of heat related illness and mortality, there are clear patterns of variability in both climate and spatial distribution. This presentation will cover: the issues in data and methodology in HRI and HRM studies; present an up to date overview of the known spatial and climate variability in HRI and HRM; and show how these studies are being used to assist in formulating more effective, and locally specific Heat Health Watch and Warning Systems.

11:30-1:30 LUNCHEON: STUDENT UNION SU 104

HYDROLOGY

SESSION I: 8:00

ROOM: 206

Chairperson: Gerald Gottfried

8:00-8:15 ESTIMATING POST-FIRE PEAK FLOWS FOLLOWING THE SCHULTZ FIRE, COCONINO NATIONAL FOREST, ARIZONA

Karen A. Koestner and Daniel G. Neary (US Forest Service, Rocky Mountain Research Station, Flagstaff, AZ) and Peter E. Koestner (US Forest Service, Rocky Mountain Research Station, Phoenix, AZ)

Wildfire is a natural ecosystem disturbance that can drastically alter watershed function depending on the severity of the burn, the vegetative cover prior to the burn, the topographic setting, and the local climate regime. Post-fire peak-flows can be over an order of magnitude greater than peak-flows under pre-fire conditions. In June of 2010, The Schultz Fire consumed 6,100 ha of mixed-conifer forest on the eastern slopes of the San Francisco Peaks north of Flagstaff, Arizona. A US Forest Service Burned Area Emergency Response team (BAER) classified 70% of the burn area as high to moderate burn-severity, largely concentrated on steep slopes greater than 40%. The onset of summer monsoon precipitation in mid-July 2010 resulted in debris flows and unprecedented flooding from the burn area. Prior to the fire and subsequent flooding, the upper mountain had few defined channels consisting largely of ridge-swale topography with thick forest cover. These swales become more defined channels in the piedmont zone before emerging onto alluvial fans and becoming obscured by developments. Prior to the fire these channels rarely flowed. A high-intensity precipitation event on July 20th, 2010 significantly impacted the channel networks. In early August of 2010, channel cross-sections were surveyed in the piedmont zone to estimate the post-fire peak flows from the July 20th event. This paper presents estimated peak-flow data following the Schultz Fire, and compares these data to peak-flows modeled by the BAER team prior to flooding

8:15-8:30 AN EVALUATION OF SOIL MOVEMENT IN ARID CLIMATES OF CENTRAL CHILE

Roberto Pizarro and Carolina Morales (University of Talca, Talca, Chile), Pablo Garcia-Chevesich and Peter F. Ffolliott (University of Arizona, Tucson, AZ), Oscar Vallejos, Leonardo Vega, Rodrigo Valdés, Claudio Olivares, and Francisco Balocchi (Univ. of Talca, Talca, Chile)

We measured, analyzed, and modeled surface water erosion, deposition, and net erosion (the difference between erosion and deposition) in three administrative provinces of Coquimbo Region in northern Chile using erosion pins. Measurements were taken on 30 experimental plots distributed throughout the region after all of the limited rainfall events occurring in the years of 2007, 2008, and 2009. Soil bulk density characteristics were also obtained at different locations to convert the measurements of soil depth to tons per hectare. Soil erosion, deposition, and net erosion were correlated with precipitation data obtained from rain gauges. However, there were no significant differences between these measures of soil movement and precipitation among the provinces. Our analysis did indicate the need for erosion control activities in parts of the region since an estimated 10-year return period rainstorm would produce soil movement rates above sustainable values.

8:30-8:45 CHALLENGES AND STRATEGIES FOR SPRING ECOSYSTEM RESTORATION IN THE ARID SOUTHWEST

Mariah Giardina (School of Earth Sciences and Environmental Sustainability, Northern Arizona University, Flagstaff, AZ)

This paper addresses the challenges and opportunities that arise when attempting to effectively and successfully restore springs in the arid southwest. Spring ecosystems are unique and vital resources that offer valuable characteristics to the surrounding arid lands. Springs are hotspots for biodiversity; they harbor endemic and sometimes endangered species, as well as provide a wealth of information about groundwater quality and quantity. Unfortunately, spring ecosystems in arid regions are severely degraded due to a multitude of anthropogenic pressure and harmful interferences. Absence or inadequacy of effective management practices to conserve and protect these important ecosystems in the past has also contributed to the degradation of spring ecosystems in the arid Southwest. As awareness for improved management of springs in arid regions continues to gain momentum, the development of sound restoration practices of degraded spring ecosystems becomes important. While there is a plethora of information on effective restoration practices and strategies for riparian ecosystems, there has been little attention paid to the restoration of spring ecosystems in the literature. Even though some aspects of riparian restoration are certainly applicable to springs, it is important to acknowledge the specific requirements to restore spring ecosystems. This is important to carry out effective and lasting restoration of springs and thereby maintain the integrity of entire ecosystems in arid regions.

8:45-9:00 CHEVELON CANYON TREND ANALYSIS USING VULNERABILITY INDICATORS

Ian Dai and Aregai Teclé (School of Forestry, Northern Arizona University, Flagstaff, AZ)

This paper examines and analyzes the conditions of Chevelon Canyon, a tributary of the Little Colorado River, and its hydrological characteristics using a number of indicators. The indicators may be categorized into (1) water supply, distribution and consumptive use, and (2) in-stream use, water quality, ecosystem support and other environmental issues indicators. The specific indicators that belong to the first category include level of development, groundwater depletion, industrial water use and others, while those in the second category include water quality parameters such as temperature, dissolved oxygen, and quantity-related parameters such as flood risk, sensitivity to low flow, drought, and species at risk. Trend analysis of these indicators may show the effects of climate change and anthropogenic activities on watershed conditions. The knowledge gained in the study will be used to develop appropriate watershed and stream management recommendations.

9:00-9:15 APPROACHES TO THE RESTORATION OF PUEBLO COLORADO WASH

Tanya Henderson (School of Earth Sciences and Environmental Sustainability, Northern Arizona University, Flagstaff, AZ)

This paper examines the physical processes that have been employed to restore the Pueblo Colorado Wash located at the Hubbell Trading Post National Historic Site. The research work connected with this paper consists of a number of activities. One of them involves reviewing the literature pertaining to restoration of streams in the arid environments of the southwest. A second one investigates the effects of the limited restoration activities within the National Park Service (NPS) unit have on the condition of the Historic Site. A third research activity looks at restoration efforts at the watershed scale, outside of the NPS unit, on the Pueblo Colorado Wash. In so doing, this paper is the first attempt to collect data and analyze the impacts of the restoration efforts on Pueblo Colorado Wash. Hence, we anticipate that the knowledge gained will provide important information to guide and motivate for more riparian restoration in Northern Arizona.

