STEM
Posters at the Capitol

February 15, 2012

"It is essential, if we want to continue to reap the benefits of science, to commit as a nation to preparing more young people for extraordinary careers in science."

—Carol W. Greider, 2009 Nobel laureate in physiology & medicine

Highlights

- Over 80 different students
- From 13 Arkansas colleges and universities
- Presenting 58 different posters of original work
- Encompassing all aspects of natural science and math


ASU
ARKANSAS STATE UNIVERSITY


ARKANSAS TECH UNIVERSITY


1876
HENDRIX
COLLEGE


HARDING


THE SEAL OF OUACHITA BAPTIST UNIVERSITY
INTEGRITY
VISION
SERVICE
1886


1890
HENDERSON
STATE UNIVERSITY


JOHN BROWN UNIVERSITY


LYON
COLLEGE
FOUNDED IN 1872


PHILANDER
SMITH COLLEGE


SOUTHERN ARKANSAS
UNIVERSITY
Magnolia


UAM
Monticello


UCA


UALR
University
of Arkansas
at Little Rock

student presenter
* primary Arkansas –based mentor

Student presenter (school) …..page with abstract

student presenter
* primary Arkansas –based mentor

Student presenter (school) …..page with abstract

presenting
10—11 am

Biodiversity in Ozark region caves

Madeline Boyd, Autumn M. Bryant, Zachary Harris, Melissa Kuehl, DeAnna M. Massey, V. Michael McQueen, Martha Moreno, Katy Nalven, Maci Powers, L. Caity Simpson, Kelsey Ward, Mark D. Schram, Han Chuan Ong, David J. Thomas*

Division of Sciences, Lyon College, Batesville, AR

Mars and the Moon possess evidence of caves, and caves are expected on most rocky and icy bodies in the solar system. Particularly on Mars, caves represent possible currently-habitable environments – good targets for the search for life. Here, we report on part of a project to isolate and identify autotrophic microorganisms from cave environments. Microbes were isolated from water sources and surfaces in six Arkansas caves: Bat Cave (Cord), Blanchard Spring Caverns (Fifty-six), Blowing Cave (Cushman), Indian Rocks Caves (Fairfield Bay) Meacham Cave (Batesville) and Sandtown Cave (Batesville). Surveys of macroscopic fauna were performed during cave visits as well. Water samples were plated onto low-nutrient agar media and incubated at 12°C. Media for photoautotrophic microbes were illuminated by cool-white fluorescent tubes (10-50 mmol photons $m^{-2}s^{-1}$). We transferred visible colonies to fresh plates for confirmation of pure cultures. Microbes were identified by microscopic observations and DNA sequences. Preliminary results indicate that photosynthetic microbes are more common in caves that have streams flowing through the sample sites, and that most heterotrophic bacteria are members of the Proteobacteria division. The NASA/Arkansas Space Grant Consortium funds this research. Members of the National Speleological Society assisted during cave expeditions.

presenting
11 am—12 pm

Molecular genetic survey of extremophile microbes from Blanchard Springs Caverns, Arkansas

Mark Castleberry, Shannon Fiser, Jonathan Shields, Lauren Story, Claudia Gonzalez, James Engman*

Dept. of Biology, Henderson State University, Arkadelphia, AR

Cave microbes are increasingly considered important members of biotic communities, facilitators of cave formation, and agents of disease, including white nose fungus, responsible for the death of millions of bats across North America. This project is using molecular genetic techniques to survey the bacterial flora of Blanchard Springs Caverns, Arkansas. Although considered to be the most biologically diverse cave in the Ozark Plateau, no previous survey of its microbes has been conducted. Samples from undeveloped reaches of the caverns were plated on selective media, with resulting cultures stored at -80• C. A conserved region of ribosomal DNA from these colonies was amplified with polymerase chain reaction (PCR) and sequenced using universal bacterial primers. Sequences were compared with those in the GenBank database using the BLASTN program, allowing identification to genus and species level. Biochemical analysis was conducted using commercially available test strips and microscopic analysis to determine phenotypic characteristics. This survey has resulted in identification of rare and unusual species including *Aminobacter lissarensis*, *Arthrobacter kerguelensis*, and *Oerskovia enterophila*, all previously unknown from North America. Additionally, members of Bacillus and Pseudomonas have not been conclusively identified to species. Work is proceeding to determine if these are species new to science.

presenting
10—11 am

Ancient astronomy: a study of the Point Remove Mound complex

Matt Hankins, Debra Burris*

Dept. of Physics and Astronomy, University of Central Arkansas, Conway

Artificial solstice markers are a common thread across many early civilizations. With the beginnings of agricultural society, the need to be able to predict the changes in the seasons became an issue of utmost importance. Many Native American groups used artificial mounds to mark different astronomical events. The Point Remove Mound Complex (located near Morrilton, AR) is a known archeological site that has never been checked for any form of astronomical alignment. The purpose of this project is to study the Point Remove Mound site for features of astronomical significance, similar to those present at Toltec Mounds (Scott, AR). Preliminary results are presented and future work is also considered. The larger goal for this project is to provide a connection between current Arkansans and our cultural heritage by preserving these remnants of the past.

presenting
11 am—12 pm

An Assessment of the Biological and Chemical Properties of Sager Creek

Rebekah Constanin, Jake Meinzer, Christa Slagter, Anna Lane, Timothy Wakefield*

Biology Department, John Brown University, Siloam Springs, AR.

A Biotic Index and Simpson's Diversity Index, which is generated by determining the kinds and numbers of benthic macroinvertebrates, are common ways of assessing the overall health of a stream. However, these indices cannot pinpoint any specific physical causes that negatively are negatively affecting the health of the stream. By using both of these indices in addition to performing water chemistry tests, the health of Sager Creek in Siloam Springs, Arkansas, was measured. The data collected over the course of the spring of 2011 was added to data attained over previous semesters to form a much larger data pool, increasing the accuracy of statistical analysis. Of the three sites studied along Sager Creek, one was significantly different in both the Biotic and Diversity Index ratings, indicating a decline in overall stream health in this location. However, no significant correlations between these two indices and any water chemistry parameters were found.

presenting
11 am—12 pm

Cooperative water quality testing in Columbia County, AR

Katherine Dockter, Tim Schroeder*

Department of Chemistry and Physics, Southern Arkansas University, Magnolia, AR

Lake Columbia, the drinking water reservoir for Columbia County in Southwest Arkansas, was recently notified of rising levels of ethylbenzene and xylenes by state testing agencies: the Arkansas Department of Environmental Quality (ADEQ) and the Arkansas Department of Health (ADH). At the request of local water officials, investigations were conducted to independently confirm or refute these reports and to locate the source(s) of any possible contaminations. Care was taken to collect samples from the same sources and locations, both at Lake Columbia and at the local water treatment facility, as those taken by the state agencies and to test them in a timely manner. Water samples were analyzed for organics by GC-MS with purge and trap sample introduction. Funding was provided through a SURF grant by the Arkansas Department of Higher Education.

presenting
11 am—12 pm

Cardamine ouachitana, a new Arkansas endemic plant revealed by DNA sequence analysis

Scott Breedlove,[a] Randall Brockman, [a] Allan Humphrey, [a]
Jeff Lawson, [a] Kirby McCallie, [a] Drew Prescott,[a] Travis Rushing,[a]
James Whitaker, [a] Karen Fawley,[a]* Marvin Fawley,[a]* Theodore Witsell[b]

[a]University of Arkansas at Monticello;
[b]Arkansas Natural Heritage Commission

Cardamine angustata var. *ouachitana*, a wildflower in the mustard family, was described by Smith in 1982 to include a form of *Cardamine* found only in the Ouachita Mountains of Arkansas. This morphologically very similar to typical *C. angustata.* The major difference noted was the complete lack of leaf hairs in the new variety, whereas typical *C. angustata* normally possesses them. However, Al-Shehbaz in 1988 rejected the var. *ouachitana*, reducing it to synonymy with typical *C. angustata*, so that the taxon *C. angustata* var. *ouachitana* is currently not accepted. We developed a project to evaluate *C. angustata* var. *ouachitana* using DNA sequence analysis. The Spring 2011 UAM Regional Flora class performed a preliminary evaluation by producing DNA sequences from specimens of *C. angustata* var. *ouachitana*. The students compared sequences of *this* variety to published sequences of *C. angustata* and other related *Cardamine* species. An unexpected result was found; specimens of *C. angustata* var. *ouachitana* were actually closely related to, but morphologically distinct from, *C. concatenata* rather than the expected close relationship with *C. angustata.* These results suggest that *C. angustata* var. *ouachitana* is actually a new species found only in the Ouachita Mountains of Arkansas.

presenting
10 am—11 am

Mineral aerosol effects on phytoplankton growth rates: A biomarker study of mineral aerosol deposition

