

STEM

Posters at the Capitol

Rotunda of the Arkansas Capitol

March 7, 2014, 10:00-Noon

On behalf of the Colleges and Universities represented today (University of Arkansas, University of Arkansas Fort Smith, University of Arkansas at Little Rock, University of Arkansas at Monticello, University of Arkansas at Pine Bluff, Arkansas State, University Central Arkansas, Harding, Henderson State, Hendrix College, John Brown University, Philander Smith College and Ouachita Baptist) I welcome you to the STEM Posters at the Capitol. In this book of abstracts you will find a wide range of research in science, engineering, and mathematics, by our students. The posters will be presented in two different sessions, each abstract indicates in which session the poster will be displayed.

Stephen R. Addison
College of Natural Sciences and Mathematics
University of Central Arkansas

University of Arkansas at Monticello

ION CHROMATOGRAPHIC STUDY OF AEROSOL SAMPLES COLLECTED FROM JONESBORO, AR

Kiara Newhouse¹, Bryant Fong²,
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[Session 1: 10:00-11:00 am, Friday March 7]

Aerosols affect Earth's ecosystem by changing the global reflectance properties of the atmosphere. This reflective property depends on their chemical composition. They may also cause adverse health effects when their concentrations increase due to increase in activities such as urban traffic congestion and/or enhanced farming practices like foliage burning. All these activities result in an increase in aerosol concentration, and consequently an increase in pollution. This study was performed to try and characterize the chemical composition of aerosols found in an urban town, Jonesboro AR, which is also surrounded by farming areas. Aerosol samples were collected in using a mini-particle collector and analyzed using ion chromatography. It was found that the majority of the aerosols contained chloride, nitrate, and sulfate components at different concentration levels. Further studies are being conducted to determine the origin of the collected aerosols and their distribution around Jonesboro AR.

PHOTOVOLTAIC GENERATION OF HYDROGEN

Esgar Jimenez
M. Jeffrey Taylor

Science Center, University of Arkansas at Monticello

[Session 2: 11:00am -noon, Friday March 7]

We are generating hydrogen and oxygen gases without using any exotic or expensive equipment or materials. This involves the electrolysis of water molecules into hydrogen and oxygen by applying an external direct current potential. Water is oxidized (loss of electrons) at the anode to form oxygen gas. Hydrogen ions are reduced (gain of electrons) at the cathode to form hydrogen gas. Currently, we use a 12 V lead acid adsorbed glass mat battery charged by a photovoltaic panel as an energy source. The anode and the cathode

stainless steel electrodes are placed in separate enclosed tubes connected by a bridge, immersed in an electrolyte solution. A direct current is supplied to the electrolyzer with a voltage exceeding 3.0 V. Twice as much hydrogen gas is produced at the cathode as oxygen gas is produced at the anode. We are currently fabricating a larger electrolyzer with the help of a grant from the Arkansas Space Grant Consortium Science Technology Engineering and Mathematics program.

HENDRIX COLLEGE

GEOMETRIC MEAN VALUE PROPERTIES

Gary DeClerk
Dr. Chris Camfield

Department of Mathematics and Computer Science, Hendrix College

[Session 1: 10:00-11:00 am, Friday March 7]

Harmonic functions are some of the most useful functions studied in mathematics with applications in heat conduction and minimal surfaces. In this project, we look at variations on the mean value property of harmonic functions. We investigate functions for which the value at the center of a disk is equal to the geometric mean of the function on the boundary of the disk (as opposed to the arithmetic mean with classical harmonic functions). We show that a function has this property if and only if its natural logarithm is harmonic, which leads to different applications. We then take advantage of this property to approximate solutions to problems through an iterative numerical process. We close with a generalized version of this property using other common averages along the boundaries of disks.

THE SCALENUS AND DIAPHRAGM MUSCLES' CONTRIBUTIONS TO INSPIRATION IN THE BOTTLENOSE DOLPHIN (*Tursiops truncatus*)

Meredith McKinney
Dr. Jennifer Dearolf

Biology Department, Hendrix College

[Session 2: 11:00am -noon, Friday March 7]

Dolphins have a unique respiratory system that allows them to have an explosive intake of air during their brief rise to the surface. This extremely quick inhalation suggests that the muscles that drive this behavior are composed primarily of fast-twitch fibers. Previous

studies have shown that in bottlenose dolphins, the diaphragm, the main muscle of inspiration (inhalation) in terrestrial mammals, is composed primarily of slow-twitch fibers, while the scalenus muscle is composed primarily of fast-twitch fibers. These results suggest that the diaphragm and scalenus of bottlenose dolphins do not contract together to drive inspiration, and muscles that do not work together should have different levels of oxidative enzyme activities. Samples of the diaphragm and scalenus muscles of eight bottlenose dolphins were taken and analyzed for their citrate synthase (CS) activity, which can be used as a measure of aerobic capacity. The scalenus muscle consistently had a higher CS activity than the diaphragm muscle from the same bottlenose dolphin, which supports the hypothesis that the scalenus and diaphragm do not work together to power the exchange of air in the lungs. Our results suggest that the diaphragm may not be the main muscle of inspiration in the bottlenose dolphin.

COMPARING WATER ADSORPTION PROPERTIES OF MONTMORILLONITE CLAY MINERALS

Rebecca Meredith
Courtney D. Hatch

Hendrix College

[Session 1: 10:00-11:00 am, Friday March 7]

The study of water adsorption on clay minerals is fundamental to soil science and important for understanding climate effects of mineral dust aerosol in the earth's atmosphere. We have studied water adsorption as a function of relative humidity (RH) on three montmorillonite clays originating from different sources, including Texas (STx-1b), Arizona (SAz-1) and Wyoming (SWy-2). The montmorillonite samples have been characterized by BET surface area analysis and scanning electron microscopy. Water adsorption was monitored and quantified using horizontal attenuated total reflectance Fourier transform infrared (HATR-FTIR) spectroscopy equipped with a flow cell. Water content was determined using Beer's law and optical constants for bulk water. Experimental results indicate that, of the three tested clays, STx-1b contains the highest percent by mass of adsorbed water (~60% water by mass at 80% RH). It was also determined that, while higher BET surface area is consistent with higher adsorbed water contents, the primary exchangeable cation also appears to be an important factor. Upon normalizing the water contents to the BET surface area, we found that the two clays with the same primary exchangeable cation (Ca^{2+}) had similar water contents but the clay with the more hydratable exchangeable cation (Na^{+}) had higher water contents at RH values greater than 50%. At these RH values, the water had already formed a complete interior layer and had access to exchangeable cations.

CHARACTERIZING THE CRURAL REGION OF THE BOTTLENOSE DOLPHIN DIAPHRAGM

Kathryn R. Powell
Dr. Jennifer L. Dearolf

Department of Biology, Hendrix College

[Session 2: 11:00am -noon, Friday March 7]

Locomotion and breathing are performed synchronously by running mammals. The decoupling of these behaviors is dependent on contractions of the crural diaphragm. However, in bottlenose dolphins, locomotion and ventilation are decoupled, when these animals breath-hold dive. Thus, since the crural region of the diaphragm acts to decouple breathing and locomotion in terrestrial mammals, we hypothesize that the crural region of the dolphin diaphragm prevents coupling by acting as the main barrier for visceral movement. To prevent the forward movement of the viscera during every downstroke of the tail while the dolphin is underwater, the crural diaphragm must maintain its contractions for the length of the dive. To maintain these contractions, the crura should have a large proportion of slow-twitch fibers. We tested this hypothesis by performing myosin ATPase fiber type analysis on tissue samples from the crural and costal regions of the bottlenose dolphin diaphragm. However, there was no significant difference between the slow twitch fiber composition of the dolphin costal and crural diaphragm. Thus, the crural region of the dolphin diaphragm is not specialized. Based on these results, we propose that the costal and crural regions of the dolphin diaphragm work in concert to prevent visceral movement during locomotion.