9:15-9:30 THE CHANGING UPPER VERDE RIVER WATERSHED AND PLANS FOR ITS RESTORATION

Wes W. Swaffar (School of Earth Sciences and Environmental Sustainability, Northern Arizona University, Flagstaff, AZ)

This paper is designed to explain how the progression of historical management regimes has altered fundamental characteristics of forested watersheds in Northern Arizona. It also looks at planned ecological restoration efforts that presumably improve (alter) fundamental watershed characteristics with time. Like many forested watersheds in the western U.S., the Upper Verde River watershed has greatly suffered from forest management practices, namely livestock grazing, timber harvesting and fire suppression activities. The conditions of the watershed (both the forests on it and the Upper Verde River itself) have declined as a result of such practices. In an effort to mitigate the occurrence of catastrophic fire potential, the United States Forest Service and many stakeholders have begun the 4FRI (Four Forests Restoration Initiative). In addition to mitigating fire potential, the 4FRI will also improve watershed health. The paper will identify the benefits of this restoration effort with respect to the Upper Verde River watershed and make recommendations for additional watershed restoration actions.

9:30-9:45 MONITORING THE EFFECTS OF AIR-QUALITY ON FORESTS: AN OVERVIEW OF THE SIERRA ANCHA EXPERIMENTAL FOREST ICP-2 SITE

Peter E. Koestner (US Forest Service, Rocky Mountain Research Station, Phoenix, AZ), Karen A. Koestner, and Daniel G. Neary (US Forest Service, Rocky Mountain Research Station, Flagstaff, AZ)

The Sierra Ancha International Cooperative Program on Assessment and Monitoring of Air Pollution Effects on Forests study site or (SAEF-ICP II) is part of an international network of cooperative forest monitoring sites spread throughout Europe and the United States. The ICP II network was established to monitor long term effects of transboundary air pollution. The Sierra Ancha Experimental Forest was chosen to be a part the U.S.'s network because it is the southernmost Experimental Forest in the contiguous US and because it is downwind from a major metropolitan area, Phoenix, Arizona. The site monitoring includes forest overstory growth, crown condition, foliar chemistry, understory vegetation, litter fall, soil chemistry in solid and liquid phases, meteorology, ozone, nitrogen deposition, and Ultra Violet radiation. The purpose of this paper is to provide an overview of the ICP forest network, and discuss the research currently underway at the Sierra Ancha ICP II site. A review the data which have been collected thus far and a discussion of the challenges implementing ICP II data collection protocols are also included.

9:45-10:00 HAZARDOUS WASTE IN NATIONAL FORESTS IN ARIZONA AND THE WATERSHED OUTLOOK ON ADDRESSING THE CONTAMINATION, 2011

Anne P. Fischer, P.E. (AZ Statewide On-Scene Coordinator, USDA Forest Service, Phoenix, AZ)

Sadly, hazardous materials and hazardous waste are commonly found on our National Forests. They come in the shape of illegal dumps of chemicals, used oil, biological and solid waste; as spills from vehicle accidents; and as byproducts from abandoned mines. The largest issues are the heavy metals, acid rock drainage, and lab chemicals at the mines and mills. The US Forest Service has authority to use the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) to clean up sites on lands under its jurisdiction. Typically, sites are investigated on a watershed basis with a view to improving water quality throughout the watershed. Often this work is done in conjunction with state and EPA resources.

10:00-10:30 COFFEE BREAK/POSTER SESSION: STUDENT UNION

10:30-11:00 LET THE WATER DO THE WATERSHED RESTORATION WORK

Bill Zeedyk, (Zeedyk Ecological Consulting, Sandia Park, NM) and Van Clothier, (Stream Dynamics, Inc., Silver City, NM)

This presentation is based on the 2009 book *Let the Water Do the Work, Induced Meandering, an Evolving Method for Restoring Incised Channels* by Bill Zeedyk and Van Clothier. As a science, induced meandering relies on the disciplines of geology, hydrology, fluvial geomorphology, biology and ecology for knowledge and guidance. As an art, it strives to assist the stream in its career, using the power of floods to shape the channel and banks over time. The presentation describes which channel types are appropriate candidates for induced meandering techniques, and an overview of the process. This philosophy of “going with the flow”, can inform all stream restoration projects as we strive to understand rivers as timeless entities governed by immutable rules, serving their watersheds, setting their own timetables, and coping with their own realities as they carry mountains grain by grain to the sea. Rivers are to be treasured and respected, never bullied or coerced.

11:00-11:15 CHANGES IN GROUND COVER ON THE CASCABEL WATERSHEDS FOLLOWING THREE BURNING EVENTS

Peter F. Ffolliott Hui Chen and Cody L. Stropki (University of Arizona, Tucson, AZ), and Gerald J. Gottfried (U.S. Forest Service, Phoenix, AZ)

Percentages of plant material (foliage, twigs, and branches), litter (the uppermost layer of slightly decomposed organic debris on a soil surface), bare soil (cobble, gravel, and stones), and bedrock on a landscape surface have been useful in predicting the rates of hillslope soil erosion and indicate the successional status of vegetative communities on a site. The protection of a site that is afforded by vegetation and soil in relation to that of the “potential natural community” of the

site can also be estimated from knowledge of the cumulative percentages of bare soil and bedrock. Estimates of the percentages of plant material, litter, bare soil, and bedrock in the oak savannas on the Cascabel Watersheds of the Southwestern Borderland region before and after prescribed burning treatments and a wildfire are presented in this paper. Management implications are also indicated.

11:15-11:30 PRECIPITATION PATTERNS ON THE CASCABEL WATERSHEDS, PELONCILLO MOUNTAINS, NEW MEXICO

Gerald J. Gottfried (US Forest Service, Rocky Mountain Research Station, Phoenix, AZ), Peter F. Ffolliott (University of Arizona, Tucson, AZ), Daniel G. Neary and John H. Yazzie, Jr. (US Forest Service, Rocky Mountain Research Station, Flagstaff, AZ)

The Cascabel Watersheds were established in 2000 to determine the impacts of seasonal prescribed fires on the hydrologic and biological characteristics of encinal oak savannas on the Southwestern Borderlands Region. The study area, which covers 451.3 acres, is on the east side of the Peloncillo Mountains. It includes 12 instrumented watersheds; half are on the north side of an east-west running ridge and drain into Walnut Creek and half are on the south side of the ridge and drain into Whitmire Canyon. Elevations are between 5380 and 5590 feet. Instrumentation includes two full recording weather stations, one at the western side of the area and one on a lower ridge in the middle of the research area. Data from the weather stations are supplemented by six recording tipping bucket rain gages. Three are on the southern facing watersheds and three are on the northern facing areas. Unfortunately, the records are not complete for all stations. The common precipitation records from the eight stations were analyzed to determine preliminary relationships between gages and across the Cascabel Study area.

11:30-1:30 LUNCHEON: STUDENT UNION SU 104

SESSION II: Moderator: Peter Ffolliott

1:45-2:00 CONTRIBUTIONS OF SNOWMELT TO STREAMFLOW IN SOUTHEASTERN ARIZONA: A CASE STUDY FROM THE SANTA CATALINA MOUNTAINS

Gerald J. Gottfried (US Forest Service, Rocky Mountain Research Station, Phoenix, AZ) and Peter F. Ffolliott (University of Arizona, Tucson, AZ)

Little is known about the contributions of snowmelt to streamflow in the sky islands of

southeastern Arizona. Therefore, historical data sets obtained on snow courses maintained by the USDA Soil Conservation Service (now the Natural Resources Conservation Service) on the Santa Catalina Mountains from 1948 through 1983 and streamflow regimes in Sabino Canyon, measured by the US Geological Survey, are used as a basis to make a comparison between the two and, in doing so, determined whether snowpacks contribute significantly to streamflow regimes from the mountain. A comparison of these findings to the results from similar investigations in the regions of more extensive snowpacks in Arizona is also presented.