Meredith Miles, Cameron C. Crane, Theogene Bucuti, Courtney D. Hatch*

Chemistry Department, Hendrix College, Conway, AR

Atmospheric dust deposition in the world's oceans supply necessary micronutrients and trace metals, impacting biogeochemical cycles. It has been shown that atmospheric mineral dust deposition can initiate phytoplankton blooms, consequently enhancing ocean bioproductivity and carbon sequestration. Clay minerals, in particular, may be a source of bioavailable iron due to the exchangeable ions within the clay structure. Phytoplankton biomarker studies were performed to study the effect of clay mineral aerosol deposition to both nutrient-rich and iron-limited ocean environments. Phytoplankton growth rates were obtained by measuring the temporal variation in chlorophyll *a* concentrations using the trichromatic method by UV-Vis spectrophotometry. The results show that with increasing concentrations of clay added to the phytoplankton cultures, there is a decrease in the relative growth rates of phytoplankton in iron-enriched environments and an increase in the relative growth rates of phytoplankton in iron-deficient environments. This multidisciplinary experimental research involving ocean and atmospheric chemistry is being done in the landlocked state of Arkansas, signifying the potential for improving scientific education and vocation for undergraduates through laboratory research.

presenting
10 am—11 am

Trends in coral reef community composition at sites in Kuna Yala, Panama

Ashleah Courtney, Vania Trujillo, Jordan Griffin, Shanna Russell, James Engman*

Department of Biology, Henderson State University, Arkadelphia, AR

Climate change, anthropogenic disturbance and ecological factors have been well documented as resulting in drastic declines in coral reef "health" throughout the Caribbean region. Reefs within the autonomous Kuna Yala province of Panama, however, are considered less impacted than most in the Caribbean due to minimal development, deforestation, and agriculture by indigenous communities. In July 2010, coral reef composition was surveyed at four sites in Kuna Yala, and one site in the rapidly developing Colon province. Each site was surveyed using three ten-minute high definition video transects over well-developed reef. Freeze-frame images were selected at five-second intervals and overlaid with five sampling points. At each point, substrate was classified as living coral, dead coral skeleton, algae, sand, etc. Organisms were identified to lowest taxonomic levels possible. Sites were a priori classified as less, more or highly impacted, based on proximity to, and intensity of, observed disturbance factors. More and highly impacted sites are predicted to have lower coral cover, lower coral species diversity, and higher macroalgal cover. Results will be compared to data from similar surveys on these reefs conducted in 2005-2007. A decline in reef conditions is predicted to have occurred in this time period.

presenting
11 am—12 pm

An investigation of scorpion toxin gene variability among populations

Brannon Broadfoot, Heather Dollar, Tsunemi Yamashita*

Arkansas Tech University, Russellville, AR

We report the variability in a sodium (Na^+) toxin gene of ten scorpion individuals from the species *Centruroides vittatus* with the purpose of characterizing and cataloging the gene's variants. This particular species, which is common to Arkansas and Texas, is a member of the toxic *Centruroides* genus; however, it only exhibits modest toxic effects on humans. The primary goal of the project is to gain a viable understanding of how Na^+ toxin genes and proteins are different from those in the more toxic species. We focus on the sodium toxin as it is one of the best studied venom components in this genus. To determine the genetic variability among scorpion Na^+ toxin genes, 100 bacterial colonies (ten clones of ten individuals from different populations) containing plasmids with the gene of interest were cultured overnight and the plasmids extracted the following day. Purified plasmid DNA was sent to the University of Arkansas for Medical Sciences for sequencing. Sequences were then aligned to determine variability and the initial analysis has shown variability among individuals and among clones from the same individual. This variability is likely due to forces such as natural selection and gene duplication. In subsequent studies, we plan to identify amino acid residues that may moderate toxicity in the scorpion's sodium toxin protein.

presenting
11 am—12 pm

Neuroanatomical connections of sensory areas in the nine-banded armadillo (*Dasypus novemcinctus*)

Johnathan.Rylee, Monica Runge, N. Scroggins, J. Padberg*

Dept. of Biology, University of Central Arkansas, Conway

We are interested in determining features of neural organization that may be common to all mammals, and are therefore examining brains from a representative species of an early branch of mammalian lineage, Superorder Xenarthra. The nine-banded armadillo (*Dasypus novemcinctus*) is the only extant Xenarthran found in North America, and these animals are anecdotally considered to be behaviorally quite simple (indeed, even stupid!). While the armadillo has become a quite important model in research due to its ability to serve as a reservoir for *M. leprae*, the causative agent in Hansen's disease, the functional organization of their sensory systems has not been well characterized. Additionally, the armadillo almost invariably gives birth to identical quadruplets, making it a potentially important model for future developmental studies. We are currently exploring the connectional organization of Xenarthran species by placing fluorescent neuoroanatomical tracers into the sensory cortex of nine-banded armadillos, and reconstructing connectional patterns using the Neurolucida imaging software. We are also developing a brain map using standard electrophysiological techniques. Through this line of experimentation, we will gain insight into the evolution of mammalian brains and how physical and behavioral differences between Xenarthran and Epitherian species translate into distinct neural organization.

presenting
10 am—11 am

Polar bears (*Ursus maritimus*) discriminate between the sex and reproductive status of conspecifics via pedal scent

Qin Yin,[a] Daniel Mark,[a] Tom Goodwin,[a]* Megan Owen,[b] Christine Slocomb,[b] and Ron Swaisgood[b]

[a]Chemistry Department, Hendrix College, Conway, AR
[b]Institute for Conservation Research, San Diego Zoo Global, Escondido, CA

Chemical communication has been demonstrated for pandas and brown bears. Polar bears are known to sniff the paw prints of other polar bears (conspecifics), and may preferentially follow the tracks of one individual over another. These observations suggest that paw prints in the snow may contain chemical signals. Behavioral bioassays illustrated that polar bears are more likely to sniff conspecific scent during the spring (breeding season). They also displayed more interested in pedal scent collected from the opposite sex, and toward estrus female scent. These results suggest that polar bears distinguish between the sex and reproductive status of conspecifics through assessment of pedal scent, and that they are seasonally motivated to do so. Analysis of pedal swab samples using automated solid phase dynamic extraction (SPDE)/gas chromatography-mass spectrometry (GC-MS) has identified a large number of volatile chemicals emanating from inter-digital swabs from wild Alaskan polar bears. These are being analyzed for evidence of sexual and individual differences. We are trying to determine whether any of these compounds serve as chemical signals between polar bears.

presenting
10 am—11 am

Reproductive cycle of Baird's pocket gopher (*Geomys breviceps*) in northern Louisiana

Douglas C. Cagle,[a] Heather E. Peek,[a] Christopher R. Ellington,[a] Matthew B. Connior,[b] John L. Hunt[a]*

[a]University of Arkansas at Monticello
[b]South Arkansas Community College, El Dorado

Knowledge of the reproductive patterns of a species can be critical in making decisions regarding conservation or agricultural pest control. One species in Louisiana that is sometimes an economic pest is Baird's pocket gopher (*Geomys breviceps*), a small fossorial rodent that spends almost its entire life within subterranean burrows. Because of these habits, pocket gophers cause damage to agricultural fields and urban yards. Reproductive data on pocket gophers in Louisiana could be used to help control pest populations. Studies have been conducted in Missouri and Texas to determine reproductive patterns of pocket gophers but no studies have been conducted in Louisiana, although patterns have been assumed based on nearby studies. We collected gophers in Union Parish, Louisiana for 18 months in 2010 and 2011 and dissected them to determine reproductive cycles. Reproductive data, sex ratios and body size data are presented. The majority of reproduction occurs in spring and early summer, as evidenced by juveniles and subadults in our collections.

presenting
10 am—11 am

The effects of ajulemic acid on pediatric cancers

Vikki K. Bennett,[a] Cara L. McKinney,[a] Jessica R. Winston,[a] Amy G. Eubanks,[a] Larry J. Suva,[b] Robert J. Griffin,[c] Lori L. Hensley[a]*

[a]Ouachita Baptist University, Department of Biology, Arkadelphia, AR [b]UAMS, Dept. of Orthopaedic Research, [c]UAMS, Dept. of Radiation Oncology, Little Rock, AR

Ewing's Sarcoma is a pediatric bone cancer that is highly aggressive, leading to a five-year survival rate of only 30% even with multi-modal treatment protocols. Improved therapeutic options are desperately needed. Our research, completed primarily by undergraduate students, has focused on the ability of the non-psychoactive cannabinoid, ajulemic acid, to induce death and inhibit metastases in cells from members of the Ewing's sarcoma family of tumors. Our data demonstrate this compound can successfully kill Ewing's sarcoma cells and related tumor cells *in vitro* through the induction of apoptosis. Our data further suggest ajulemic acid can limit the migration of tumor cells and endothelial cells (required for new blood vessel formation to feed the tumors), reducing their metastatic potential. In order to test the efficacy of this compound in a more realistic model of human cancer, we developed a novel bioluminescent mouse model of Ewing's sarcoma in which engineered tumor cells were injected into the tibiae of mice, and the growth of tumors in control and ajulemic acid treated mice was tracked using specific imaging techniques. We hypothesize that these experiments provide the rationale for the development of improved therapies for this devastating family of cancers.