CONTROL AND SENSOR SYSTEM (CASSY)

Claude Shyaka
Dr. Ann Wright

Physics Department, Hendrix College

[Session 1: 10:00-11:00 am, Friday March 7]

A novel robot called Control and Sensor System (CASSY) has been developed for use in engineering, computer science, and physics classes at Hendrix and UALR and will be used to support research in control theory. The robot is built using Vex robotics parts, a custom electronic circuit board, several sensors, and custom machined parts, and is relatively inexpensive (about \$1500). Wireless telemetry between the robot and a host computer allow all control signals to be saved for later analysis. Hendrix students built two CASSY robots and programmed several behaviors using RobotC . These behaviors are used in the

problem of border patrol, and include covering the patrol area efficiently, locating "intruder" robots or obstacles, and pursuit of intruders. They will compare experimental results to similar results from a new control algorithm called Layered Mode Selection Logic (LMSL).

EFFECTS OF PRENATAL GLUCOCORTICOIDS ON THE FETAL GUINEA PIG SCALENUS MUSCLE

Macrina R. Butler
Dr. Jennifer L. Dearolf

Biology Department, Hendrix College

[Session 2: 11:00am -noon, Friday March 7]

Glucocorticoids are commonly administered to women considered at risk for premature birth to speed up fetal lung development and reduce infant mortality. However their effects on breathing muscles are not well documented. This study examined the effects of betamethasone, a glucocorticoid, on the fast-twitch fiber-type profile, citrate synthase (oxidative enzyme) activity, and myoglobin expression of the fetal guinea pig scalenus, an accessory inspiratory muscle. Based on previous studies of the rectus thoracis and scalenus muscles, we hypothesized that steroid-treated scalenus muscles would exhibit elevated proportions of IIA fibers, increased fast-twitch fiber diameters, elevated citrate synthase activity, and increased myoglobin expression. These changes would render the muscles stronger and more able to withstand breathing challenges than their untreated counterparts. To test these hypotheses, pregnant guinea pigs were injected with either betamethasone or sterile water twice a week, twenty-four hours apart, at 65%, 75%, and 85% gestation. Fetal muscles samples were collected and prepared for immunohistochemistry or biochemical analyses. No significant differences were found between the steroid-treated and control scalenus muscles for any measures studied. Thus, although steroids do not cause measurable benefits to the scalenus muscle, doctors may continue to administer prenatal steroids without worry of causing detriment to its function.

OUACHITA BAPTIST UNIVERSITY

MONITORING BIS-PHENOL A (BPA) IN WATER EXPOSED TO THERMAL RECEIPT PAPER USING FLUORESCENCE SPECTROSCOPY

Pete Brunson
Sara E. Hubbard, Ph.D.

Department of Chemistry & Physics, Ouachita Baptist University, Arkadelphia, AR

[Session 1: 10:00-11:00 am, Friday March 7]

Bis-phenol A (BPA) is a chemical that is used in the manufacture of plastics and resins. Experiments have shown that BPA can bind to estrogen receptors in the body. Suspected effects of this binding include reduced fertility, altered development and cancer, particularly in infants and children. In 2012, the United States banned BPA from products designed for infants. However, BPA remains one of the highest produced chemicals by volume worldwide, with over 3 million tons produced each year. Due to this high production volume, there are many items in our trash and landfills that contain BPA, including can linings and thermal receipt paper. This creates a concern for ground water sources becoming contaminated with BPA. We sought to better understand this behavior. In our work, water samples were exposed to thermal receipt paper to mimic contact of landfill trash with ground water. BPA concentrations in the water samples were monitored over time using fluorescence spectroscopy. Data showed that BPA concentrations in the water samples increased during exposure time to receipt paper.

PREDICTING THE TIME OF DEATH USING INSECT DATA IN CENTRAL ARKANSAS

Brianne Baley and Tyler Files
Jess Kelly, Ph.D.

Department of Biology, Ouachita Baptist University, Arkadelphia, AR

[Session 1: 10:00-11:00 am, Friday March 7]

Insects are known to colonize deceased animals and humans (carrion). The time and manner in which they do it in Arkansas is not well documented. From the moment of death, insects are attracted to carrion and lay eggs. Other insects such as beetles quickly show up to eat those eggs. By developing an understanding of the rates of insect colonization on carrion, we can establish a timeline to estimate the time between the discovery of a carcass and the time of death based on insect behavior. Models have been

established to assist in time of death estimates, however most of those models were developed in the Northern United States where temperatures are colder. Temperature is a major factor in the rates of insect colonization on carrion. Hot temperatures cause faster colonization rates and a faster decomposition process. Studies are needed in the South to account for geographic temperature effects which cause northern-developed models to inaccurately predict time of death. This study investigated insect colonization rates, the effect of temperature on the models which predict time of death estimates and also served as a baseline study to document the forensically important insects which are native to Arkansas.

USING AN INNOVATIVE THREE-DIMENSIONAL SPHEROID MODEL OF TUMORS TO STUDY PEDIATRIC CANCER

Mikey Sullivan, Jason Stevenson, Ryan Strebeck, and Barrett Burger
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[Session 1: 10:00-11:00 am, Friday March 7]

Over a ten-year period, the Arkansas Cancer Registry reported 1,409 new cases of cancer in Arkansans under the age of twenty, resulting in 193 deaths. The Ewing's family of tumors is a group of highly malignant pediatric cancers affecting bone and soft tissue with a five-year survival rate of only 30%. Our lab is interested in the microenvironment of these tumors, the cellular pathways that are altered to enable their aggressive behavior, and how the compound ajulemic acid (AJA) interferes with these pathways. In order to investigate these issues, our lab has optimized a new tumor model called spheroids. In order to create a realistic model in which to study these tumors, we created 3-dimensional spheroids containing three cell types. Spheroids allow for co-culture of these cell types in a tumor-like ball, mimicking actual tumors. In this context, interactions between the different cells allow us to study pathways and proteins responsible for the aggressive behavior of Ewing's tumors and the mechanisms by which AJA alters these. It is our hope that our collective data from this model provide the rationale for the development of improved therapies for children in Arkansas with Ewing's sarcoma and related solid tumors.

DISCOVERING DRUG INTERACTIONS USING CHEMICAL COMPUTER SIMULATIONS

Mallory J. Burroughs and Jessie R. Meyer
Grover P. Miller² and Martin D. Perry, Jr.¹

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²Department of Biochemistry and Molecular Biology, University of Arkansas for Medical Sciences, Little Rock, AR

[Session 1: 10:00-11:00 am, Friday March 7]

Molecular level interactions of drugs with proteins play a critical role in how the human body processes and eliminates their products. For many drugs, including many currently on the market, a complete understanding of these interactions is unknown. About 50% of drugs are mixtures of two different forms of the same molecule. Warfarin, routinely used as an anti-coagulant, is a prime example with one structural form metabolizing 1000-fold more effectively. The motivation behind such selective metabolism is likely the arrangement of amino acids, or residues, within the protein. Certain residues steer metabolism based on the drug's three-dimensional structure. Computational approaches help identify the residues responsible in multiple drugs. Several residues show much more favorable interaction with one form of a drug than with the other. This evidence allows for tailoring of drugs to specific proteins or altering the protein to enhance the drug's effectiveness.

USING THE RbcL GENE AND DNA BARCODING TECHNIQUES TO IDENTIFY MEMBERS OF THE CACTACEAE FAMILY

Emily Sanders
Nathan Reyna, Ph.D.