**2:00-2:15 INCORPORATING FUZZY LOGIC AND STOCHASTIC PROCESSES IN
MULTIOBJECTIVE FOREST MANAGEMENT**

Aregai Teclé (School of Forestry, Northern Arizona University, Flagstaff, AZ) and Shafiu Jibrin (Department of Mathematics and Statistics, Northern Arizona University, Flagstaff, AZ)

This presentation is concerned with the development of a multi-objective forest ecosystem management model that incorporates fuzzy logic and stochastic processes to tackle data uncertainty. The developed model would be suitable for selecting the most preferred management scheme for a complex forest ecosystem. The complexity arises from having a myriad of ecosystem components that intimately interact with each other. Another situation that adds to the complexity is the presence of a plethora of decision-makers that have varying and sometimes conflicting interests in the way the forest ecosystem is managed. The complex relationships and their dependence on the changing environmental conditions make it difficult to gather precise data for modeling purposes. This leads to uncertainty and imprecision on how the various ecosystem components respond to environmental and societal stresses such as drought, wildfire, excessive use of resources and other disturbances. The outcome of this preliminary investigation will lead to a more comprehensive research projects that would have wide scale applications.

**2:15-2:30 INTEGRATED WATERSHED MANAGEMENT: A COMPREHENSIVE
APPROACH TO LAND STEWARDSHIP**

Peter F. Ffolliott (University of Arizona, Tucson, AZ)

The underlying goal of integrated watershed management is to provide people with their desired goods and services in ways that sustain productive capabilities of the natural resources while minimizing the detrimental impacts to the basic soil and water resources. People desire or demand a variety of goods and services from a watershed landscape including water for their personal use, agricultural irrigation, or hydro-power; trees for processing into primary and secondary products; agricultural crops, meat, and dairy products; quality habitats for indigenous

wildlife populations; and outdoor recreational opportunities. Integrated watershed management practices develops and sustains production systems, protection capabilities, and social values that are inherently suited to the landscape conditions for the present and future generations of people in providing these benefits. Included in these management practices are those maintaining or enhancing the flows of high-quality water; preventing excessive soil erosion and nutrient loss from occurring; reducing downstream sedimentation and the flows of other pollutants; rehabilitating degraded watershed landscapes; or combinations of these benefits. A discussion of integrated watershed management practices in providing for better land stewardship is the focus of this paper.

POSTER SESSION

SESSION: 10:00-10:30

ROOM: Student Union 104

Chairperson: Erik Gergus

INHIBITION OF THE UREASE ACTIVITY FROM THE URINARY TRACT PATHOGEN *STAPHYLOCOCCUS SAPROPHYTICUS

A. Loes (Arizona State University, Tempe, AZ), L. Ruyle, M. Arvizu, and C. E. Deutch (Arizona State University West, Glendale, AZ)

The enzyme urease has been shown to be a virulence factor for the Gram-positive bacterium *Staphylococcus saprophyticus*, a leading cause of urinary tract infections. A 105,000 x g soluble extract was prepared to test enzyme inhibition by several known classes of urease inhibitors *in vitro*. Ammonium production by the enzyme was measured using a colorimetric assay which was linear with respect to time and volume. The range of inhibitory concentrations, the nature of the inhibition, and the K_i value were determined for hydroxamic acids, phosphorodiamidates, imidazoles, several glycosidal flavonoids, and structural analogues of the preferred substrate urea ($K_m = 6.8$ mM). Acetohydroxamic acid ($K_i = 8.2$ μ M) and DL-phenylalanine hydroxamic acid ($K_i = 8$ μ M) were shown to inhibit competitively. The phosphorodiamidate flurofamide exhibited mixed inhibition ($K_i = 553$ μ M), while phenyl phosphorodiamidate functioned as an alternative substrate. Omeprazole, an example of the imidazole compounds, did not inhibit the urease from *S. saprophyticus*, due to an absence of cysteine residues in the protein structure. Several compounds isolated from green tea extract also demonstrated mixed inhibition including (+)-catechin hydrate ($K_i = 1.23$ mM), and (-)-epigallocatechin gallate ($K_i = 460$ μ M). Dimethyl sulfoxide, a structural analogue of urea, inhibited in a competitive fashion ($K_i = 30$ mM). The data collected in this study indicate that these compounds might be considered as potential antibiotics to treat infections caused by *S. saprophyticus*.

*** FUNCTIONAL EVALUATION OF A NOVEL CARDIAC VITAMIN D RECEPTOR INTERACTING PROTEIN AS A POTENTIAL MEDIATOR OF HEART HEALTH**

C.R Tabacaru¹, I. Aguayo¹, Z. Hernandez¹, P.A. Marshall¹ and P.W. Jurutka^{1,2} (¹Arizona State University West, Phoenix, AZ, and ²University of Arizona College of Medicine, Phoenix, AZ)

The nuclear vitamin D receptor (VDR) modulates gene transcription in 1,25-dihydroxyvitamin D (1,25D) target tissues such as kidney, intestine, and bone. VDR is also expressed in heart and we have discovered, using *in-vitro* and two-hybrid assays, proteins expressed in cardiac tissue that interact with VDR and modify receptor activity. One such protein, Fas-activated

serine/threonine kinase (FASTK), appears to interact with VDR in a 1,25D-dependent manner based on GST "pulldown" assays. The functional effects of FASTK expression on 1,25D-mediated gene activation were explored in transcriptional assays in C2C12 mouse myoblasts as well as human embryonic kidney cells. In these transfected cells, VDR displayed robust transcriptional activity at physiological levels of 10^{-9} M 1,25D. Importantly, titration experiments revealed that increasing amounts of FASTK significantly increased VDR transactivation. The mechanism of FASTK augmentation of VDR activity was explored via ^{32}P phosphorylation assays, which revealed a decrease in the phosphorylation of VDR in the presence of FASTK. It is hypothesized that FASTK, a protein kinase, acts indirectly through phosphorylation of a protein phosphatase to dephosphorylate VDR, thereby further activating the receptor. These discoveries may facilitate development of drug analogs that could potentiate VDR activity, or mimic/enhance receptor dephosphorylation, in cardiovascular and renal systems to help prevent chronic heart and kidney disease.

***MAN(UAL) VERSUS MACHINE IN MICROBIAL FINGERPRINTING USING MALDI-TOF-MS: EFFECT OF AUTOMATING DATA ACQUISITION ON FINGERPRINT REPRODUCIBILITY AND QUALITY**

Stephanie Schumaker (Glendale Community College, Glendale, Arizona), Susanne M. Rust, Nam Nguyen, and Todd R. Sandrin (Arizona State University West; Glendale, AZ)

Of increasing importance is the development of faster, more cost-effective approaches to identifying microorganisms. Protecting water and food sources, preventing the spread of infectious diseases and defense against bioterrorism are driving forces behind studies investigating such approaches. Mass spectrometry (MS)-based approaches, in particular, MALDI-TOF-MS, have shown promise. Several studies have proposed "universal" protocols; however, most protocols employ manual data acquisition while a few, more recent ones employ automated data acquisition. The effect of automating data acquisition on fingerprint reproducibility and quality has not been investigated. In blinded experiments with eight microorganisms, 20 replicate fingerprints were obtained for each microorganism in both manual and automated fashions. Results suggest that automating data acquisition reduces fingerprint reproducibility. Manual data acquisition yielded intrareplicate similarity coefficients ranging from 92.7 ± 11.7 to 99.5 ± 0.3 , while automated data acquisition yielded similarity coefficients ranging from 85.4 ± 8.7 to 99.5 ± 0.6 . Fingerprint quality, as measured by peak number and intensity, was also reduced by automation. The effect of automation on reproducibility and fingerprint quality using MALDI-TOF MS merits further study as efforts to standardize methods continue, particularly when the method is applied to more closely related microorganisms.