presenting
11 am—12 pm

Investigation of a dual gene in growth and tumor development

Robert Rose and Mary J. Stewart*

School of Math & Natural Sciences, University of Arkansas at Monticello

Human cancer development is a multistep process in which many gene mutations occur. Our understanding of the genetic processes that go awry in cancer has been enhanced by studying tumor development in simple organisms that have genes similar to human genes. For example, many of the genes of the fruit fly, a model organism for genetic studies, are counterparts to human disease genes. We are studying a gene in fruit flies, which when mutated, causes tumors and early death. This gene is unusual in that it is a "dual gene", with one gene called *snoRNA DmOr_aca2* being nested within the boundaries of the other gene called *RpS6*. In humans, there are approximately 463 different types of *snoRNA* genes and some have been implicated in cancer development. Likewise, there are many different types of human *Rp* genes and at least seven are associated with predisposition to leukemia. The first goal of our work is to determine if one or both portions of the "dual gene" are important for tumor development. Another goal is to determine the role of the gene in tumor development. We expect that this research will contribute to our understanding of human cancers and potentially to cancer treatments.

presenting
10 am—11 am

Developing a fetal disorder diagnosis system

Aaron Crawford,[a] Karen Gilmer,[b] Travis Jones,[c] Chase Mitchell, [a] Shengli Victor Sheng [a]*

[a]University of Central Arkansas, Conway; [b]Georgia College and State University, Milledgeville, GA; [c]University of Arkansas at Pine Bluff

The purpose of this research project was to develop a system for predicting neurological and growth disorders among fetuses. The data used is attributed to the University of Arkansas for Medical Sciences (UAMS) and the novel application of their SQUID array for reproductive assessment, or SARA system. For ease of use in various algorithms, incoming data pertaining to gestation week, stimulus application, and heart rates was stored in the attribute-relation file format (ARFF). Converting this data required manipulation of the provided cardiac cycles as well as filtering of erroneous data. Using the Waikato Environment for Knowledge Analysis (WEKA), this data was run through many widely used algorithms to set a benchmark for prediction accuracy. Though the decision table algorithm found using WEKA produced 77% prediction accuracy, an algorithm specifically designed for time series data, Dynamic Time Warping (DTW), was implemented. DTW was used to match similar patterns found in fetal heart rates in a nonlinear way and thus revealed hidden similarities. Early results yielded a prediction accuracy of 55%, which is quite high for non-discretized data. The system developed shows great promise for predicting high-risk pregnancies while being adaptable for many medical purposes.

presenting
10 am—11 am

Regulation of the xenobiotic stress response in *C. elegans* – combinatorial action of nuclear receptors?

Leah Blackwell, Amanda Marra, Tim Lindblom*

Division of Science, Lyon College, Batesville, AR.

We are working to help understand how chemicals from the environment impact human health. These chemicals, commonly called xenobiotics, come in many forms including environmental contaminants, drugs, dietary supplements, and compounds normally found in food and drink. When present in the body, xenobiotics are sensed by proteins known as nuclear receptors. Binding of xenobiotics to nuclear receptors causes these proteins to induce the production of the cellular machinery that detoxifies and exports these compounds from the body. Research with the soil nematode, *Caenorhabditis elegans,* offers a powerful system in which to study biological processes common to all animals. *C. elegans* contains a nuclear receptor known as NHR-8, which is very similar in structure and function to the "xenobiotic sensing" nuclear receptors in humans. NHR-8 is hypothesized to control the production of enzymes involved in both xenobiotic detoxification as well as for normal cellular biochemistry, such as lipid and carbohydrate metabolism. Thus, NHR-8 offers a unique entryway into to study of the intersections between normal and xenobiotic metabolism. By studying NHR-8 in *C. elegans*, we will contribute to the understanding of how pollutants, drugs, and other chemicals impact the body's metabolic state and the removal of offending and helpful xenobiotics.

presenting
10 am—11 am

Improving drug Metabolism using chemical computer simulations

Kasa B. Cooper,[a] Benjamin M. Ford.[a] Tanner W. Simon,[a] Tyler W. Simon,[a] Grover P. Miller,[b] and Martin D. Perry, Jr.[a]*

[a]Dept. of Chemistry, Ouachita Baptist University, Arkadelphia, AR; [b]Dept. of Biochemistry and Molecular Biology, University of Arkansas for Medical Sciences, Little Rock

Humans have several families of proteins that play important roles in normal dietary metabolism. Specific sub-families of proteins participate in the metabolism of foreign substances in the human body such as steroids, drugs, mutagens, and carcinogens. Drug labels list many side effects, most of which are rarely exhibited, indicative of the body processing drugs in unique ways. There are multitudes of competing pathways that can alter a drug's properties and associated side effects. As an example, the metabolism of one form (the S-form) of the widely used drug warfarin, commonly prescribed as a blood thinner, by proteins is nearly 1000-fold better than the R-form of the drug. The molecular interactions responsible for this difference are unknown. Chemical computational simulations of these foreign substances with human proteins were conducted using commercially available software to examine molecular interactions in an effort to understand and improve drug metabolism. Molecular simulations included nitroanisoles (known environmental carcinogens) and drugs such as warfarin and flurbiprofen (commonly utilized as a pain reliever). Once the specificity of the molecules was confirmed, the intermolecular interactions with the protein were identified. The data obtained from identifying these interactions are allowing for mutation of specific amino acid sequences and confirming their importance in drug metabolism.

presenting
11 am—12 pm

Fractal dimension and circularity measure for melanoma detection

Melissa Perkins,[a] Ashley Lawrence,[b] Sait Suer,[b]
Sinan Kockara[b]*

[a]Arkansas Tech University, Russelville
[b]University of Central Arkansas, Conway

Dermoscopy has been an essential technique used by doctors to help examine suspicious pigmented skin lesions. Forming an automatic assessment of dermoscopy images is being increasingly important with current practices being expensive, time consuming, and regularly with error. Melanoma is known as the fastest growing cancers. Computerizing dermoscopy will help doctors in accurate diagnosis of melanoma. Melanoma is often characterized by its discoloration and irregularity. Fractal dimension, the measurements of rough or fragmented areas, helps determine irregularity and can be determined several different ways. Box counting and circularity are two methods in which we have furthered examined using border drawn and region drawn images both by a physician and by a computer. In 2010, and estimated 68,130 were diagnosed in the United States and approximately 8,700 of them died. Our hopes are that our research will help diagnosed melanoma quicker and determine the exact lesion region.

presenting
10 am—11 am

Curves in two-dimensional vector spaces over finite fields

John Pope,[a] Andrew Todd,[a] Jeremy Chapman[b]*

[a]Lyon College, Batesville, AR
[d]Div. of Math and Science, Lyon College, Batesville, AR

The study of curves at the undergraduate level is taught almost exclusively using real numbers. All of the numbers in $\mathbb{R}$ function in such a way to allow the familiar operations of addition, subtraction, multiplication, and division. The technical term for this is a "field," and more specifically $\mathbb{R}$ is an infinite field. Nonetheless, $\mathbb{R}$ is by no means uniquely so, with the set of all integers, even integers, odd integers, rational numbers and so on sharing the same characteristics. Interestingly, fields don't have the requirement of being infinite at all and $\mathbb{Z}p$, with p prime, is in fact a commonly cited finite field. Departing from $\mathbb{R}$, we explored the paradigm of calculus using a coordinate system of $\mathbb{Z}p$; that is using the $\mathbb{Z}p$x$\mathbb{Z}p$ vector space. Specifically, we examined the appearance of familiar curves, the concept of slope, and the concept of derivation. The body of our results attempts to show the deeper similarities between calculus in the $\mathbb{R}$x$\mathbb{R}$ and $\mathbb{Z}p$x$\mathbb{Z}p$ vector spaces.

presenting
11 am—12 pm

Right-handed and left-handed: A reaction in stereo

Suyen Espinoza, Rebekah Henderson, Susan Newton*

Chemistry, John Brown University, Siloam Springs, AR

Molecules can be arranged in two different ways. They can be right- or left- handed molecules, which means that they contain the same atoms but have these atoms arranged differently. In other words, these molecules are mirror images that cannot overlay each other just as a right hand will not fit in a left glove. The focus of our study is to isolate the four products of a particular reaction and to determine how much of each of these products is produced in a single reaction. These products differ from each other only in their handedness. Once these ratios are established, further research can be performed to test if these products can inhibit growth of cancerous KB3 cells. This study is beneficial to the better understanding of the molecular arrangement in our bodies. For example, depending on the assembly of a molecule such as ibuprofen, our bodies will respond in different ways. Ibuprofen, a common drug used to sooth pain, is only effective if the molecular composition is right-handed. This importance of molecular assembly will be discussed.

presenting
10 am—11 am

New derivative leading towards improvements in RNA chemical synthesis

Wezley C. Griffin, Vincent K. Dunlap*

Department of Chemistry, Henderson State University, Arkadelphia, AR

In recent years, chemical synthesis of RNA has become a valuable biochemical tool. As a result, the demand for RNA nucleoside monomers has increased significantly. The reagents used to accomplish this chemical synthesis, otherwise known as protecting groups, have seen improvements recently, but the product yields from these protecting group reactions still require improvement. In order to improve these yields, we have developed a derivative of the common protecting group dimethoxytrityl (DMT), which is commonly used in both DNA and RNA chemical synthesis. Presented here is the process for synthesis of the DMT derivative. When combined with other common protecting groups, the designed derivatives will lead to improvements in the product yield and overall efficiency of RNA chemical synthesis.

presenting
10 am—11 am

How distinct are the geographically isolated coastal populations of ponderosa pines in the Willamette Valley of Oregon and Fort Lewis, Washington?