Department of Biology, Ouachita Baptist University, Arkadelphia, AR

[Session 1: 10:00-11:00 am, Friday March 7]

DNA Barcoding is a method of identifying and classifying living things at the genetic level based on short DNA sequences that are about 700 nucleotides in length. Using the DNA Barcoding technique, this study attempted to identify plants in the areas of Arkadelphia, AR, Conway, AR, and Helena, MT. PCR primers that recognized conserved regions of the Rubisco Large Subunit (RbcL) were created. PCR primers for each specimen were then cloned and sequenced for further analysis. A FASTA file of the sequenced RbcL gene was submitted to iPlant Collaborative's "DNA Subway" to find comparisons within the RbcL gene across other plant species within the database. This study successfully created a DNA

barcode of a plant collected in Helena, MT and found similarities across the family Cactaceae. Additionally, the goal of this study was to assess the feasibility of incorporating the lab protocol of DNA Barcoding and DNA Subway's bioinformatics tools into a freshman level research project for the Botany course at Ouachita Baptist University. Bioinformatics analysis of isolated plant DNA will be presented, as well as how novel DNA barcoding experiments will be incorporated into the classroom.

JOHN BROWN UNIVERISTY

A FEASIBILITY STUDY OF GRID-INDEPENDENT PHOTOVOLTAIC SYSTEM IN BELIZE

Liany Ayuso, Kaitlyn Bradley, Jonathon Estes
Dr. Ted J. Song

The Division of Engineering, John Brown University

[Session 2: 11:00am -noon, Friday March 7]

This study examines the goal of fulfilling 100% of energy needs with renewable energy sources in Belize. At the Hill Bank Field Station of Belize, the conservation of nature resources is a top priority. Since this location is far from a central power grid, installing a new transmission line may not be a cost-effective solution. In addition, using stand-alone diesel generators does not comply with the facility's mission of sustainability. This study proposes the alternative of exclusively using photovoltaic (PV) modules to establish energy independence from the power grid and fossil fuels. This transition would support the mission to serve as a role model of self-sustainability in resource management under a theme of sustainable business development. Moreover, relatively high insolation availability and the expensive energy price in Belize make PV a practical energy solution. As a result, combining a PV system with a substantial battery bank will be a dependable energy source that is capable of meeting all energy needs for this large facility. Becoming 100% renewable will help Hill Bank to further embody their mission of sustainable development of Belize, educating visitors about renewable energy and facilitating their self-dependency as an organization.

THE ROLE OF PROTEIN KINASE C ISOFORMS DURING *Coxiella burnetii* INFECTION OF THP-1 MACROPHAGES

Lucas DeYoung and Olivia Hilario
Joel Funk, PhD

Department of Biology, John Brown University

[Session 1: 10:00-11:00 am, Friday March 7]

Q fever is a zoonotic disease of humans that begins as a respiratory illness and causes flu-like symptoms. The disease is initiated by the bacterium *Coxiella burnetii* as it enters macrophages and manipulates the host cell into forming a bacterial replication vacuole, called a parasitophorous vacuole (PV). As an intracellular bacterial pathogen, *C. burnetii* redirects the normal endosome-lysosome pathway in favor of PV formation. Previous studies using inhibitors indicated *C. burnetii* uses host kinase pathways to manipulate the host. One group of kinases, the protein kinase C (PKC) family, has been demonstrated to be involved in PV formation. However, since ten PKC isoforms have been identified, the focus of this study was to decipher which PKC isoforms were activated during *C. burnetii* infection. We examined the role of six PKC isoforms in differentiated THP-1 cells with immunoblot analysis using antibodies made against both total and phospho-specific versions of each PKC isoform. The blots indicated three PKC isoforms (-alpha, -betaII, and -eta) were activated during *C. burnetii* infection. The ability to understand crucial kinase signaling events during infection by *C. burnetii* will be useful for the evaluation and development of potential antibiotics for this pathogen.

BENZOYL PEROXIDE AND COMMON ANALGESICS AS POTENTIAL ANTITUBERCULAR AGENTS

Christin Garrison, Joshua Lochala
Francis E. Umesiri, PhD

Chemistry Department, John Brown University

[Session 2: 11:00am -noon, Friday March 7]

Tuberculosis (TB) continues to present a global health challenge due to the increasing incidence of multidrug and extensively drug-resistant *Mycobacterium tuberculosis* (MDR-TB and XDR-TB) strains. Therefore, it has become urgent to develop new drug candidates with novel mechanisms of action. One increasingly popular approach is to re-position old drugs for possible use in treating MDR-TB, since the existing knowledge of their safety,

toxicity, pharmacological profiles lead to huge savings in time, effort and expenses. Adopting a structure-based discovery approach in this study, we demonstrate that benzoyl peroxide, a common over-the-counter medication for acne, and some common analgesics such as Aleve and Ibuprofen possess anti-tuberculosis activity. Screening for anti-tubercular activity with *Mycobacterium smegmatis* (ATCC 14468) using both Kirby-Bauer disk diffusion assay and resazurin-based microplate assay suggest that mycobacterial activity of benzoyl peroxide is very similar to that of isoniazid (INH), an effective drug against TB, with a zone of inhibition of 17 mm (INH showed a zone of inhibition of 19 mm), and minimum inhibitory concentration (MIC) of 0.25 mg/mL at optical density of 0.1. Aleve and Ibuprofen showed a zone of inhibition of 10 mm and 13 mm respectively at a concentration of 20 mg/mL in dimethyl sulfoxide (DMSO).

NOVEL AURONE SULFAMATES AS ANTI-TUBERCULOSIS AGENTS

Ashley Lick, Hannah Wright
Francis E. Umesiri, PhD

Chemistry department, John Brown University

[Session 1: 10:00-11:00 am, Friday March 7]

The increasing incidence of drug-resistant strains of *Mycobacterium tuberculosis*, and its co-infection with HIV/AIDS has complicated the management of tuberculosis (TB) worldwide. As a result, there is an immediate need for discovery of new anti-tuberculosis leads with different mechanism of action from current drugs in the market. Adopting a structure-based approach in our search for new anti-TB leads, we have designed, synthesized and screened a number of new aurone sulfamate analogs for their mycobacterial inhibitory activity. Taken together, the study shows that while aurone sulfamates tested so far exhibited only minimal inhibitory activity against *Mycobacterium smegmatis* (ATCC 14468), further structural modifications has the potential to lead to more potent aurone sulfamate anti-TB leads. Synthetics were characterized by ¹H and ¹³C NMR spectroscopy.

NANOPHOTONICS SURFACE ENGINEERING TO ENHANCE LIGHT ABSORPTION FOR PHOTOVOLTAIC DEVICES

Melissa Hirsch
Carla Swearingen, Ph.D.

Department of Chemistry, John Brown University

[Session 2: 11:00am -noon, Friday March 7]

The germanium-silicon interface has many applications in the modern microelectronics industry; however, it is difficult to control germanium formation during molecular beam epitaxy or chemical vapor deposition without a selectivity controlling agent. In order to

manipulate the germanium structure during deposition, a monolayer of nano-spheres must be created on the surface of a silicon substrate, and because silicon and germanium have similar chemical properties, silicon dioxide nano-spheres maximize adherence. This uniform sphere placement also creates inverse opal nano-structures, or parabolic formations, which lower the band gap width of the silicon-germanium semiconductor and enhance the infrared light absorption rate of the substrate. To create germanium concave nano-structures, we tested the methods of dip-coating, free evaporation and the Langmuir-Blodgett technique (LB), but because of the agglomeration caused by capillary forces, LB was the only method to produce a consistent sphere pattern on the surface of the silicon lattice structure. By compressing the nano-spheres into a single layer and using an amphiphile to functionalize them, the LB trough created a replicable, uniform monolayer with the ability to control germanium formation during deposition processes, and ultimately enhance the absorption rate of the semiconductor.

UNIVERSITY OF ARKANSAS FORT SMITH

ELECTROLYTE-INDUCED AGGREGATION OF GOLD NANOPARTICLES IS MODULATED BY CATION SIZE

Alice J. Tholen

Jennifer A. Jamison, PhD

Department of Physical Sciences-Chemistry, University of Arkansas – Fort Smith

[Session 1: 10:00-11:00 am, Friday March 7]

Aggregated nanoparticle systems have increased in interest due to their unique properties, which can differ drastically from both the isolated nanoparticle and bulk material forms. For example, these assemblies of nanoparticles have displayed enhanced electronic capabilities and provided colorimetric responses in biological sensors. However, the key to exploiting these properties and also tailoring them for a variety of applications is to control the extent of aggregation and interparticle spacing.