***EXPLORING MATHEMATICAL MODELS OF ROTAVIRUS INFECTION**

Buffy Lloyd (Arizona State University, Phoenix, AZ)

Rota virus is the most common cause of severe gastroenteritis among young children worldwide resulting in the deaths of over half a million children each year. Mathematical models, specifically stochastic models, are used to display and demonstrate the transmission of the disease on a population as well as preventive methods. These models also show how the disease is spread and what co-factors contribute to the dynamics of the infection. In addition, ordinary differential equations (ODEs) inform us of the structure that the behaviors of corresponding stochastic systems are built. The topic of stochastic epidemic modeling is huge and is highly successful in describing infectious diseases.

***EVALUATION OF NOVEL CURCUMIN ANALOGS AS BIOLOGICAL ACTIVATORS OF VITAMIN D RECEPTOR SIGNALING**

J.H. Lee¹, C.E. Wagner¹, M. Galligan¹, M.R. Haussler² and P.W. Jurutka^{1,2} (¹Arizona State University West, Glendale, AZ, and ²University of Arizona College of Medicine-Phoenix, AZ)

The active metabolite of vitamin D, 1,25-dihydroxyvitamin D₃ (1,25D) functions as a ligand for the nuclear vitamin D receptor (VDR). This hormone-receptor complex mediates a wide range of bioactivities such as bone mineral homeostasis, cancer prevention, and possible anti-aging mechanisms. Important VDR-containing tissues include the intestine and colon where 1,25D has known anti-cancer properties. Curcumin (CM), a turmeric-derived bioactive polyphenol found in curry, has recently been identified as an additional ligand for VDR, and it is possible that CM facilitates chemoprevention via a similar and/or novel mechanism(s) involving direct binding to VDR. Using mammalian-two-hybrid (M2H) and vitamin D responsive element (VDRE) biological assay systems, we tested CM and 9 novel CM synthetic analogs for their ability to activate VDR signaling. The M2H assay revealed that RXR and VDR association was induced by CM, and at least two of its analogs, in human colon cancer cells (Caco-2) resulting in transcriptional activity that was 2-fold higher than the negative vehicle control (DMSO). VDRE-based assays demonstrated that pure curcumin (10⁻⁵ M) activated transcription of a luciferase plasmid containing the CYP3A4 distal DR3 (XDR3) VDRE at levels exceeding that of 1,25D (10⁻¹⁰ M) in transfected human colon cancer cells (HCT-116). Moreover, assays in HCT-116 indicated that four CM analogs stimulated VDR-mediated transactivation to levels equal or greater than 1,25D (10⁻¹⁰ M). These studies may lead to the discovery of novel curcumin analogs that activate VDR resulting in similar health benefits as those observed for vitamin D, in addition to possibly lowering the risk of intestinal and colon cancers.

***NUTRITIONAL CROSSTALK BETWEEN RESVERATROL AND VITAMIN D SIGNALING IS MEDIATED BY THE VITAMIN D RECEPTOR**

Shane Batie¹, Jamie Lee¹, Mark R. Haussler² and Peter W. Jurutka^{1,2} (¹Arizona State University West, Glendale, AZ, and ²University of Arizona College of Medicine-Phoenix, AZ)

The nuclear vitamin D receptor (VDR) modulates gene transcription in 1,25-dihydroxyvitamin D (1,25D) target tissues such as kidney, colon, and bone. The 1,25D lipid hormone is derived from vitamin D in the skin or diet, and binds to and activates the VDR. While VDR activity is increased when bound to 1,25D, less is known about the ability of other nutritionally-derived lipids to act as VDR ligands. The current study was designed to evaluate resveratrol, an antioxidant found in the skin of red grapes, as an effector of VDR signaling, and to test the hypothesis that resveratrol and vitamin D may collaborate in a signal transduction network that is utilized by both molecules. Employing mammalian two-hybrid (M2H) and vitamin D response element (VDRE) transcriptional assays, we tested resveratrol for its ability to activate the VDR signaling pathway. The M2H assay revealed that resveratrol stimulates the dimerization of VDR with its retinoid X receptor (RXR) partner, inducing transactivation 2-fold over the negative vehicle control (EtOH). Moreover, cells treated with both resveratrol and vitamin D resulted in a 4.5-fold increase in transcription over the positive control (1,25D), suggesting a synergistic effect. VDRE-luciferase based transcriptional assays were employed in human kidney (HEK293), colon cancer (Caco-2 and HCT116), and mouse myoblast (C2C12) cells, and revealed a 2- to 10-fold induction of luciferase by resveratrol, and 200- to 1200-fold for resveratrol plus vitamin D. Our results suggest that VDR is a high affinity “endocrine receptor” for 1,25D, and an “adopted orphan” nuclear receptor that serves as a lower affinity lipid sensor to mediate the biological effects of nutritionally-derived “healthy” lipids like resveratrol.

***CHARACTERIZATION OF FIRST AND SECOND GENERATION, NOVEL RXR SELECTIVE AGONISTS FOR THE TREATMENT OF CUTANEOUS T-CELL LYMPHOMA**

Joanna Yang, Julie K. Furmick, Jaskaran Bhogal, Drew Browder, Carl E. Wagner, Pamela A. Marshall and Peter W. Jurutka (Arizona State University, Phoenix, AZ)

Clinical treatment of various skin disorders and certain cancers often involves retinoids, a class of compounds derived from vitamin A and of pertinence in regulating epithelial cell growth. One derivative of vitamin A, 9-cis retinoic acid (9-cis RA) binds to the nuclear retinoid X receptor (RXR), inducing homodimerization and subsequent transcriptional activity. Bexarotene (Bex), which is used for the treatment of cutaneous T-cell lymphoma (CTCL), is a synthetic analog of endogenous 9-cis RA that can bind to RXR and stimulate homodimerization and activation of 9-cis RA target genes. Bex, however, also impacts RXR heterodimerization, dysregulating RXR-mediated pathways involving other receptors and leading to its numerous contraindications. Our study thus seeks to model and synthesize novel RXR selective agonists analogical to Bex and

capable of regulating anti-tumor genes while minimizing disruption of other RXR pathways. An initial panel of 19 Bex analogs was tested via mammalian two-hybrid screening for RXR homodimerization followed by RXRE-mediated transcriptional assays to assess receptor binding. Several positive analogs were analyzed in apoptosis, mutagenicity and cytotoxicity assays, and K_i and EC_{50} values were determined and compared to Bex. Retinoic acid receptor (RAR) assays to test for RAR agonism were also performed. Finally, testing of 10 new second generation analogs (A20-29) suggested 5 potential RXR selective agonists (A20, 21, 22, 28, 29). These 5 analogs contain halogen groups which appear to reduce RAR binding and/or increase RXR activation ability. Further modifications of Bex may produce additional rexinoids with enhanced biological profiles capable of combating CTCL.