Kristen Finch,[a] Ann Willyard,[a]* Stephen Meyers[b]

[a]Biology Department, Hendrix College, Conway
[b]Oregon State University, Corvallis, OR

Conservation efforts for native species like ponderosa pine depend on proper classification to inform decisions on species needing preservation. Natural stands of ponderosa pines in the Willamette Valley (OR) and on the Fort Lewis military base (near Puget Sound, WA) were studied. One or both of these populations are reportedly unique, including spring growth timing, wood density, and biochemistry. Currently classified as *Pinus ponderosa var. pacifica, they grow far* from other var. *pacifica* in coastal California. In addition their climate is different from the nearer populations sampled in eastern Oregon and eastern Washington (var. *ponderosa*). Thirteen chloroplast simple sequence repeat loci were genotyped from 227 individual plants. We cannot reject the hypothesis that the Willamette Valley and Fort Lewis pines are more closely related to each other than to var. *pacifica* or var. *ponderosa*. In fact, there is some weak support that they may be. However, after removing the two most distant populations, Fort Lewis is unexpectedly distant from Willamette Valley. With these intriguing preliminary results, we plan to analyze nuclear data and add ecological niche modeling to test for distinct habitats. Our results will contribute new information for the preservation of this and other native species.

presenting
10 am—11 am

"Translating" studies from experimental species to humans: A web-based tool for researchers and clinicians

Travis Kersh,[a] Alan Lim,[b] and Barbara Clancy[b]*

[a] Dept. of Management Information Systems, [d]Dept. of Biology
University of Central Arkansas, Conway

Human brain development is usually studied in non-human species like rats or monkeys. Useful methods for converting the timing of brain development in experimental species to that of humans have proved inadequate; even the rare available data are not easily accessible. We address this problem by employing concepts from neuroscience, evolutionary science, computer science and statistics, creating an online model to "translate time." Our project makes research accomplished in one species directly applicable to another. Our web application, http://www.translatingtime.net/, provides public access to this tool, including predicted dates of human brain development, important because most research studies cannot be accomplished in humans. Use of these translations also minimizes the numbers of animals used in studies of developmental disorders and diseases. This project was developed by undergraduate students at the University of Central Arkansas, and currently includes students and researchers from the University of Arkansas at Little Rock and Cornell University. The site has been accessed over 68,000 times, and is in daily use by researchers and clinicians in Arkansas and throughout the world. We estimate the project has already saved many thousands of dollars in research funding, and plan to add new species and developmental ages in the near future.

presenting
11 am—12 pm

Rapid quantitative method for salicin from a willow tree by utilizing an attenuated total reflectance (ATR) fourier transform infrared (FT-IR) spectrometer

Fanchon P. Laster, Terry L. Anderson II, Insu Frank Hahn*

Department of Chemistry, Division of Natural and Physical Sciences, Philander Smith College, Little Rock

It has been reported that willow trees contain a significant amount of salicin, which is a chemical analogue of acetylsalicyclic acid (Aspirin) and a natural product having less side effects. However, there have been no reports for the rapid quantitative analysis of natural salicin extracts using ATR-FT-IR spectrometer. Here, quantitative analysis was performed at 60 ^{o}C utilizing a Thermo® 6700 ATR-FT-IR spectrometer for the rapid estimation of the salicin amount in an extract from barks and leaves of a willow tree, *Salix Babylonica.* In this quantitative study, reproducible salicin standard curves between four prepared salicin standards and their infrared absorbance of characteristic peaks were obtained with excellent correlation coefficients (average r^2=0.995). The natural salicin extract was obtained with a significant yield (63.75%) via an extraction process of a mixture from barks and leaves of the willow tree. The obtained salicin standard curves were then applied to the reproducible infrared absorbance of the salicin extract, giving the concentration of 0.0758 ± 0.0031 M for the salicin extract. A quantitative software of OMNIC® was used to analyze the data collected. This study can augment current pharmaceutical research in Arkansas or the States to produce analgesic or anti-inflammatory drugs from natural products.

presenting
11 am—12 pm

Metabolic profiling of antioxidant phytonutrients in the *h*igh *p*igment (*hp*-1, *hp*-2^{dg}) photomorphogenic mutants of tomato

Ryne Ramaker, James Emmet, Stephen Embry, Stephen C. Grace*

Biology Department, University of Arkansas at Little Rock,

We determined antioxidant content in three tomato cultivars and two *h*igh *p*igment mutants (*hp*-1 and *hp*-2^{dg}) that exhibit altered photomorphogenic responses. Antioxidants included cinnamic acids, flavonoids, and carotenoids. Activity was assessed by the Trolox Equivalent Antioxidant Capacity and Oxygen Radical Antioxidant Capacity assays. HPLC measured chlorogenic acid (CGA), rutin, lutein, β-carotene, and lycopene levels, while untargeted metabolic profiling was performed by LCMS. Green fruits contained substantially higher levels of CGA and rutin than red fruits, while β-carotene and lycopene were subtantially higher in red fruits, indicating a shift in resource allocation from phenolic to carotenoid metabolism as fruits transition from photosynthetic to non-photosynthetic stages. A strong correlation was seen for CGA and rutin levels across all genotypes, particularly in green fruits, suggesting generation of hydroxycinnamic acids and flavonoids is coordinately regulated. *hp*-2^{dg} contained significantly higher levels of CGA and rutin than other cultivars, particularly in green fruits, and higher levels of β-carotene. The antioxidant content of tomato fruits was strongly correlated with CGA and rutin levels, indicating that phenolics are the major antioxidants in tomato. This study provides a framework for engineering more nutritious tomatoes by selective breeding, genetic engineering, and optimal growth conditions.

presenting
11 am—12 pm

Indistinguishability in excitation-ionization

Brian Milum,[a] Don Madison,[b] Allison Harris[a]*

[a] Physics Department, Henderson State University, Arkadelphia, AR
[b] Department of Physics, Missouri University of Science and Technology, Rolla, MO

The study of electron impact excitation-ionization of helium is of continuing interest in order to better understand the dynamics of four-body processes. In the process of excitation-ionization, a projectile electron collides with a helium atom causing one atomic electron to be ionized and the other atomic electron to be left in an excited state of the He^+ ion. The participation of both atomic electrons in this process makes excitation-ionization a four-body problem. Current models for this particular four-body process assume that the projectile electron can be distinguished from the atomic electrons. However, nature and experiment cannot distinguish one electron from another. We will present theoretical fully differential cross section results using the 4-body Distorted Wave - Exchange (4DWE) model where the possibility of electron exchange is included. The results will be compared with experiment and the 4-body Distorted Wave – Direct (4DWD) model where exchange is neglected.

presenting
11 am—12 pm

Dynamics of a nonlinear oscillator driven by pulse-width modulated square waves

Jaime Garcia and Juan Serna*

School of Math & Natural Sciences, University of Arkansas at Monticello,

We investigated a nonlinear mechanical oscillator, consisting of a mass suspended by three springs and kicked by a train of pulse-width modulated square waves. We observed that, every time a pulse "kicked" the system, the oscillator changed its mode of oscillation, varying its amplitude, frequency, and region of oscillation, remaining bonded in a periodic orbit in the phase plane. In addition, we noted that, after successive kicks from the train of pulses, the amplitudes and regions of oscillation varied in a randomly manner. We studied the behavior of the oscillator numerically as a function of the frequency of the system, the initial elongation of the springs, and the frequency and strength of the square pulses. We also explored the sensitivity of the system to the initial elongation of the springs and the strength of the pulses. This particular mechanical system could be used to investigate possible quantum-classical analogies with delta-kicked, nonlinear quantum oscillators.

presenting
10 am—11 am

An object-based method for interoperability in HIT systems

Cody Hudson,[a] Brent Sanderson,[b] Danielle Osborne,[a] Priyatham Anisetty,[a] and Paul Young[a]*

a Department of Computer Science, University of Central Arkansas, Conway; b Department of Computer Science, Belmont University, Nashville, TN