Here, we report the controlled aggregation of aqueous gold nanoparticles by utilizing multiple electrolytic salts that vary in cation charge and size. By changing the cations, we demonstrate that we can measurably and reproducibly affect the aggregation process by monitoring the visible-range absorption profiles, which in turn are a measure of the extent of aggregation and also interparticle spacing. We predict these two properties will have a direct effect on the electronic properties of aggregated nanoparticle assemblies.

THE EFFECTS OF SYMMETRY ON THE SCHWARZ-CHRISTOFFEL MAPPING

Cassie Peer
Dr. Jeanine L. Myers

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[Session 2: 11:00am -noon, Friday March 7]

The Riemann mapping theorem guarantees the existence of a conformal mapping or Riemann map in the complex plane from an open unit disk onto a simply connected domain, which is not all of the complex plane. Riemann maps have important applications in fluid mechanics, fluid dynamics, electric field theory, electrostatics, heat conduction, elasticity, hydrodynamics, temperature, brain surface mapping, and even art. Although the Riemann mapping theorem is very useful in conformal mappings, determining the explicit form of the Riemann map is difficult. The Schwarz-Christoffel mapping is a Riemann map that maps the open unit disk onto a simple polygon in the complex plane. The difficulty with the Schwarz-Christoffel mapping is that it depends on the pre-vertices and those are rarely known, so any information that can be found about this map can be very useful.

Through this research, we will be examining the Schwarz-Christoffel mapping onto regular polygons with one vertex on the positive real axis and with the assumptions that the origin is mapped onto the origin and the derivative of the mapping at zero is positive. We will determine the nature of the coefficients of the Taylor series representation about the origin of this mapping.

THE MARS ROVER PROJECT (MRP)

Osman A. Martinez and Daniel Schwartz,
Kevin R. Lewelling, PhD

Department of Engineering, University of Arkansas – Fort Smith

[Session 2: 11:00am -noon, Friday March 7]

A joint research project to design and construct a Mars rover between the University of Arkansas – Fort Smith (UAFS) and Harding University started summer 2012 after receiving funding from the NASA Collaborative Research Program grant and both universities, respectively. This research project is unique due to the rover's capabilities of scanning large areas of the Martian terrain. A group of undergraduate students at Harding University has designed a suite of optical instruments to sense and measure atmospheric

compositions, including biomarker gas presence on solid-surface solar system bodies such as Mars and Enceladus. UAFS Electrical Engineering students have designed and constructed an on-board power supply system based on a 12 V Lithium Ion (LI) battery pack, motor speed controllers, and programmed/implemented a HC912 microcontroller. A recent addition to the rover is a robotic arm that can lift and place weather stations, drill holes into the Martian surface, and help aid rover maneuverability in rough terrain causing immobility. This robotic arm will allow the collection of soil samples and placement of sensor arrays to measure temperature, moisture, and wind speed over a large area. The next step in completing the rover's design is coordination of all individual sub-systems thus allowing rover autonomous guidance and data collection.

UNIVERSITY OF ARKANSAS

GROWTH OF BREAST TUMORS IN VITRO TO CHARACTERIZE A NOVEL IMAGING PLATFORM

Scarlett Acklin¹

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[Session 1: 10:00-11:00 am, Friday March 7]

In this research, different methods are being investigated to grow in-vitro breast cancer tumors embedded in gel using the 4T1 cell line. The goal of this research is to test a new medical imaging modality available at the University of Arkansas using terahertz waves. The terahertz imaging and spectroscopy system has shown capability of high-resolution imaging and characterization of human breast tumors fixed in formalin and embedded in paraffin. In order to further examine this new imaging system in a laboratory environment, attempts to grow breast tumors in-vitro are conducted. A well is created for the cancer cells to grow in and is lined with a non-adhesive gel. Another layer of gel mixed with cells and their food source are added on top of the bottom layer. The cells continue to divide and clump together until clusters form, which eventually develop into a tumor. The gel encasing the mass is meant to mimic the margin around breast tumors. This method shows great promise for providing a reliable, parameter-controlled source of breast tumors for research needs. The ultimate goal of terahertz imaging is to illuminate excised tumors to assess the margins during the surgery and hence preventing cancer metastasis.

SUSTAINABLE ENERGY FROM FRACKING WATER RECYCLE

Hailey Dunsworth
Jamie Hestekin PhD, Ralph E. Martin

Department of Chemical Engineering, University of Arkansas

[Session 2: 11:00am -noon, Friday March 7]

“Blue Energy” is the energy available from salinity gradients, or two solutions of differing salt concentrations. Salinity gradients are sources of energy that are relatively untapped, such as the Mississippi River Waterway into the Gulf of Mexico and mixing recycled fracking water with fresh water. These gradients have the potential to generate more than 3 TW of energy worldwide, the equivalent of replacing 3,000 coal fired power plants.

Unfortunately, the cost structure for technology to harvest blue energy has been unfavorable to date. My research breaks these barriers by providing a new reverse electrodialysis (RED) scheme capable of extremely high power densities. If you consider this concept like a battery, we are coming up with a way to produce the energy from a “D” battery on the size of an “AAA.”

To date, I have incorporated an ion-exchange “wafer” into this RED system. The wafer drops the resistance on a comparable sized system by 1,000 fold. This work has led to a provisional patent, and I am currently working on creating a “prototype”. If theoretical goals can be met, this technology has the potential to provide a sustainable solution to revolutionize the fracking industry.

CAN CLASS C FLY ASH BE USED TO PREVENT ALKALI-SILICA REACTION IN CONCRETE?

Sydney Dickson
W. Micah Hale, Professor and Mentor

Department of Civil Engineering, University of Arkansas Fayetteville

[Session 2: 11:00am -noon, Friday March 7]

Fly ash is the residue produced from coal combustion in electricity generating plants. There are two types of fly ash, Class C and Class F. Approximately 40 percent of fly ash generated from coal combustion can be used as a partial cement replacement in concrete. Incorporating fly ash improves concrete properties and extends its service life. Alkali-Silica Reaction (ASR) is an expansive reaction between reactive silica typically found in aggregates (rock and sand), alkalis in cement, and an external source of water. This reaction forms a gel that imbibes water, which exerts internal pressure in concrete. This

leads to cracking and premature concrete deterioration. ASR can be prevented by replacing approximately 35 percent of the cement with Class F fly ash. Due to the chemical composition of Class F fly ash, it is more effective in preventing ASR. Sources of Class F fly ash are limited in Arkansas and occurrences of ASR are increasing. This research examines the amount of Class C fly ash necessary to prevent ASR. Fly ash (Class C or Class F) replacement rates ranging from zero to 50 percent will be examined. Aggregate with varying levels of reactivity will be included in the study.

RESONANT SPECTRA OF METAL NANOTOROIDS WITH VARIOUS SIZES

Huong Quynh Tran, Nathan Burford, Seyed Amir Ghetmiri and Liang Huang
Dr. Magda El-Shenawee, Dr. Shui-Qing (Fisher) Yu,

Electrical Engineering Department, University of Arkansas, Fayetteville.