***BALANCING ACT: THE CHALLENGES FACING WORKING STUDENTS**

Meg Phillips, Samm Thul, Jomana Sweiss, Sarah Courtney, Jana Sirotnik, Kenny Colt, Amanda Heim and Matt Newman (Arizona State University, Phoenix, AZ)

Previous research suggests that nearly half of all full-time working college students are working enough hours to hurt their academic achievement and the overall quality of their education. At the same time, the majority of these students report that they would not be able to attend college if they did not work (2002). In the present study, we used a survey design in order to gather information about student's attitudes, perceptions of the campus, and how their time is spent, with a direct focus on the challenges that arise for working students. This survey was given to 366 Arizona State University students on all 5 campuses during the fall semester of 2010. We hypothesized when students work more it would interfere with their educational achievements, campus involvement and overall stress levels. Results revealed a surprising disconnect between actual hours worked and the perception that "work interferes." These only correlate with each other at $r(240)=.41$, $p<.001$. Perceptions of work interference-but not actual work hours-correlated with perceived stress, perceived health problems, and feeling depressed. However, upperclassmen report fewer difficulties balancing work and classes. $t(237) = -2.80$, $p < .01$, suggesting that many students gradually find a way to balance the demands of work and school.

***ANALYSIS OF VOLUTIN GRANULE FORMATION IN SACCHAROMYCES CEREVISIAE**

David B. De La Rosa and Pamela A. Marshall (Arizona State University, Phoenix, AZ)

In the budding yeast, *Saccharomyces cerevisiae*, phosphate is stored in the lysosome-like vacuole, in a long chain of polyphosphate, historically called volutin. The volutin can be monitored by simple staining and microscopy. However, polyphosphate also accumulates in organelles called acidocalcisomes, which are necessary for the malaria parasite infection. We were interested in determining the physiological properties required for yeast to make volutin so we treated the yeast with various pharmacological agents. Using DMSO as a control as well as a solvent for all agents used, we tested for the formation of volutin for each series. Ionomycin,

which causes the yeast vacuole to lose calcium, and CCCP and concanamycin A, both of which cause the vacuole to become more basic, all seemed to inhibit polyphosphate body formation. Cyclohexamide, which stops protein synthesis, did not seem to greatly affect volutin formation. This data is still qualitative, however, and needs careful statistical analysis to check significance.

***PREDICTORS OF STUDENT ENGAGEMENT**

Jomana Sweiss, Jana Sirotnik, Samm Thul, Meg Phillips, Sara Courtney, Kenny Colt, Amanda Heim & Matt Newman (Arizona State University, Phoenix, AZ)

The goal of all universities is to increase the extent to which their students feel “engaged,” or involved with the campus environment. In this poster we focus on predictors of student involvement among a sample of college students. An online survey was used to collect data on multiple topics of interest including student employment status, the number of hours students work, the number of credits taken, number of clubs involved in, and living arrangements. Participants (N= 366) were recruited by email for all Campuses at Arizona State University to participate in the survey. Participants were a sample of college students who were 18 and older. (M=2.73, SD= 1.74) There were significant differences ($p<.05$) that were found between students who are on campus more often and the level of involvement on campus. Students who spent more days out of the week on campus were more aware of student organizations, and were more likely to be involved in clubs and activities. Data, also indicates that students who are employed, and who work more hours are less engaged on campus. Arizona State University, specifically organizations at its various campuses, may benefit from this information by reaching out to those students who are unaware of on-campus activities in hopes of creating more awareness and involvement.

CONSTRUCTIVIST CLASSROOM MANAGEMENT FOR EFFECTIVE INQUIRY TEACHING

William P. Baker & Belinda J. Baker (Arizona Christian University, Phoenix, AZ)

Classroom management is an important concern when using inquiry-based activities. Students focus on observations and cooperative group interactions. The constructivist teacher becomes a participant in the exploration, moving between groups of students, providing helpful suggestions and asking probing questions. This approach may lead to a loss of order unless adequate thought is given to effective classroom management. In our experience, inquiry-based activities increase student interest and motivation, thereby, greatly reducing classroom management issues. However, many teachers report that they encounter classroom management problems when teaching with inquiry. The purpose of this article is to briefly describe the problems identified by classroom teachers and to suggest constructivist solutions. The intent is to provide teachers with a list of problems and potential solutions so that they can avoid such problems altogether, or reduce their severity. In our view, it is extremely important that constructivist teachers develop a range of techniques that will allow for the effective implementation of inquiry-based activities.

THE COMPARISON OF THE SI AND SIS MODELS WITH ORDINARY DIFFERENTIAL EQUATIONS AND STOCHASTIC MODELS

Getta, Yung

I will compare the deterministic Ordinary Differential Equations to the stochastic model of both the SI and SIS models noting the pros and cons of using each type of model, including some basic mathematical analysis of each model. I will also include a comparison of the SI and SIS model and their applications to different infectious diseases.

***MINIMIZING TIME AND MATERIAL WASTE IN ALGAL GROWTH ASSAYS THROUGH THE USE OF MICROPLATES**

Linda Castillo and Amy King (Glendale Community College, Glendale, AZ)

In GCC's Biotechnology program we have several labs that involve the cultivation of algae. Typically, this involves growing the algae in test tubes and assessing growth by spectrophotometric methods. The Biotechnology program recently purchased a microplate reader. The microplate is a self-contained vessel that would appear to reduce the chance of contamination and the loss of sample due to the fact that the entire microplate is read at once without the need to remove a portion of the sample for spectrophotometry. We decided to grow our algae directly in microplates and perform growth assays in a microplate reader, potentially reducing time, space, and contamination issues. It was important for us to compare this approach with the older approach utilized in our laboratory. Algae were grown in identical environmental conditions in 20 ml screw-cap test tubes as well as two different sizes of microplates with varying concentrations of growth media. Algal growth curves were made under each condition; the time required to carry out assays as well the incidence of contamination were also noted. The microplate samples had growth curves resembling those of the test tubes cultures and those assays took less time and were less prone to contamination. The small volume of the 96-well microplate resulted in a use of twenty-fold less material per trial, making it a more cost-effective method. These findings will allow for greater integration of the microplate reader into the lab curriculum for routine assays of algal growth.