Due to the large number of disparate computing systems within the healthcare industry, software system interoperability poses a major problem within the field of Health Information Technology. There are many attempted means of making HIT systems interoperable, although due to the presence of a large number of legacy systems most such methods require that changes be made to the existing systems. As a means of achieving interoperability between these systems without the need for modification, an integrated development environment (IDE) is being developed with the purpose of resolving heterogeneities among cooperating systems using an object-based approach noted as the Object-Oriented Method for Interoperability (OOMI). This IDE would aid the work of an interoperability engineer, allowing for a graphical representation of objects and relationships, and decreasing time spent creating translations between existing HIT systems and helping streamline the healthcare industry by producing an interoperable superstructure model.

presenting
11 am—12 pm

Evaluating the quality of web-based health information quality: The perspective of the African American consumers

D'Andrea Magee,[b] Samar Swaid,[a]* Veronica Maples,[b] Pakeshia Benton[b]

[a]Dept. of Computer Science, [b]Dept. of Biology,
Philander Smith College Little Rock, AR

Many studies investigated the concept and metrics of online healthcare information quality to enhance consumers' health education and promotion. However, few studies focused on the perception of minorities in evaluating the quality of healthcare information. A two-phase study was conducted to understand how African American consumers evaluate the information quality of healthcare websites. In phase one, we applied the think-a-loud protocol as a qualitative method to poll perspectives of healthcare information seekers. In the second phase, the Kano model (1984) was used to classify the quality metrics onto the "must be" criteria, the "performance" criteria and the "excitement" criteria. The think-a-loud protocol identified reliability, credibility, currency, relevance, sources, readability, external links, statement of purpose, authorship, navigation tools, search engines and website accessibility as qualities of healthcare information. 102 subjects answered our questionnaire explaining consumer satisfaction with information quality and dissatisfaction using the Kano model. Analysis indicates quality criteria of reliability, currency, relevance and readability are "must" criteria whose absence results in dissatisfaction. "Performance" criteria increasing satisfaction are website usability, navigation tools, search engines and website accessibility. Criteria of external links, statement of purpose and authorship are found to be the "excitement" ones that exceed consumers' needs and expectations.

presenting
11 am—12 pm

A managed security environment for enterprise iPhones

Wes Copeland, Chia-Chu Chiang*

University of Arkansas at Little Rock

Due to the increasing use of smartphones, enterprise entities are beginning to need tools to ensure their data information security. However, very few tools have been developed to support this growing need. In this work, we demonstrate an understanding of Virtual Private Network servers, packet sniffing, and logging technologies, all of which embody many principles of smartphone managed network security. Our technique of establishing a VPN server as a middleman while using advanced packet sniffing technology is a stepping stone for a possible option that would empower a network or security administrator to better determine if their organization's information assurance policies are being violated. This work could have an impact in the state of Arkansas by helping companies make their property phones and the data stored on them more secure.

presenting
11 am—12 pm

Design and Implementation of a Cellular Digital Transmission System

Bruce Stracener, Nidhal Bouaynaya*

Dept. of Systems Engineering, University of Arkansas at Little Rock

This research aims at designing and implementing an electronic system to transmit digital data over the audio spectrum of a cellular telephone. Specifically, we will design and implement a circuit consisting of a transmitter and a receiver to transfer numerical data over the audio spectrum. The proposed project has numerous possible applications including smart grid advanced metering infrastructure data transmission, human body area network systems, sensor network deployment, and the transmission of (encrypted) data for security purposes. The data transmitted will be generated by a counter circuit fed directly into a modified cellular telephone headset. Our preliminary design shows that the transmitter circuitry will be largely comprised of Voltage Control Oscillators (VCOs), Digital to Analog Converters (DACs), Timers, bit counters, and various digital logic components. Signal conditioning will be achieved using Operational Amplifiers (Op-Amps), resistors, and transistors.

presenting
10 am—11 am

Exploiting a stable equilibrium to simulate and control high-definition video of a human face

Harry M. Hull, Keith A. Bush*

Department of Computer Science, University of Arkansas at Little Rock

This work describes and demonstrates a real-time, controllable simulation of high-definition video of a human face. The simulation is built from tools originally used to identify and control nonlinear dynamical systems exhibiting periodic strucutre; these tools were adapted to exploit the stable equilibrium exhibited by video datasets recorded using a specific videography technique, termed "piece to camera" (PTC), in which a human or human-like narrator is displayed directly facing the camera. By demonstrating the ability to control high-definition PTC video, these tools carry the potential for a transformative role in conversational agents: human-computer interfaces that often exploit model-based PTC animation in combination with voice synthesis and dialogue management. Toward achieving this role, this work describes the technical framework necessary to extend the simulation to include audio and be combined with dialogue management.

presenting
11 am—12 pm

Consumer acceptance of quick bread when non-fat plain yogurt is substituted for canola oil

Jessica Heimrich, Lisa Ritchie*

Department of Family and Consumer Science,
Harding University, Searcy, AR

The purpose of this experiment is to determine the consumer acceptability of color, density, flavor, moisture and texture, as well as overall acceptability, of a quick bread when non-fat plain yogurt is substituted for oil at two levels through subjective evaluation by panelists. Three samples were prepared with variations of fat content using vegetable oil and non-fat, plain yogurt and evaluated by forty-two panelists. The product evaluations suggest a 50% substitution of yogurt for oil in pumpkin quick bread is acceptable to consumers. 47.6% of panelists rated sample 193, the sample with 100% oil, as most acceptable (‘1’ on the three-point hedonic grading scale). Concurrently, 45.3% of panelists rated the 50% substitution sample as most acceptable. Sample 193 was determined acceptable for all five subjective characteristics by at least 64% of panelists. The sample made with half oil and half yogurt, sample 217, was rated as acceptable for all five subjective characteristics as well, yet slightly less acceptable (ranged from 55% - 71%). Sample 892, the sample with no oil added, was rated acceptable only for color.

presenting
10 am—11 am

Method development for the characterization of fatty acid content in freshwater *Eustigmatophyceae*

Misty Jager, Andrew Williams*

School of Math & Natural Sciences, University of Arkansas at Monticello

Characterization of algae for their fatty acid content is one of a variety of tests done to determine the applicability of the algae. Applications include use as nutrients for aquaculture, in human consumption, or potential ability as biofuels. A number of freshwater eustigmatophyceae have been collected by the Fawley Group at UA-Monticello. These samples will be tested to determine if there are any differences in fatty acid concentration between species. Modification of previous methods of sample preparation has been required, and will be described. Results of fatty acid content will then be compared against a standard. Our results will show if these organisms produce distinctly different fatty acid content.

presenting
10 am—11 am

Intelligent phase ordering for traffic signals

Jason Barnes[a], Christopher Chase Mitchell,[b] Vamsi Paruchuri[b]*

[a] Dept. of Computer Science, Washington University, St Louis MO; [b] Dept. of Computer Science, University of Central Arkansas, Conway

Road Transportation is a crucial component of today's society, which drives several facets of our lives. However, current road transportation systems are very inefficient. The US Department of Transportation estimates that the annual cost of lost productivity due to congestion is about $100 billion and 2.8 billion gallons of wasted fuel consumption. The World Bank estimated that 650,000 people died prematurely from urban air in 2000. Road transportation accounts for about 9.9% of GHG emissions globally, and in US, the contribution is about 21.6%. The objective of this research is to evaluate optimal phase ordering within a signal cycle to minimize average waiting delay of vehicles and in turn minimize fuel consumption and GHG emissions. Through extensive analysis and simulations, we show that optimal phase ordering out -performs current phase and can result in reducing delay by about 40% per car per signal and save about 100 gallons of fuel per signal per day. For Little Rock metro area, with about 150 traffic signals, this translates upto $45,000 daily savings and upto $16M annual savings. *To the best knowledge of the authors, this is the first report investigating the impact of ordering of the phases within a traffic cycle.*

presenting
10 am—11 am

Stress vs. strain and elemental analysis of bones obtained from rats subjected to simulated microgravity

Niravkumar Patel,[a] Kristopher Watson,[a] Rahul Mehta,[a]* Parimal Chowdhury,[b] Michael Soulsby,[b] and Nawab Ali[c]

[a]Dept. of Physics and Astronomy, U. of Central Arkansas, Conway; [b]Dept. of Biophysics and Physiology, U. of Arkansas for Medical Sciences, Little Rock; [c] Graduate Institute of Technology, University of Arkansas at Little Rock

Scanning Electron Microscopy (SEM) was used to study the elemental composition of the leg bone tissue of rats after exposure to Hind-Limb Suspension (HLS). The leg bones were cleaned of soft tissues and then were cross-sectioned, dried and sputter coated. These were placed horizontally on the stage SEM and bombarded with electron beam. The SEM images were obtained using a backscattered detector and a secondary electron detector. X-rays emitted from the sample during electron bombardment were measured with an Energy Dispersive The control groups and experimental groups were analyzed on well-defined parts of the leg bones. Also measured was the mechanical stress from stress induced by attaching weights to the bones. The elemental composition of bones above and below the knee was analyzed and results indicated a strong relationship between the compositional ratios of calcium, carbon, phosphorus and oxygen with the location on the leg. The analysis of bone shows that there must be some change in the hydroxyl group of the main compound of the bone. My research will present the state of Arkansas as leading state in the microgravity research. This research can be used to help NASA find a cure for effects of Microgravity.