[Session 1: 10:00-11:00 am, Friday March 7]

Nowadays, the manipulation of light by using metallic nanostructures has wide applications in photonics, optoelectronics and energy conversion. In this work, variously sized nanotoroids, which are organized in arrays, are computationally investigated in order to observe their resonances by using the commercial finite element electromagnetic solver Ansoft® HFSS. One important factor in finite element method is surface resolution, which is very essential for the accuracy of the result. After convergence study with HFSS on an object of a gold sphere dimer with a radius of 40nm and a gap of 1nm, a surface approximation of 0.02 nm which provides an accurate result in acceptable computation time is used for all following simulations. In addition, in order to reduce computation time and memory consumption by reduction of computational domain, the appropriate boundary conditions are studied and applied. This work also focuses on simulations of three samples of infinite arrays of silver nanotoroids with sizes of the inner radii: 13nm, 15nm and 21nm, respectively, while outer radius of 42nm. Moreover, other three samples of infinite arrays of gold nanotoroids with the sizes of inner radii: 50nm, 60nm and 100nm, respectively, while outer radius of 150nm are simulated as well. These gold nanotoroids are fabricated on glass substrate and then optically characterized by ellipsometry's transmission measurement. The difference between simulation and experimental results in shifting resonances' frequencies is analyzed.

AUTOMATING SPLICE IDENTIFICATION ON A TUBE FINNING MACHINE

Casandra Bright, Aaron Schmitt, Jeffrey Holmes
John Hamilton M.S., PE

Department of Mechanical Engineering, University of Arkansas

[Session 2: 11:00am -noon, Friday March 7]

In recent years Trane has identified unreliable splice identification on their spine finning machine as a major contributor to monetary loss. This loss calculation considers material waste, unit replacement costs, and damage to the company's reputation. Since the finning material is laid over the tubing with no gaps, visual inspection is not an option. Currently this guess-work identification is done by a single employee who simultaneously operates multiple finning machines. Even their best operators are not totally effective in this regard, and subsequent product testing sometimes fails to identify faulty tubing. As a company that prides themselves in product quality and community involvement, Trane addressed this issue of quality control by contacting our creative project team. Developing and implementing a means by which these splices are accurately located and visibly marked ensures quality in product. Our design came from an overall goal of simplicity and reliability. We identify the splice with a proximity switch and deform the finned material with a pair of truncated sheaves. This contributes to low operation and maintenance costs—adding to the economic feasibility of our design.

PHILANDER SMITH COLLEGE

NEUTRALIZATION AND pH EFFECT OF MILK ON ASPIRIN SOLUTIONS

Jordan Miller, Nikisha West and Fontaine Taylor
Insu 'Frank' Hahn, PhD

Department of Chemistry, Philander Smith College

[Session 2: 11:00am -noon, Friday March 7]

Aspirin or acetylsalicylic acid (ASA) has been used as a keratolytic and antifungal agent, or an agent to ease pain and reduce fevers. However, it has been reported that aspirin can cause severe stomach bleeding, upsets or irritation. According to previous studies, milk can help to reduce potential stomach and cancer problems. In this study, pH and neutralization effect of homogenized milk on a series of aspirin suspension solutions with different concentrations have been investigated with the in-vitro simulations of acid-base neutralization reactions with volumetric analysis, computer data processing and

predictions. The pH values of the aspirin mixtures with different quantities of milk were measured to understand acid-base equilibria through the neutralization effect of milk. Excellent curves of neutralization or equivalent points, standard quantitative equation and pH information were obtained to predict the neutralization amounts of aspirin and milk. Throughout this research process, all the resulting multiple calibrations and data were statistically processed, analyzed and interpreted using statistical computer software. The obtained data have large potential impact on proper drug dosage for the patients who need aspirin.

A COMPARISON BETWEEN STILL-IMAGE CAPTCHA AND VIDEO CAPTCHA: A USABILITY PERSPECTIVE

Diamond Hawkins, Bathsheba Petty
Samar Swaid, Ph.D

Department of Applied Mathematics and Computer Science; Philander Smith College

[Session 2: 11:00am -noon, Friday March 7]

CAPTCHA or Completely Automated Public Turing Test to tell Computers and Humans Apart, is a widely adopted security mechanism used by websites to stop hacking. Although there are a different types of CAPTCHAs, Image CAPTCHAs and Video CAPTCHAs have been increasingly preferred over other types. As a result, it is imperative to understand usability factors that would support efforts to develop robust usable CAPTCHAs. In this study, we propose a framework to be used to evaluate the usability of Image-CAPTCHAS and Animation-CAPTCHA. Based on critical literature review and content analysis of user-generated content of 78 different resources, we found that usability issues differ. Not only that, but we identified usability categories for both types. Our data analysis indicate that image-based CAPTCHA to be usable, developers should consider factors of: image size, number of images, image pixels, images content, click positions and alternatives to solve. On the other hand, video CAPTCHA usability includes factors of color of moving object, speed of movement, background, context of use, understandability of moving objects, and direction of movements. Our work would be of interest to CAPTCHA designers, usability experts and website security practitioners.

QUANTITATIVE EVALUATION OF OPEN EDUCATION RESOURCES: WEBSITE ARCHITECTURE APPROACH

Jalen Mayfield,
Samar Swaid, Ph D

Department of Applied Math and Computer Science; Philander Smith College

[Session 1: 10:00-11:00 am, Friday March 7]

The concept of sharing educational resources freely around the world, termed here "open education", has been adopted by a considerable number of institutions. Not only that but open education is gaining acceptance both inside and outside of the academic community to be used as a mechanism for instructional innovation to provide cutting-edge post secondary education that empowers individuals to pursue successful career. Although open education resources enable teachers, learners and the general public to get access to their educational resources, no study examined the website architecture to ensure it meets the needs of its users. In this study we apply theories human-computer interaction to analyze the website architecture of three of the open education recourses and purpose a framework to quantitatively evaluate the website architecture. Based on data collected from 135 subjects, and a factor analysis, we found that variables of content, navigation and interactivity can be used to evaluate open education websites architecture. A regression exercise indicate that content has the highest impact on user satisfaction and intentions to re-use. Our findings would enhance understanding of the impact of website architectures on learner's satisfaction and re-use intention.

ARKANSAS STATE UNIVERSITY

TECHNOLOGIES FOR USING BIOLOGICAL THERAPEUTICS IN AQUACULTURE TO IMPROVE FISH HEALTH

Alyssa Caparas
Maureen C. Dolan

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[Session 2: 11:00am -noon, Friday March 7]

Aquaculture plays a primary role in the world's consumed fish supply. Naturally, the upbringing of the fish in tanks and ponds constricts their movement. High density growth conditions increase fish stress and disease spread. A protein identified in fish has been correlated with improving their immune health. We hypothesize that introduction of this

protein (interleukin-22; IL-22) to fish, through immersion or feed, may provide a more natural biological therapeutant that is safer than the limited antibiotics and chemicals available to farmers. Tobacco plants can be used as factories to produce and express recombinant proteins, including IL-22, that has potential cost advantages to farmers. The challenge is proteins tend to be unstable and inactive when placed in “harsh” environments. Combining the protein with a protective sugar covering may keep the protein functionally active in the aquaculture environment. Hyp-O-Glyco technology places large amounts of sugar on proteins produced in plants. We have established the optimal timepoint for expressing IL-22 in plants and shown that this sugar modified IL-22 protein is produced at higher levels than unmodified IL-22. If successful, this platform technology will provide an innovative solution to effectively address issues in fish health management for improved production and increased consumer safety.

OPTICAL PRESSURE AND ENERGY RELATIONS OF RELATIVISTIC ELECTRODYNAMICS

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¹College of Sciences and Mathematics, Arkansas State University

²College of Engineering, Arkansas State University

[Session 1: 10:00-11:00 am, Friday March 7]

The momentum of light in media, or Abraham-Minkowski debate, is a highly controversial and unresolved topic that demonstrates the forces utilized in the optical manipulation of matter. Within the past decade, the debate has had a renewed interest due to modern applications dealing with the inherent forces that light imposes on materials. These applications span throughout the varying fields of science and nanotechnology, all with the purpose of moving or manipulating macroscopic materials with light. The electrodynamics NSF research project at Arkansas State University looks into these optical forces while considering relativity. By using energy relations from Doppler shifted light along with two formulations of electrodynamics and mathematical techniques, the researchers derive the two debated momenta and demonstrate the relations between the optical forces. This research has recently been published in the *Physical Review A* [C. J. Sheppard and B. A. Kemp, *Phys. Rev. A* 89, 013825 (2014)], with continuing research looking into other related formulations of electrodynamics.