***DIFFERENTIAL ANALYSIS AND BACTERIAL FINGERPRINTING OF WILD TYPE AND TRANSFORMED E. COLI USING MALDI-TOF-MS**

Jason Goldstein, Daniel Murray, Anastasia Chidester, Ryan Richholt (Glendale Community College, Glendale, AZ) and Todd R. Sandrin (Arizona State University at the West campus, Glendale, AZ)

Time and resource efficient microbial identification is critical in many settings. With Matrix-Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF-MS), a microbial fingerprint may be able to differentiate down to the strain level. Although this

technique is very rapid and sensitive, there are currently concerns as to its accuracy and reproducibility, particularly at the strain level. Before these concerns can be addressed, the overall feasibility of the process must be determined along with an assessment of the required degree of sample preparation. To examine the usefulness of MALDI-TOF MS for fingerprinting closely related strains of *E. coli*, three slightly differing samples of *Escherichia coli* K-12 were tested at multiple cellular and molecular levels. The samples were manipulated by introducing a pGLO plasmid to two of the three samples and only allowing one of these two samples to fully express the pGLO gene. The third sample remained untransformed. Spectra were then collected from each sample on the basis of genomic DNA, plasmid DNA, cell homogenates, and whole cells. The greatest discrimination was obtained at the level of the whole cell sample. Whole cells yielded unique fingerprints that allowed discrimination between the wild type and transformed *E. coli*. In addition, clear differences were observed between the expressing and non-expressing *E. coli* samples. Our data suggest that MALDI-TOF MS-based microbial fingerprinting has the requisite resolving power to differentiate very closely related strains of *E. coli*.

***DNA FINGERPRINTING OF 16 S rRNA GENES OF ORAL INDIGENOUS MICROBIOTA TRANSFERRED THROUGH A HUMAN BITE.**

Phillip Spencer and Colin White (Glendale Community College, Glendale, AZ)

There are known to be between 600 and 700 microbial inhabitants living within the human oral cavity, although only a comparatively small proportion are typically found in a particular host. A species that is universal to human incisors, *Streptococcus mutans*, creates a bio-film on the anterior teeth and is readily transferred to the skin during a bite. Because bacterial DNA contains both conserved and variable regions, a genotype analysis should provide enough uniqueness to warrant an alternate forensic methodology to the very subjective, traditional bite mark analysis and to host salivary DNA profiling, which degrades significantly with time. To demonstrate this, bacterial cells were taken from the incisors of 10 subjects and cultured for 3 days at 37⁰C. The colonies were flooded with saline and the wash was centrifuged to collect bacterial cells. DNA was then extracted and 16 S rRNA genes were PCR amplified with 27F and 1492R primers to ensure a bacterial genomic profile. Nested PCR, using a second set of primers, Sm1 and Sm2, specific to *S. mutans*, allowed amplification of a variable region that was then digested with the restriction enzyme HaeIII. Gel electrophoresis allowed for a comparative analysis of the *S. mutans* 16 S rRNA genes from each of the 10 subjects, with a positive control of pre-cultured *S. mutans*, a negative control of *E.coli*, and two skin swabs from actual bites. The results of this study will contribute to the development of a forensic technique that is effective and inexpensive in the prosecution of bite assault cases.

ANTIMICROBIAL PROPERTIES OF *CHLAMYDOMONAS REINHARDTII

Sheena Carbaugh and Belynda Buser (Glendale Community College, Glendale, AZ)

In this study we examined the antimicrobial properties of the green alga, *Chlamydomonas reinhardtii*. Samples of laboratory cultivated *C. reinhardtii* at different growth phases were collected over a 15 day period. These samples were centrifuged and the cell pellets were washed with methanol and hexane. The supernatant was concentrated under vacuum pressure. Nitrocellulose disks containing the supernatant, methanol pellets, hexane pellets, and methanol/hexane pellets were assembled. These disks as well as disks impregnated with Ampicillin, Gentamicin or distilled water (negative control) were placed on Mueller-Hinton plates. Ampicillin and Gentamicin are commonly used against gram positive and gram negative organisms respectively. Lawns of either *Staphylococcus epidermis* (gram positive) or *E. coli* (gram negative) were grown on respective Mueller-Hinton plates. Each plate was incubated at 37⁰C for 24 hours. Certain *Chlamydomonas* fractions gave zones of inhibition similar to that of Gentamicin on *E.coli* plates. The *S. epidermis* plate proved inconclusive.

ACADEMY BUSINESS AND ANNUAL REPORTS

OFFICERS 2010-2011

ELECTED

Robert McCord.....	President
Pamela Marshall	Membership Secretary
Pedro Chavez.....	Permanent Secretary
Karen Conzelman	Treasurer
Philip Rosen	Director, Southern Arizona
Erik Gergus.....	Director, Central Arizona
Shafiu Jibrin	Director, Northern Arizona
Barbara Adams	Director, Nevada

APPOINTED

Anthony Brazel	Editor, Journal
Florence Slater	Editor, Proceedings
Karen Conzelman.....	Science Olympiad/Science Bowl Liaison
Theodore Manno.....	Editor, Newsletter
Boris Poff	Webmaster

SECTION CHAIRS

Robert Bowker	Biology
Anthony Brazel.....	Geography
Robert McCord	Geology
Gerald Gottfried.....	Hydrology
Shafiu Jibrin	Mathematics
Erik Gergus	Posters
Florence Slater	Psychology

COMMITTEE ROSTER

BUD ELLIS SCHOLARSHIP

Stephen M. Shuster

MEMBERSHIP

Pamela Marshall

OUTSTANDING SCIENCE TEACHER

William Perry Baker

OUTSTANDING SERVICE AWARD

Anthony Brazel
Karen Conzelman

GRANTS-IN-AID

Erik Gergus

PROGRAM

Karen Conzelman

NECROLOGY

Pamela Marshall

BUDGET

Karen Conzelman

BEST STUDENT PAPER

Robert McCord

BEST STUDENT POSTER

Erik Gergus

BUD ELLIS SCHOLARSHIP

The Arizona Nevada Academy of Science offers the **Bud Ellis Scholarship** of \$1,000 to a graduating senior in an Arizona or Nevada High Schools or Preparatory School.

This one-year scholarship award is made to a student with an outstanding high school academic record and who intends to enter one of the institutions of higher learning in Arizona or Nevada the following year as a science or engineering major. Applications are limited to students in the top ten percent of their class who plan to continue in a field of science. In each case, the cash award is sent to the college or university of the winner's choice and accredited to his/her account. The amount of the scholarship is not affected by any other scholarships received.

The winner of the Bud Ellis Scholarship for 2010 is **Shannon Leigh McClain**, a senior at Shadow Mountain High School in Phoenix, AZ. She is a member of the National Honor Society and the Society of Women Scholars. She has been involved in her school choir for her four years at Shadow Mountain and has served in several capacities as an officer in the organization. She is a member of the Drama Club and the Thespian Honors Society. In addition, Shannon is a varsity volleyball player and has played basketball and ran track at Shadow Mountain High School.

This latter experience led to an injury that appears to have inspired her future career choice. She plans to attend the Exercise Science Program at Northern Arizona University this fall in hopes of entering the NAU Physical Therapy program as a graduate student.

Congratulations, **Shannon McClain!**

Stephen M. Shuster
Bud Ellis Scholarship Committee

OUTSTANDING TEACHER AWARD

The recipient of this year's ANAS Outstanding Teacher Award is:

Theodore G. Manno of San Luis Middle School, San Luis, AZ.

Congratulations to our winner!