presenting
11 am—12 pm

Evaluation of consumer acceptance, baking properties, and nutritional content of chocolate cupcakes with flaxseed flour

Elizabeth L. Provencher, Lisa Ritchie*

Department of Family and Consumer Science, Harding University, Searcy, AR

This experiment determined the effect on consumer acceptance of volume, texture, flavor, moisture, and tenderness, measured the effect on volume, weight, and height, and evaluated overall consumer preference when flaxseed flour replaced the flour in chocolate cupcakes at two ratio levels. The cakes were prepared according to a standard formula with the addition of two different levels of ground flaxseed, one for each variation. Variation 1 replaced 15% of the flour with ground flaxseed. Variation 2 replaced 45% of the flour with ground flaxseed. The parameters were rated by a panel of forty untrained members. Panelists rated moisture content and perceived density both as increasing with the addition of flaxseed. The product was described as having a greater tendency to crumb when flaxseed was added. Volume and sweetness were rated to decrease as flaxseed content increased. Variation 1, preferred by 40% of panelists, was almost equally preferred as the control, chosen by 47% of panelists. Substitution of flaxseed for all-purpose flour increased the amount of fiber, protein, and •-linolenic acid. Therefore, substituting flour with ground flaxseed in baked goods is an effective and acceptable method to increase the nutritional content of chocolate cupcakes and the consumption of essential omega-3 fatty acids.

presenting
11 am—12 pm

Fuelling the Future: Catalytic Hydrogen Production

Robert Bowman,[a] Derek Karr,[a] Ruixiao Gao,[a] Andrew Williams,[a] Charlette Felton,[b] Kyra Brigance,[a] Jonathan Curlin,[a] Marissa Tedford,[a] Joshua Trujillo,[a] Britney Rosenthal,[a] Bruce Noll,[c] Charles Mebi[a]*

[a]Department of Physical Sciences, Arkansas Tech University, Russellville; [b]Department of Applied Science, University of Arkansas at Little Rock; [c]Bruker AXS Inc, Madison, WI

President George W. Bush declared in his 2003 State of the Union address that hydrogen will become the primary source of energy in the future. Hence, there is renewed interest in the development of hydrogen fuel-cell technology and basic research on the production and storage of hydrogen. Hydrogen is a clean alternative to fossil fuels and can be produced from water which is abundant and readily available. Current method of hydrogen production from water requires expensive platinum catalyst. The goal of this project is to develop new catalysts based on cheap metal (Iron). Our catalysts are iron-carbonyl clusters coupled to polyaromatic thiolate ligands. We have studied a series of these compounds and the results show that they are effective hydrogen generation catalysts. The preparation and evaluation of these catalysts will be discussed.

presenting
10 am—11 am

Research on biofuel pellets made from Arkansas crop residues

Shyam Thapa, Frederick Felizco, Joshua Vangilder, Michael Jason Newell, Maqsood Ali Mughal, John Hall, David McNew, Elizabeth Hundley, Robert Engelken*

Arkansas State University, Jonesboro

We report ongoing research in identification and development of optimal constituents of biomass-based fuel pellets with long-term potential to serve as alternatives to fossil fuels. In addition to the primary combustion material made from ground residues of regional crops, we are investigating binders and encapsulants for the pellets, to maximize durability and water/rot resistance. A variety of binder materials have been investigated, with pine resin/amber, starch-based rice and wheat glue, lactose (dry milk), fatty acids such as stearic acid, and gelatin all leading contenders as low cost, low hazard binders. Crop residues include stalks and stubble of rice, soybeans, cotton, wheat, and corn. We also plan to investigate preservatives to maximize immunity from mold and bacterial decomposition, and/or attack by insects and vermin. Various minerals such as oxide/hydroxide/chloride mixes of calcium, magnesium, sodium, and/or potassium, and organic repellants such as cayenne pepper or green persimmons, may prove good candidates. We hope to advance the research to the point where the vast waste biomass available in Arkansas and the Midsouth can be safely and environmentally responsibly utilized as a viable fuel to help with the nation's energy needs and economic stimulation. We thank the ASU Center for Efficient and Sustainable Use of Resources (CESUR) for their collaboration and use of equipment.

presenting
11 am—12 pm

DNA sequence analysis in the algal class *Eustigmatophyceae*, a potential source of biofuels and essential fatty acids

Nathan Probst,[a] Karen Fawley,[a]* Marvin Fawley,[a]*
Charles M. Eliáš,[b] Charles K. Nemjová[b]

[a]University of Arkansas at Monticello
[b]University of Prague, Czech Republic

The *Eustigmatophyceae* are a poorly studied class of highly diverse linage of algae that includes the diatoms, brown algae (kelps), and chrysophytes. Some *Eustigmatophyceae* produce fatty acids that are important nutrients for aquaculture, as well as for human food consumption. In addition, some *Eustigmatophyceae* produce hydrocarbons and may useful in biofuel production. The class as currently defined comprises only a few genera and species, primarily from soil and marine environments. However, recent studies of freshwater isolates using DNA sequence analysis have revealed a wealth of diversity in the class. Many isolates that may represent new genera and species are simple spherical organisms with few distinguishing morphological features. Results of phylogenetic analyses of plastid rbcL and nuclear 18S rDNA sequences from these isolates and authentic strains of named *Eustigmatophyceae* indicate a need to revise and expand the taxonomy of the class. We have detected several new lineages among the freshwater isolates, including possible new genera, families and orders.

presenting
10 am—11 am

Updating the Qweak Database: Maintenance and accessibility

Vincent Gammill, Damon T. Spayde*

Physics Department, Hendrix College, Conway, AR

The Qweak experiment at Thomas Jefferson National Accelerator Facility is being conducted by a collaboration representing over 25 universities and research institutions, and is an attempt to precisely measure the weak charge of a proton for the first time. The relationship between weak charge and the weak force is analogous to the relationship between electric charge and the electromagnetic force. The weak charge can be used to calculate the value of the Weinberg mixing angle at low energies. The Standard Model makes a prediction for the mixing angle at low energies, so divergence could point to physics beyond the Standard Model, while agreement will constrain new and existing models. As the name “weak force” suggests, the effect is subtle and hard to measure -- separating it out from the dominant electromagnetic force means measuring a difference on the order of two -hundred-thousandths of a percent, so an exceptional quantity of data (2200 hours of beam operation) must be gathered. Storing and organizing this data presents a considerable challenge, which the Qweak database aims to satisfy. Tools to improve accessibility for researchers, efforts to improve efficiency, and ongoing expansion of the database will be discussed.

presenting
11 am—12 pm

Taxonomy-based approach to understand the quality factors of e-science environments

Freddie Brown, Dominic Buffington, Samar Swaid*

Department of Applied Mathematics and Computer Science, Division of Natural and Physical Sciences, Philander Smith College, Little Rock

In contrast to usability criteria and user-centered design concepts that have matured in commercial software, software engineers for scientific environments face a number of challenges in identifying quality factors of e-science platforms. As a number of projects in Arkansas aim onto developing communities of practice (e.g., Arkansas Minority Cyberinfrastructure Training, Education Consortium project) that use web 2.0 technologies and Cyberinfrastructure to enable participation, usage, and collaboration among intended users, it is important to identify quality of such e-science environments. In this study we adopt a taxonomy-based approach in identifying the quality factors of e-scientific software. A total of 38 journal articles and reports that detail the development of e-science platforms are analyzed. The developed classification scheme includes dimensions of: (i) descriptive dimension; (ii) knowledge dimension; (iii) communication dimension; (iv) and social dimension. The developed taxonomy can be used by e-science platform developers, usability experts, and research librarians to evaluate e-scientific platforms.

presenting
11 am—12 pm

From freshmen to seniors, active inquiry-based learning in the biology curriculum at Ouachita Baptist University

Addison McCarver, Kate Collins, Dustin Walter, Nathan Reyna*

Ouachita Baptist University, Biology Dept., Arkadelphia AR

Educational reform is moving students from passively listening to lectures to active inquiry-based learning environments. In 2011, OBU was one of twelve schools (only member from Arkansas) accepted into the Howard Hughes Medical Institute's-Science Education Alliance (Cohort IV). Through this program, twenty-five freshman biology majors are working to discover new viruses that infect and kill *M.smegmatis*, a close cousin to the bacteria that causes tuberculosis (TB). Harmless to humans, *M.smegmatis* is an ideal model to study alternate TB treatments needed to treat emerging antibiotic resistant strains. In addition, forty senior biology students are characterizing new genes for use in synthetic biology and are depositing their results in the International Genetically Modified Machine (iGEM) database at MIT. Synthetic biology is the field of genetically reprogramming bacteria and plants to work as functional devices for human benefit. Current examples of synthetic biology include creating bacteria to work as biosensors for water contamination and the production of anti-malaria drugs and human insulin. Cell biology students are using genetically reprogrammed tobacco plants to study Arkansas agricultural problems. While most research programs only involve a handful of students, as many as 60 OBU students each semester participate and contribute to the body of scientific knowledge.