PRODUCTION AND PURIFICATION OF THE ANTICANCER COMPOUND ARACHIDIN-1 FROM HAIRY ROOT CULTURES OF PEANUT

Christopher Aaron Tollett
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Department of Biological Sciences and Arkansas Biosciences Institute, Arkansas State University

[Session 2: 11:00am -noon, Friday March 7]

Stilbenoids are compounds found in plants like peanut and grape which have a wide range of potential benefits to human health. Among the peanut stilbenoids is arachidin-1 which shows to be effective in inducing cell death in different cancer cell lines. In order to develop a sustainable production system for arachidin-1, hairy root cultures of peanut were established. To induce the production of arachidin-1, the cultures were treated with a combination of chemical inducers and metabolic precursors at different concentrations and for different periods. The desired compound arachidin-1 and other stilbenoids were found in the culture medium at high concentration after the treatment. To purify arachidin-1, crude extracts from the culture medium were pooled and separated by chromatography. The retrieved fractions containing arachidin-1 were assessed for purity. Our studies have shown that high levels of arachidin-1 can be obtained by treating the root cultures with the combined inducers/metabolic precursors. The purified arachidin-1 could be further used in different assays to investigate other medicinal properties of this peanut-derived compound.

HENDERSON STATE UNIVERSITY

ARKANSAS PLANTS AS SOURCES OF NATURAL PRODUCTS

Alyssa Barnes, Oktawia Clem, and Cynthia Holland
Martin J. Campbell, PhD

Department of Chemistry, Henderson State University

[Session 2: 11:00am -noon, Friday March 7]

In view of the fact that nearly 50% of current pharmaceuticals trace their origin to a naturally occurring product, our group has started evaluating local native plants as possible sources of medically interesting compounds. To date, we have started working on

Deciduous holly (*Ilex deciduas*) and Woolly Croton or Dove weed (*Croton capitatus*). Neither plant has been systematically evaluated for bioactivity. There are several reports of other, phylogenetically related hollies containing compounds of interest. Likewise, some studies have been reported on other Crotons. Plant samples have been collected, dried, and separated into seeds and stems and berries. Some of the components have been extracted by a series of solvents. These solvent extracts are being evaluated for interesting biological activity using a variety of protocols. Samples showing activity will be isolated for detailed study in an attempt to purify and identify the active compound.

SYNTHESIS OF POSSIBLE ANTIMALARIAL DRUGS

Erika Bass and Andrew Brooks
Martin J. Campbell, PhD

Department of Chemistry, Henderson State University

[Session 1: 10:00-11:00 am, Friday March 7]

Malaria kills over 600,000 people annually, mostly children. The nature of the organism is such that it develops resistance to the current best available treatments. Artemisinin and related compounds developed from a natural plant extract are currently the front line in treatment, and resistant malarial strains are emerging. There is therefore a constant need to develop treatment strategies employing new methods for attacking the organism. Recent computer modeling by various groups around the world has led to the publication of a variety of new structural motifs predicted to possibly possess antimalarial activity. Each must be prepared and actually tested in order to know for sure. We are exploring the synthesis of one such possible structure and its analogues. Once the target is obtained, it will be submitted for testing. Based on our current synthetic approach, a fairly large number of analogues should be possible with little variation in the overall synthetic scheme.

Drug Discovery through Simple Analog Synthesis and Toxicity Determination in the Undergraduate Laboratory Experience

H. A. Wayland, M. K. Huffstickler
Dr. T. David Bateman

Department of Chemistry, Henderson State University

[Session 2: 11:00am -noon, Friday March 7]

Tramadol is an opioid prodrug that, along with its *O*-desmethyl metabolite, expresses significant biological activity. The drug is a weak μ -opioid receptor agonist, a reuptake inhibitor of norepinephrine, and a serotonin releasing agent. Consequently, it has various prescribed and off-label applications. This project is focused upon creating a library of Tramadol analogs by altering the amino, aryl, and hydroxyl positions of the opioid core structure, beginning the synthesis with various readily available starting materials, and crystallizing different salts of the final products. In-house bioassaying of the compounds will include: brine shrimp toxicity, MTT, resazurin, and sulforhodamine B assays. The least toxic analogs with the most promising activities will be subject to NCI 60 carcinoma screenings. The overarching goal of the project is to incorporate the synthesis and bioassaying concepts into undergraduate organic chemistry and biochemistry laboratories, respectively, in order to provide an interdisciplinary experience for students.

UNIVERSITY OF ARKANSAS AT PINE BLUFF

CHARACTERIZATION OF ACTIVE TRANSPORTER SYSTEMS AT BLOOD-BRAIN BARRIER

Kelin Key, Kameron Lee, Trenton Ware, Johnmesha L. Sanders
Antonie H. Rice PhD,

Department of Chemistry & Physics, University of Arkansas at Pine Bluff.

[Session 1: 10:00-11:00 am, Friday March 7]

The delivery of therapeutic drugs to the brain continues to be a challenge for the pharmaceutical industry. The blood-brain barrier (BBB) regulates the influx and efflux of a wide variety of substances, and remains the major obstacle in the delivery of drugs to the central nervous system (CNS). Various strategies have been devised to circumvent the BBB in order to increase drug delivery to CNS. The purpose of this work was to assess the potential mechanistic pathways present at the Blood-brain barrier in bovine microvessel

endothelial cells (BBMECs). The following transporters were characterized in the BBMEC cell culture system: a) the monocarboxylic acid transporter (MCT), and b) the organic anion transporter (OAT). Western blot analysis was employed to demonstrate the presence of each transporter. These transporters were characterized by assessing the uptake and permeability properties of known substrates. To assess the functionality of each transporter, uptake experiments were performed in the presence/absence of known metabolic inhibitors of the transporters. Competitive uptake and permeability experiments were also performed for each. The experiments demonstrate that all of the transporters are present and actively functional in the BBMEC system. These transporters offer alternate routes for delivering therapeutics to the brain that may exhibit poor brain/CNS bioavailability.

ASSOCIATIONS BETWEEN CYTOCHROME P450 GENOTYPES AND STRESS IN BEEF HEIFERS

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2- Jackson State University

Charles Rosenkrans, Jr.,

Department of Animal Science, University of Arkansas, Fayetteville

[Session 1: 10:00-11:00 am, Friday March 7]

Cytochrome P450s are a superfamily of heme-containing monooxygenases active in the metabolism of endogenous compounds. Our goal was to determine the frequency of single nucleotide polymorphism (SNP) 994 and 979 in the CYP3A28 gene of crossbred beef heifers. In addition we determined the relationships between genotypes and heifer growth, and stress response. Genomic DNA was evaluated from 71 heifers. Amplification of DNA was through PCR using specific primers for bovine CYP3A28 (P450F: CAACAACATGAATCAGCCAGA; P450R: CCTACATTCCTGTGTGTGCAA). The amplicon was a 565 base segment (based on GenBank accession number Y10214). Genotypes were determined by Restriction Fragment Length Polymorphisms (RFLPs) analysis using the AluI restriction enzyme. The genotyping of the heifers for SNP C994G resulted in 11 as CC, 34 as CG, and 26 as GG which displayed an allelic percentage of 39 for the C allele and 61 for the G allele. For SNP CG979, the genotyping of the heifers resulted in 61 as CC and 19 as CG displaying an allelic percentage of 88 for the C allele and 12 for the G allele. Preliminary results in SNP C994G suggest an association with heifer plasma HSP concentrations where that concentration of HSP plasma changes over time within the genotype. The pregnancy rates of the heifers with the CC genotype were the highest, and heifers with the genotype CC have the lowest stress level compared to the genotypes CG and GG.