William Perry Baker
Outstanding Teacher Committee

OUTSTANDING SERVICE AWARD

FLORENCE SLATER

This year's recipient of the Outstanding Service Award is Florence Slater, Ph.D., a member of Glendale Community College's Biology department faculty. Since 2002, Dr. Slater has miraculously transformed the hodgepodge of randomly formatted abstracts she receives into a professional looking Proceedings volume of which the Academy can be proud. This award recognizes this important work, but also the way in which Florence has gone above and beyond her editorial responsibilities to coordinate many aspects of meeting planning. Each year Florence plans the pre-meeting timeline, identifies the session chairs, and works with them to solicit participants and organize their schedules. She pulls together the annual reports of officers and committees. She works with the host to make sure all necessary local arrangements are made and keeps track of registration. For the last ten years, Florence has held everyone to task to make sure that the annual business of the Academy has gotten done. It is for these significant contributions and others that the Academy honors Dr. Florence Slater with this award.

Karen Conzelman

Outstanding Service Award Committee

FELLOWS REPORT

The ANAS Fellows Committee nominates the following two members as Fellows of the Arizona Nevada Academy of Science in recognition of their contributions to the organization and community.

Karen A. Conzelman obtained a Ph.D. from Yale University in 1987, and since then has been a faculty member in the Department of Biology, Glendale Community College. Karen has served as ANAS Treasurer since 1995. She has been a leader in ANAS Science Education, has received over a dozen honors for educational achievement and has authored sixteen modules, animations and publications on science and science education. From 2003-2009 Karen administered \$80,000 in grants from Salt River Project, the Employee Community Fund of Boeing, Southwest Gas and Phelps Dodge to the Arizona Science Olympiad. In 2005 she successfully combined the finances of the Arizona Science Olympiad with those of ANAS and sponsored the addition of a Science Olympiad/Science Bowl Liaison to the Arizona-Nevada Academy of Science Board of Governors.

Robert Dudridge McCord obtained a Ph.D. from The University of Arizona in 1997, and from 1998 to present he has been the Curator of Paleontology at the Arizona Museum of Natural History (formerly Mesa Southwest Museum). Bob has been a member of ANAS since 2005, and has served as chair of the ANAS Geology Session since 2006. Prior to then he served as Chair of

Society of Vertebrate Paleontology annual meetings in 2004-2005, and as Chair of Southwest Paleontological Symposium of Mesa Southwest Museum from 2003-2005. Robert McCord is author of forty seven scientific publications and editor of five volumes of Mesa Southwest Museum Bulletin including the special volume: "Vertebrate Paleontology of Arizona."

MEMBERSHIP REPORT

We currently have a total of one hundred and three ANAS members that includes forty- three active members and sixty emeritus or life members who are exempt from annual dues.

Pamela Marshall
Membership Secretary

NECROLOGY REPORT

The Academy is sad to announce the passing of James M. Stephenson.

James was a Charter Member and Member Emeritus of the Arizona-Nevada Academy of Science. After receiving his AB and BS in Education degrees from Northwest Missouri State Teachers College, he started his teaching career in 1938. He taught math and science (Biology) for forty-one years in Missouri, Iowa and Arizona. Retiring in 1979, he had spent the last twelve years of his career teaching Human Anatomy and Physiology to advanced students. A great accomplishment of his was that he inspired so many others to go into the teaching profession.

Pamela Marshall
Necrology Committee

SCIENCE OLYMPIAD/SCIENCE BOWL REPORT

In an impressive show of strength, Catalina Foothills High School in Tucson swept the top two places in this year's Arizona Science Olympiad, beating out thirty four other teams by a healthy margin. As state winner, their "Blue" team of fifteen students will advance to the National competition in May. This will be the fourth trip in a row to nationals for their coach, Kiki Moore.

The overall rankings are determined by combining the teams' scores from the many events that make up this annual competition. The events always cover a diverse range of topics in the areas of science, engineering, mathematics and technology. Among the twenty four different events in this year's competition were Mousetrap Vehicle, Ornithology, Optics, Wind Power, Protein

Modeling, and Forensics. The 2011 tournament, held on March 5th, drew teams from Tucson, Morenci, Phoenix, Scottsdale and Holbrook. In addition to the trophies given to the top ranking teams overall, the students in top seven places in each event are given ribbons or medals during the Awards Ceremony. It is clear from the energy and enthusiasm in the room during this culminating event that the Science Olympiad helps keep kids excited and interested in science. These students represent some of the state's best and brightest, and this program challenges them with interesting problems and areas of study. Thanks to the Science Olympiad, many of these students go on to pursue further education and careers in the sciences. ANAS members assisting at this year's tournament included: Robert Bowker, Karen Conzelman, Steve Williams, Pedro Chavez, and Don Young. The Academy awards \$100 to the club accounts of five teams randomly selected from each of two events - this year Chemistry Lab and Sumobots. We also award \$50 to the top ranking teams in the Ecology and Ornithology events in memory of our colleague, Bud Ellis. Desert Vista High School of Phoenix beat out thirty one other teams to win the first Arizona Regional Science Bowl they ever entered. In addition to receiving a \$1500 prize from the Department of Energy, their team will compete against more than sixty other regional winners in the National Science Bowl in Washington, DC, April 28 to May 2. BASIS Scottsdale High School finished second, BASIS Upper School of Tucson third and Brophy College Preparatory of Phoenix fourth. Fifteen high schools participated in this year's event. The Science Bowl is a double elimination tournament that features head-to-head competition in a fast-paced question and answer format similar to Jeopardy. The students compete to be the first to answer questions on all science disciplines including astronomy, biology, chemistry, earth science, mathematics and physics. Science Bowl is a proven tool in encouraging high school students to excel in math and science and to pursue careers in those fields.

We gratefully acknowledge Glendale Community College for their twenty plus years of co-sponsorship. Without their facilities, faculty and staff, it would be impossible to run these events.

Alison Smith

Science Olympiad/Science Bowl Liaison

TREASURER'S REPORT

2010

Operating and Short Term Reserve Fund (Vanguard Prime Money Market Fund)

Account Value on 12/31/09	\$26,974.92
Dividend Deposits	\$16.66
Account Value on 12/31/10	\$26,991.58

Goethe Educational Endowment Fund (Vanguard Index 500 Mutual Fund)

Account Value on 12/31/09 (214.63 shares at \$102.67/share)	\$22,036.06
Dividends +4.015 shares Total: 218.645 shares	
Account Value on 12/31/10 (218.645 shares at \$115.83/share)	\$25,325.65

General Fund

December 31, 2009 Balance	\$3,790.26
Deposits	\$15,013.48
Expenses	(\$7,653.40)
Transferred to ASU General Fund	(\$1,500.00)
December 31, 2010 Balance	\$9,650.34

ASU General Fund

December 31, 2009 Balance	\$845.98
Transfer from General Fund	\$1,500.00
Expenses	(\$2,065.79)
December 31, 2010 Balance	\$280.19

Science Olympiad General Fund

December 31, 2009 Balance	\$52,144.82
Deposits	\$23,879.51
Expenses	(\$19,844.48)
December 31, 2010 Balance	\$56,179.85

Science Bowl General Fund

December 31, 2009 Balance	\$6,894.63
Deposits	\$0.00
Expenses	(\$12.50)
December 31, 2010 Balance	\$6,882.13