presenting
11 am—12 pm

Synthesis and screening of a small compound library: an interdisciplinary laboratory experience

Lucas H. Whisenhunt, Aaron Cupp, T. David Bateman*

Dept. of Chemistry, Henderson State University, Arkadelphia, AR

A small compound library based on a known analgesic can be accomplished using two common sophomore organic chemistry reactions. By varying the structure of the two component starting materials a diverse array of compounds of varying complexity can be achieved. The second- semester organic chemistry students synthesize the compounds in two consecutive lab periods, and the compounds are passed on to the upper division biochemistry students. These students conduct brine-shrimp toxicity assays of the compound library to determine relative toxicity. The results are shared with the organic chemistry students at the completion of the assay. This exercise provides the students with insight into the collaboratory nature of pharmaceutical research both in industry and academia.

presenting
10 am—11 am

Usability measures of weight loss websites and its relation to satisfaction

Viniecia Wade,[a] Cervonn Whitmore[a], Samar Swaid [b]*

[a]Department of Biology; [b]Department of Applied Mathematics and Computer Science Philander Smith College, Little Rock

Obesity is one of the biggest public health challenges the country has ever faced and Arkansas is named the eighth most obese state in the nation. As a result, a number of steps has been taken in Arkansas to address the obesity crisis. One of the efforts is to develop web-based weight loss programs that help its intended users to manage weight loss. Past research suggests that web-based weight loss programs may be an effective mean to facilitate weight loss. However, a number of studies found that such online programs suffer from high attrition rates that result from the inadequate usability of such programs. This study aims onto understanding the usability measures of web-based weight loss programs and its relation to user satisfaction. Based on usability testing sessions with 18 African American potential users and an empirical study, we construct a multi-dimensional scale for measuring the usability of web-based weight loss programs. Our findings support health practitioners, website designers and usability experts who work on developing online programs for weight loss. More importantly, our work supports movements in Arkansas to develop online weight loss programs that satisfy the needs of their intended users.

presenting
10 am—11 am

Particle size dependence of superparamagnetic blocking in magnetite (Fe_3O_4) nanoparticles

Joy. D. Counts,[a] Cristian E. Botez,[b] Ronald J. Tackett[a]*

[a]Department of Physical Sciences, Arkansas Tech University, Russellvill; [b]Department of Physics, The University of Texas at El Paso, TX

In recent years, driven by many factors including the push for consumer technologies that are lighter, stronger, and most importantly, stronger, the field of nanotechnology has been one of extreme activity. With this said, the need for a basic understanding of the underlying physics behind materials on the microscopic scale has never been more evident. This poster will outline experimentation on nanoscale magnetite (Fe_3O_4), a common magnetic material which exhibits the interesting property of superparamagnetism when dimensionally constrained. Focus will be put on the synthesis of these particles as well as the characterization of their interesting magnetic properties.

presenting
11 am—12 pm

Nanochemistry: characterization of small metal nanoparticles for diverse applications

Katie Primm, Donald Perry*

Department of Chemistry, University of Central Arkansas, Conway

Nanotechnology has had a pervasive impact on many parts of society by influencing diverse applications such cosmetics, medicine, auto/farm products, and agriculture. These new technologies are already altering the health, lifestyles, and livelihoods of Arkansans in many ways. Questions also arise as to how these new chemistries derived from nanotechnology will impact human biochemistry and the chemistry of the environment. In particular, our research explores how metal nanoparticles effect biological and organic thin film growth. Work presented here focuses on the structural characterization of silver and gold nanoparticles of less than 100 nanometers in size using different types of microscopy techniques. Below is a scanning electron microscopy image of gold nanorods grown at a grazing angle on a salt plate.

presenting
11 am—12 pm

Fluid motion with magnetohydrodynamics

Amanda Hicks, Carla Swearingen,[a]* Ingrid Fritsch[b]

[a] John Brown University, Siloam Springs, AR
[b] University of Arkansas, Fayetteville

When an electrical current is run through a liquid within a magnetic field, the liquid will move. This is known as Magnetohydrodynamics. In Redox Magnetohydrodynamics, ions are added to the liquid to keep the electrodes from being destroyed. The direction and speed of the liquid motion varies depending on the strength of the current, the concentration of the ions, and the depth of the cell in which the experiment is performed. In this study, the magnetic field was set up as parallel to the chip, which caused the liquid to move in four small circles around and over the electrodes, as compared to previous perpendicular orientations which caused the liquid to move in a straight line between the electrodes. Potential applications include being used for mixing in small-scale "Lab on a Chip" analytical equipment, which could be used in the field to analyze water content of lakes and streams. The principle of magnetohydrodynamics has also been used for engines in motorboats, and in circulating the coolant in nuclear reactors.

presenting
10 am—11 am

Comparisons of lighter n-capture elements in galactic halo stars

Jacob Teffs, Tristan Odekirk, Debra L. Burris*

Department of Physics and Astronomy, University of Central Arkansas, Conway

There are two main processes involved in the creation of elements with a Z > 30; the "rapid" r-process, and the "slow" s-process. The r-process and s-process are neutroncapture processes, meaning that starting with a base nuclei, they capture neutrons which then beta decay into a proton and an electron. The r-process requires extreme conditions: a high neutron density and high temperatures thus limiting the environments where it can occur. Current understanding of these processes alone does not appear to account for all n-capture isotopic abundances observed. We propose to look for such trends in the lighter n-capture elements such as Yttrium, Zirconium and Strontium. These elements are of interest since they do not appear to have a single r-process component responsible for their production. Using survey stars from Simmerer et al (2004) new abundance values for these elements have been determined. Element to element comparisons have been conducted to search for trends similar to those known for main r-process elements as well as similarities between the lighter n-capture elements.

presenting
11 am—12 pm

Non-linear structures in Earth's auroral regions

Clark Scholz, D. S. Daniel Main *

Department of Physics, John Brown University,
Siloam Springs, AR

Earth's space environment extends from about 100 km to 100000 km in altitude. This vast region of space interacts with a stream of high energy particles (mainly electrons and protons) from the sun called the solar wind. Earth's space environment is dominated mainly by geo-magnetic field, which also protects us from the solar wind. The solar wind is a source of energy and matter input into the space environment. The solar wind particles indirectly input its energy and matter into earth's upper atmosphere in a region called the Auroral Borealis (northern lights) and Auroral Australis (southern lights). The visible display of lights results from high particles interacting with atmospheric nitrogen and oxygen leading to the emission of mainly green and red lights. In this poster we talk about some of the physical processes which lead to the northern and southern lights. This research impacts Arkansas in the following ways. The high energy solar wind particles can cause power grid disruptions if the energy is too great. By understanding the physical processes in the space environment, we can predict when a power grid disruption could possibly occur and take steps to prevent the disruption.

presenting
11 am—12 pm

Construction of a spectrometer for measuring biomarker gases on Mars

Darah L. McDaniel, Edmond Wilson*

Department of Chemistry, Harding University, Searcy, AR

An open-path, diode laser spectrometer has been built to detect and locate the exact surface position for biomarker gases escaping into the atmosphere of Mars. The gases to be measured include oxygen, ammonia, carbon monoxide, methane, water vapor, carbon dioxide and nitrous oxide. The spectrometer is mounted on a sensitive tilt and pan mechanism for pointing the laser beams. The tilt and pan is driven by high resolution stepper motors having micro stepping capability. The lasers are DFB lasers that operate near room temperature or slightly below. The laser beams are shaped by a high precision collimating lens that has a Rayleigh length of 287 meters. In operation, a laser beam is aimed at a retroreflector some 10 to 1000 meters away and the reflected signal captured by an extended wavelength InGaAs PIN photodiode detector. A reduction in signal indicates a biomarker gas is present. The attenuation of the transmitted light is a proportional to the amount of gas present. The detected light signal is sent to a low noise pre-amplifier before sending it to a lock-in amplifier that eliminates most of the signal noise. A National Instruments cRIO Real Time Controller captures the raw data, processes it and stores it for transmission to the home base. A laser rangefinder measures the distance from laser spectrometer to retroreflector so that Beer's Law calculations can be made to determine the concentration of the biomarker gas.