ApoE DEFICIENCY DOES NOT ALTER IGF-1 SIGNALING DURING SKELETAL MUSCLE REGENERATION

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Tyrone A. Washington, Exercise Muscle Biology Laboratory, Human Performance Laboratory, Department of Health, Human Performance, and Recreation, University of Arkansas, Fayetteville, AR

[Session 1: 10:00-11:00 am, Friday March 7]

High cholesterol impacts many across the globe and ultimately can lead to cardiovascular disease (CVD). ApoE, a ligand for lipoprotein receptors, mediates the uptake of triglycerides, cholesterol, and other lipids into the cells and liver. Muscle when subjected to damaging stimuli initiates a complex and coordinated regenerative response. ApoE KO are used as a model to demonstrate hypercholesterolemia. The physiological role of hypercholesterolemia and its impact on skeletal muscle regeneration is unclear. PURPOSE: To determine if skeletal muscle would adapt normally during regeneration from bupivacaine injection in the absence of the apoE gene. C57/BL6 (WT) and apoE KO were given either bupivacaine (injured) or phosphate buffered saline (PBS) (uninjured) in the tibialis anterior (TA). Muscle was extracted 3 days post-injection. Western Blot technique was run to determine protein expression of AKT and p-AKT. Real-Time PCR was conducted to determine gene expression of IGF-1. TA muscle wet weight in both WT and apoE KO mice showed a decrease. There was no difference in AKT protein expression but a fourfold increase was observed in p-AKT. IGF-1 data shows nearly 5 fold increase in WT and nearly 4 fold increase in apoE KO. In summary, apoE KO mice had an increase in IGF-1 and p-AKT levels during muscle regeneration. ApoE gene deficiency does not alter IGF-1 signaling compared to wild -type mice during muscle regeneration.

IN-VIVO COMPARATIVE STUDY OF METAL COMPLEXES IN AMELIORATION OF TOXIC KIDNEY INJURY

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[Session 1: 10:00-11:00 am, Friday March 7]

It has been shown that metals have cytoprotective activity by stimulating antioxidant enzymes and inhibiting apoptotic enzymes. Zinc or copper combined with an antioxidant ligand has even greater cytoprotective effects. Studies show that zinc and copper complexes of amino thiols and salicylates have better cytoprotective activity than either metal or ligand. Both *in vivo* and *in vitro* data collected in this study strongly indicate that these metal complexes satisfy many of the criteria for prevention and treatment of kidney injury, as they are active, stable, and nontoxic antioxidants.

The study started with synthesis of the new zinc and copper compounds, characterization by elemental analysis and spectrochemical methods, followed by antioxidant activity using ABTS assay (zinc compounds) and NBT assay copper compounds) and *in vivo* toxicity studies. The compounds with lower IC₅₀ and less toxicity *in vitro* were further studied *in vivo*.

The animal study involved the elaboration of the model to ensure that the used dose of cisplatin induces kidney injury did not induce animal death. A total of 130 animals were used for these experiments. The mice were euthanized 96 h after cisplatin injection (IP, 20 mg/mg), and blood and kidneys were collected. The compounds were also tested in another model of acute kidney injury, rhabdomyolysis model induced by intramuscular glycerol injection (50% solution, 8 ml/kg). In both models our endpoints included: serum blood urea nitrogen (BUN) and creatinine to measure kidney function, and H&E histology to assess structural injury to the kidney.

Zn-RibCys exhibits strong protection in the Rhabdo model, but not in Cisplatin model. Zn-Pen exhibits relatively strong protection in both models. Zn-PTCA may exhibit mild protection in both models. Cu-DIPS appear to be mildly protective in the rhabdo model, but not the Cisplatin model. In an interesting twist, Cu-DBS and Cu-DCS exhibit strong protection in the Cisplatin model, but none whatsoever in the rhabdo model. These metal complexes may be useful agents in preventing kidney toxicity and eventually can be used for nephroprotection during skeletal muscle trauma leading to rhabdomyolysis.

HARDING UNIVERSITY

CONSTRUCTION OF A RAMAN SPECTROMETER

Trevor R. Drury and Maria J. Medrano
Edmond W. Wilson, Jr.

Harding University Department of Chemistry

[Session 2: 11:00am -noon, Friday March 7]

Raman spectroscopy is a versatile analytical technique that provides valuable information when you need to identify and measure the amounts of substances in mixtures. A definite advantage is that samples can be in water solution in contrast to analysis by infrared spectroscopy which requires samples to be dissolved in organic solvents. With the recent availability of inexpensive and powerful diode lasers, we have been able to design and build a sensitive Raman spectrometer using a 635 nm diode laser with output power of 35 milliwatts. Samples are radiated with the laser beam and the laser light scattered from the solution containing the samples is collected and focused onto the slits of a moderate resolution monochromator by means of a large silvered ellipsoidal mirror. The monochromator is equipped with adjustable slits at both the entrance and exit to the monochromator to maximize wavelength resolution. Detection of the scattered light is measured with a sensitive photomultiplier detector. A computer controlled stepper motor turns the monochromator grating to produce the spectrum for the desired wavelength range. The data from the experiment is digitized and stored on a disk in a computer for further analysis. Samples we are interested in include blood for detection of cancer and illegal drugs and wastewater samples for detection of the manufacture of illicit drugs.

BIOCHEMISTRY OF CHROMIUM

Shelby V. Sorrells
Edmond W. Wilson, Jr.

Harding University Department of Chemistry

[Session 2: 11:00am -noon, Friday March 7]

Chromium has been reported to play several roles in the chemistry of both plants and animals. Hexavalent chromium is toxic and can produce cancer. It is a strong oxidant and reacts with both DNA and proteins. Glutathione in cells is believed to reduce toxic hexavalent chromium to the trivalent state which is considered safe. Trivalent chromium

has been studied intensively for several years and many investigators believe it to be a trace micronutrient needed for maintenance of a healthy body. There have been health supplements and energy drinks marketed which purport to provide the necessary chromium to deficient individuals. The role of the trivalent chromium is reported to be related to glucose and lipid metabolism. In spite of these studies, there has yet to be a storage protein found for chromium. Nor has there been any other carrier molecule found for this metal. Our studies seek to provide additional information about the chemistry of this most interesting metal in order to help provide a more definitive answer as to the biochemistry of chromium or even if there is a biochemistry for chromium. We will be using various chromatographic and spectrometric techniques in our researches.

MOBILE ROBOTIC VEHICLE FOR SPACE MISSIONS

Stephanie J. Inabnet
Edmond W. Wilson, Jr.

Harding University Department of Chemistry

[Session 1: 10:00-11:00 am, Friday March 7]

We have designed and built a mobile robotic vehicle for space missions. The vehicle is designed to carry instruments for detecting and measuring gases in the atmosphere of Mars. The purpose of the project is to provide evidence indicating life on Mars. We also want to provide important information about the habitability of Mars in anticipation of human missions to Mars during this century. One instrument is an open path diode laser absorption spectrometer that can detect and measure biomarker gases such as water vapor, methane, carbon dioxide and ammonia. The rationale is that any life in existence on Mars today would most likely be underground in a warm and moist environment and would probably be microbial. Microbes produce gases that can seep to the surface and enter the atmosphere. Our instrument can locate and measure these gaseous signals. Other robotic vehicles could then dig into the surface to collect samples for analysis and characterization. Our instrument can make wide area surveys more efficiently than other instruments. Another instrument is composed of two spectrometers for measuring atmospheric gases over the whole open sky. Any gas of sufficient concentration that absorbs radiation in the wavelength range of 200 nm to 1650 nm can be measured with this instrument suite. Our instruments can also be used in a variety of ways on the Earth to provide information about the health of croplands and forests as well as surveying accident sites where there may be toxic vapors.