Market Value of Assets (as of December 31, 2010) **\$125,309.74**

<u>Deposits</u>	<u>General Funds Details</u>	<u>Expenses</u>
\$1,395.00	ANAS Membership dues	
	PayPal charges	14.01
	Postage	13.44
	Journal:	
1,090.00	Subscriptions	
	Refunds	6.00
6,498.38	BioOne Royalties	
90.00	Sale of Back Issues	
1,630.00	Reprints/Page Charges	
	Printing	1,483.90
	Typing	750.00
	Postage	570.87
	Hydrology Proceedings	456.25
	Other	
109.01	Royalties from book	
	Web hosting fee	45.00
	Scholarships:	1,000.00
	Grants-in-Aid, High School:	200.00
	Grants-in-Aid, Graduate	300.00
	Grants-in-Aid, Undergraduate	200.00
	Science Olympiad awards	1,100.00
	Annual Meeting:	
1,675.00	Registration Fees	
	PayPal Charges	29.70
2,526.09	Sponsor donations	
	Proceedings, Printing	519.84
	Proceedings, Postage	90.68
	Coffee Breaks	387.67
	Friday Reception	205.43
	Saturday Luncheon	1,453.47
	Meeting Rooms	441.50
	Awards	
	Outstanding Service	50.00
	Outstanding Teacher	0.00
	Printing/Postage	0.00
	Plaques	20.62
	Best Student Papers	200.00
0.00	Goethe Endowment Fund Contributions	
	AZ Corporation Commission	10.00
	NAAS Dues	0.00
	Supplies	156.76
	Postage/Office	14.05

\$15,013.48	Printing/Office	0.00
	SUBTOTAL	9,719.19
<u>Deposits</u>		<u>Expenses</u>
	Science Olympiad	
\$41.34	Interest	
13,669.67	Sponsor donations	
9,026.00	Membership dues	2,160.00
	Tournament	
	Awards and Prizes	2,148.28
	Scholarships	0.00
	Team Travel	2,346.60
348.00	T-shirts	6,058.83
	Supplies	115.03
794.50	Lunches	1,630.42
	Coaches gifts	0.00
	Office Expenses	
	Copying and Postage	116.79
	Office supplies	9.83
	Bank Charges	0.00
	Outreach	
	Workshop stipends	2,780.00
	Seed money	2,000.00
	Brochures/PR	
	Mileage	
	Travel to Nationals (State Director)	472.70
	Other	6.00
23,879.51	SUBTOTAL	19,844.48
	Science Bowl	
0.00	Sponsor donations	
0.00	School registration fees	0.00
	Scholarships	0.00
	Room rental fees	0.00
	Photographers	0.00
	Food	0.00
	Supplies	0.00
	Conference registration fees	0.00
	Trophies and prizes	0.00
	Online detail fee	7.50
0.00	SUBTOTAL	7.50
\$38,892.99	TOTALS	\$29,571.17

(Please note that the Science Olympiad is held in February or March of each year and this report is based on the calendar year. Some sponsorship dollars are received in the fall in anticipation of the upcoming year's tournament).

Karen Conzelman
Treasurer

MATHEMATICS SESSION

SESSION: 8:30

ROOM: 207

Chairperson: Shafiu Jibrin

8:30-8:40 *COLLABORATIVE SECURITY MONITORING IN LARGE INTERNET DATA CENTERS

Christopher Gutekanst and Kuai Xu (Arizona State University West, Phoenix, AZ)

The rapid growth of cyber attacks towards Internet data centers calls for new and innovative approaches of securing and managing networks and servers in data centers. In this study, we propose a collaborative security monitoring algorithm based on peer-to-peer principles to monitor network traffic of data center servers, which collaboratively detect and share anomalous behavior traffic patterns. In addition, we apply consistent hashing technique, also known as distributed hash tables, for building a simple and robust alert sharing channel, which efficiently distributes security alerts among thousands of servers deployed in Internet data centers. To evaluate the cost and performance of the proposed method, we design, implement and evaluate a prototype system in a small cloud computing environment with simulated attack traffic, including TCP SYN attacks, DNS spoofing, and port scanning activities. Our results show that the proposed security monitoring model is very efficient in detecting emerging threats and distributing security alerts among data center servers.

8:40-8:50 SUMMARIZING INTERNET TRAFFIC FOR EFFICIENCY SECURITY MONITORING

Cory Steeley and Kuai Xu (Arizona State University West, Glendale, AZ)

As the Internet continues to grow, it has become a challenging task to collect, analyze, and understand Internet traffic and network applications for network management and security monitoring. In this study, we introduce a simple and efficient data summarization technique to compress vast amounts of IP data packets toward end systems into a small number of underlying

network activities. The purpose of the summarized activities is to provide network operators with meaningful and actionable event information extracted from high-volume Internet traffic streams. In addition, we develop a Web-based interface that allows network operators to search and query real-time network events, such as top N application ports and their changes over time, from a database of summarized network activities. These real-time queries are able to provide in-depth insight on interesting traffic behaviors, e.g. an uncommon port used in denial of service attacks suddenly becoming one of the top N ports in the last time window. The combined aspects of data summarization techniques and search

8:50-9:10 STOCHASTIC MODEL OF A TWO-STRAIN ROTAVIRUS INFECTION

Jennifer Ortiz (Arizona State University, Glendale, AZ)

Rotavirus diarrhea causes a disproportionate amount of the world's childhood mortality. Approximately 611,000 children die each year due to complications of rotavirus infections. All children are born susceptible, but there are vaccines that may be utilized to decrease the risk of infection. In order to study this disease even further, a common research technique is to create a stochastic model that has the capability to model how the disease may spread across the population. For this study, we have explored rotavirus through a mathematical model generated in Matlab. Based on a deterministic ordinary differential equation on a two-strain modified SIR model, the code has been generated to handle a model with 8 compartments. Through the use of random variables in the code, we are able to generate the possibility of when an event happens or whether it even happens at all.

9:10-9:30 CONSTRAINT CONSENSUS METHODS FOR FINDING INTERIOR FEASIBLE POINTS IN SECOND ORDER CONES

Shafiu Jibrin (Northern Arizona University, Flagstaff, AZ, Anna Weigandt (Illinois State University, Normal, IL and Kaitlyn Tuthill (Saint Michael's College, Colchester, VT)

Optimization problems with second-order cone constraints (SOCs) can be solved efficiently by interior point methods. In order for some of these methods to get started or to converge faster, it is important to have an initial feasible point or near-feasible point. In this paper, we study and apply Chinneck's *Original* constraint consensus method and *DBmax* constraint consensus method to find near-feasible points for systems of SOC. We also develop and implement a new backtracking-like line search technique on these methods that attempts to increase the length of the consensus vector, at each iteration, with the goal of finding interior

feasible points. Our numerical results indicate that the new methods are effective in finding interior feasible points for SOCs.

9:30-9:50 GENERALIZED TIC-TAC-TOE

Ian Norris (Northern Arizona University, Flagstaff, AZ)

In a biased weak (a,b) polyform achievement game the maker and the breaker alternatively mark a,b (in $\{0,1,2,\dots\}$) previously unmarked cells on an infinite grid. The maker's goal is to mark a set of cells congruent to an "animal", specified before the start of the game. The breaker tries to prevent the maker from achieving this goal. In our paper, Professor Sieben and I study only square and triangular animals on their respective infinite grids. We determine which player has a winning strategy for each (a,b) pair for each animal of size four or less. My talk will mainly concern square animals on the infinite square grid.