presenting
11 am—12 pm

Protecting humanity, one flying space rock at a time

Haley Morris, Jeff Robertson*

Department of Physical Sciences, Arkansas Tech University Russellville,

We provide astrometry observations of minor planets designated Near-Earth-Object Potentially Hazardous Asteroids (NEO-PHA). In short, we'd like to help find "the next big one" before it finds us and does to us what it did to the dinosaurs. Follow up observations of NEO-PHAs both newly discovered and those with poor orbital elements are obtained, analyzed and processed to yield celestial coordinates used to accurately calculate and refine the orbits of these objects and help determine their long-term trajectories and Earth impact hazard probabilities. Our asteroid astrometry results in improved accuracy of their orbits and lessens losing track of them resulting from lack of timely follow-up observations after initial discovery. These observations support NASA in fulfilling its congressional mandate to identify potentially hazardous space objects and can also help in solar system mission planning. But really, we do it for humanity.

presenting
10 am—11 am

Electrodeposition of cadmium telluride and indium sulfide films for photovoltaics

John Hall, Joshua Vangilder, Maqsood Ali Mughal, Michael Jason Newell, Frederick Felizco, David McNew, Shyam Thapa, Elizabeth Hundley, Robert Engelken,* Bruce Johnson, Ross Carroll

Arkansas State University, Jonesboro, AR

We report ongoing research on the electrodeposition of thin films of cadmium telluride (CdTe) and indium (III) sulfide (In_2S_3). In_2S_3 has potential as a lower toxicity alternative to the commonly-used but hazardous cadmium sulfide (CdS) as the window/buffer layer in solar cells, while CdTe is a well-known absorber layer for solar cells. Electrodeposition offers potential cost-saving, scale-up, and precise monitoring and control advantages (by virtue of its electrical nature), but still has potential for process improvement. The presentation will describe recent innovations in process variables and procedures, and their potential to eventually impact photovoltaics. The authors acknowledge the gracious support provided by Arkansas State University (Dr. David Beasley-Dean of Engineering; Dr. Thomas Risch-Director of the Graduate Program in Environmental Science), National Science Foundation grant EPS-1003970 administered by the Arkansas Science and Technology Authority, and NASA grant NNX09AW22A administered by the Arkansas Space Grant Consortium. Dr. Alan Mantooth, Kathy Kirk, Dr. Greg Salamo, Dr. Omar Manasreh, Dr. Alex Biris, Dr. Tansel Karabacak, Dr. Hyewon Seo, and other collaborators at the University of Arkansas (both Fayetteville and Little Rock campuses) are also thanked, as are Dr. Keith Hudson and Laura Holland at ASGC, and Dr. Gail McClure, Cathy Ma, and Marta Collier at ASTA.

presenting
10 am—11 am

Fabrication of Micromirror Templates Using a Focus CO_2 Laser

Sonia Perez,[a] Ben Petrak,[b] Konthasinghe,[b] Andreas Muller[b]

[a]Henderson State University, Arkadelphia, AR
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Micromirrors are an important component in quantum optics, for example in Fabry-Pérot microcavities, where light can be recirculated within small volumes. Recently, a CO_2 laser method has been demonstrated as a way to fabricate micromirror templates with an exceptionally high surface quality. However, these templates typically vary in size significantly, which is undesirable in many applications, for example when arrays are needed. Here we address this problem by implementing a feedback method, which uses the light emitted by the sample during the ablation process. By measuring the intensity of the light emitted and correcting, in real time, the laser intensity, we can control the feature size to be less than 5%.

presenting
10 am—11 am

Progress in electrodeposition of indium sulfide and copper indium sulfide films for potential solar cell use

Maqsood Ali Mughal, Michael Jason Newell, John Hall, Joshua Vangilder, Frederick Felizco, David McNew, Shyam Thapa, and Elizabeth Hundley, Robert Engelken,* Bruce Johnson, Ross Carroll

Arkansas State University, Jonesboro, AR

Interest in alternatives to reduce dependence upon fossil fuels motivates research on new solar cell materials and/or methods to reliably and inexpensively produce them as thin films. We report on continuing research on the electrodeposition of thin films of In_2S_3 and $CuInS_2$. In_2S_3 is a lower toxicity alternative to the commonly-used but hazardous cadmium sulfide as the window/buffer layer in solar cells, while $CuInS_2$ offers comparable lower hazards as the absorber layer, and could replace hazardous CdTe and $CuIn_{1-x}Ga_xSe_2$. Electrodeposition offers potential cost-saving, scale-up, and precise monitoring and control advantages. We are investigating organic (ethylene glycol-based) solvents of $InCl_3$ or other indium salts, NaCl (to increase bath conductivity), copper salts in the case of $CuInS_2$, and either/both molecularly dissolved elemental sulfur and/or sodium thiosulfate as the sulfur source. Cathodic substrates include glass coated either with indium tin oxide or molybdenum, and metal foil pieces, to complement the graphite anode and either Ag/AgCl or graphite reference electrode. Recent work involving the Taguchi Method of experiment design has revealed that a cathode-to-reference electrode voltage of -0.685 V and a temperature of 150 ^oC yield the best adherence, uniformity, and stoichiometry (that is, sulfur-to-indium ratios near 1.5 in In_2S_3).

presenting
11 am—12 pm

Compton scattering and topological reconstruction of gamma rays in a xenon time projection chamber

Jeremy Dunklin,[a] Abdel Bachri,[a]* and Azriel Goldschmidt[b]

[a]Southern Arkansas University; [b]Lawrence Berkeley National Laboratory, Berkeley, CA

The role of the research group at the Lawrence Berkeley National Laboratory (LBNL) is to develop a prototype Xenon gas time projection chamber (TPC) as part of the Neutrino Experiment with a Xenon TPC (NEXT) collaboration. The primary advantage of the xenon gas TPC is that it gives both excellent energy resolution and the ability to map events within the chamber. Compton scattering is well understood, making it ideal for testing the TPC's ability to properly map event topology. Compton scattering occurs when an incoming gamma ray ejects an electron from an atom and scatters at an angle. The scattered gamma ray, having given some of its energy to the electron, then interacts with another atom, usually via the photoelectric effect. The Compton event can be reconstructed using the energies and positions of the two resulting electrons. After reconstructing the event, the scattered gamma energy can be calculated using the position of the electrons and then compared to the actual value measured in the TPC. After comparing these measurements, there has shown to be significant error in the scattering angle measurement. This discrepancy is due to the fact that the two electron tracks are actually quite long, meaning there is a substantial amount error regarding their actual original positions.

presenting
11 am—12 pm

Energy resolution deterioration due to recombination in high pressure xenon detectors along delta electron tracks

Kahli Remy,[a] Abdel Bachri,[a]* Azriel Goldschmidt,[b]
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The energy resolution of xenon degrades as its density becomes higher than 0.5g/cm^3, reaching a plateau in the liquid phase. Determining specific reasons for this is the goal of this work. The accepted explanation involves the creation of high energy (delta) electrons; however, few of these are made and they are unpredictable. Following a primary ionizing collision between an electron and a xenon atom, one or more energetic electrons are ejected. Delta electrons are the small fraction of the ejected electrons possessing energies larger than the ionization potential of xenon. Because of the scarcity of delta electrons, statistical fluctuations can be very large. Energy loss per unit length is high for them, increasing the chance that xenon atoms that lost electrons may grab free electrons in a process known as recombination. The rate of recombination at high density is hard to predict, and it is difficult to determine how many delta electrons were made initially. Testing this and developing alternative explanations by computer simulations in Garfield++ and Root is the focus of this work. The Onsager Radius we simulated was used to evaluate the rate of recombination at high pressures for xenon. Our preliminary results up to 10.5 atmospheres of xenon show only a low rate of recombination. Future efforts are testing still higher pressures.

presenting
10 am—11 am

Neutrino-induced electron-positron pair-production in intense magnetic fields

B. Jordan Russell, Todd M. Tinsley*

Department of Physics, Hendrix College, Conway, AR

When stars that are approximately nine times the size of our sun or larger exhaust their fuel, they die in extremely violent explosions known as supernovae. Over the course of several weeks, a supernova can emit as much energy as our sun will emit over its ten billion year lifetime. The processes leading up to a supernovae event are complex and not fully understood. It has been known for some time, however, that particular subatomic particles (neutrinos) are intimately involved in all phases of a star's evolution. A complete understanding of their role in supernovae events is crucial for describing such phenomenon. To assess the degree to which neutrinos could contribute to supernovae explosions, we consider a certain neutrino interaction that can only occur in the presence of intense magnetic fields like those found inside of stars. Our research involves calculating the rate at which this interaction occurs. This work is generously supported by the Arkansas Space Grant Consortium.

Acknowledgements

Capitol liaison
Jeff Pitchford, Government Relations, UCA

Representative/Senator Contacts
Will Slaton, Assoc. Prof. of Physics, UCA

Poster session refreshments
Tim Atkinson, Director of Sponsored Programs, UCA

Easel rentals
Martin Campbell, Assoc. Prof. of Chemistry, HSU

Foam easel boards
Cathy Ma, Arkansas Science & Technology Authority

Additional planning, luncheon assistance
Tom Goodwin, Prof. of Chemistry, Hendrix College

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Carl Frederickson, Assoc. Dean Natural Sciences & Math, UCA

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with tips on planning poster-at-capitol events

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