UNIVERSITY OF ARKANSAS AT LITTLE ROCK

USING VIRTUAL REALITY AND BIM IN SAFETY TRAINING OF HIGHWAY CONSTRUCTION

Whit Montague
Haiyan Xie, PhD

University of Arkansas at Little Rock

[Session 1: 10:00-11:00 am, Friday March 7]

This research project investigates the use of four dimensional Building Information Modeling technologies (4-D BIM) to develop innovative safety training for highway construction firms and students. The goals of the research are to analyze the factors that contribute to the success or failure of training; identify existing and emerging technologies that can be incorporated into safety training; and improve safety training results.

Typically in safety training classes, instruction is drawn heavily on text, using federally mandated manuals. More detailed explanations are provided via use of visual aids such as PowerPoint presentations, pictures, or computer-generated videos. This training does not provide a direct link to existing projects or real-time environments. In this research, the focus is on procedures to connect safety requirements and training more closely with real-world application. Software systems will be investigated to generate visual representations for construction projects in three- and four-dimensional forms (i.e., space and time).

The focus of this investigation will be the issues that highway construction contractors face in safety training. Specifically, the study will seek to identify a more realistic, user-friendly training system for end users.

TOPOLOGICAL STRUCTURAL SHAPE OPTIMIZATION AND VISUALIZATION

Hector Loya

University of Arkansas at Little Rock

[Session 2: 11:00am -noon, Friday March 7]

The combination of finite element structural modeling and a genetic optimization code enables the optimal design of structural components. One of the basic problems with the process, however, is being able to visualize the design optimization process. The addition of a volume rendering technique to the process would allow for a detailed look at what is

happening in the computational modeling. What would start as a solid square in 2D space would transform into a structural component visually during the process. By coupling the color of each element to the volume rendering, the elements which are not required in the final design would become more and more discolored, allowing a view of the emerging component within the initial design space. A set of design rules would help guide the component formation process on top of a genetic optimization algorithm.

UNIVERSITY OF CENTRAL ARKANSAS

THE BEARCLAW: MIXED REALITY SYSTEM FOR PHYSICAL & OCCUPATIONAL THERAPIES

R. Kyle Eichelberger, Ben Tackett, John White, Michelle Enfinger,
Dr. Tansel Halic, Dr. Sinan Kockara,
Computer Science Department, University of Central Arkansas

[Session 1: 10:00-11:00 am, Friday March 7]

We propose an affordable, easily portable and accessible mixed reality smartphone based therapy system that will assist physical and occupational therapy patients, to be used in conjunction with current rehabilitation treatment. With modern advances in medical and computational sciences, far too many rehabilitation patients still do not obtain optimal results for their hand/wrist/forearm related ailments. Boredom or lack of motivation to attend their frequent therapy appointments is one factor in this problem – not to mention the expected at home exercises the patient is generally required to do by their specialist. The costs of time and money to make each of appointments, one will find even less motivation to continue receiving proper care for their condition. Therefore, we designed and developed bear claw system allows for exercising to be done virtually anywhere, any time. This is achieved with using a full range of motion glove infused with pressure, flex, stretch and motion sensors rigged to a smart phone, accompanied with a family-friendly game app developed for therapy. This creates an easy to use mixed reality system that will allow 3d stimulus and immersive environment that offers new options in the rehabilitation process. The user will be able to practice exercises within the game without the direct attention and care of medical professionals. As the user progresses in their ability to perform their exercises, they advance in the game. This provides direct motivation to improve strength, mobility, and flexibility in their hands and fingers in order to make progress. All the while, the specialist is receiving instant progress reports of the patients' rehabilitation sessions away from the clinic via the patients' mobile device and our interactive game app. As a result, the BearClaw system offers an innovative way to improve on the individualization of the rehabilitation process and an increase in field standards. We also carried out preliminary survey among occupational therapy students to understand the effectiveness of Bear Claw system.

THE EFFECT OF LOW PLASMA ESTROGEN ON MESENTERIC ARTERIAL FUNCTION IN FEMALE MICE

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[Session 2: 11:00am -noon, Friday March 7]

Circulating plasma estrogen (E2) protects women against the development of abnormal vascular tone which is often associated with the enhanced Ca^{2+} entry into smooth muscle cells (SMCs) via voltage-gated Ca^{2+} channels (VGCCs). The purpose of this study is to determine the effect of E2 deficiency on VGCCs. Female mice (C57BL/6) were instrumented for biotelemetry at 7 wks of age. At 8 wks, the mice underwent an ovariectomy (OVX) or sham surgery. Biotelemetry measured a drop in heart rate 2 wks post-OVX surgery suggesting a baroreceptor reflex compensation. At 12 wks the mice were sacrificed. The OVX mice had a decline in their plasma E2 concentration. They also exhibited atrophied uteri and weight gain. The mesenteric arteries were isolated and pressurized at 80 mmHg to measure arterial reactivity to the VGCC agonist, FPL64176 (3×10^{-7} to 1×10^{-6} M); there was no difference between groups in their spontaneous tone and response to FPL64176. Western blots showed a slight increase ($p=0.12$) in the pore-forming α_{1C} subunit of the VGCC. There was no change in the VGCC beta1 subunit. Smooth muscle cells (SMCs) were isolated from the arteries to conduct fluorescent imaging of the SMCs loaded with the *ratio-metric calcium* indicator, fura-2AM. There was an enhanced fura-2 ratio in cells from OVX mice exposed to the VGCC agonist, FPL64176 ($p=0.03$). However, when the sarcoplasmic reticulum (SR) was Ca^{2+} depleted (using the ryanodine receptor agonist, caffeine, and the SR Ca^{2+} -ATPase pump inhibitor, thapsigargin) before exposing the cells to FPL64176 there was no difference in the fura-2 ratio between OVX and sham mice. This suggests that the SR contributes to the enhanced VGCC-mediated entry of Ca^{2+} into SMCs. Overall, our results indicate that the decline in E2 in women can enhance Ca^{2+} entry into SMCs. Long-term this may lead to an elevation in arterial tone and blood pressure in resistance arteries. Support: NIGMM of the NIH, Grant #P20 GM103429-11.

ESTROGEN-MEDIATED MECHANISMS FOR THE REGULATION OF VOLTAGE-GATED, CALCIUM CHANNELS IN CORONARY ARTERIES

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²Pharmacology & Toxicology, University of Arkansas for Medical Sciences

[Session 2: 11:00am -noon, Friday March 7]

Many vascular dysfunctions demonstrate an upregulation of voltage-gated, L-type Ca²⁺ channels (VGCCs). Previously, our lab has shown that estrogen (E2) can downregulate VGCCs, and thus, prevent excessive vasoconstriction. The aim of this study is to determine the mechanisms associated with this E2-induced downregulation. The right coronary artery was obtained from hearts of female pigs. The coronary arteries were sectioned into longitudinal strips (Western blots, real-time PCR) or rings (isometric tension) and incubated for 24 hrs in 1nM E2 or EtOH (E2 solvent). Total mRNA was isolated and the relative mRNA abundance was determined using real-time PCR. There was similar abundance of the alpha1C transcript between EtOH and E2 treated arteries. This suggests that the E2-induced downregulation of VGCCs are posttranscriptionally regulated. To determine if the downregulation occurred via estrogen receptors (ER) the arterial strips were individually incubated for 24 hrs in 1nM E2, EtOH, an estrogen receptor (ER) alpha/beta antagonist (ICI 182,780), and a G-protein-coupled ER antagonist (G-15). The arterial strips were homogenized for Western blot analysis using an antibody reactive to the VGCC alpha1C subunit. Our results indicate that E2 mediates the VGCC downregulation via activation of ERalpha/beta. The role of the endothelium was evaluated by mechanically removing the endothelium of the artery with a toothpick before the 24 hr incubation period. The Western blots indicated that the presence of the endothelium did not affect the expression of the VGCC alpha1C subunit. Isometric contractions were also measured to the VGCC agonist, FPL64176, in endothelial intact and removed rings. Although E2 decreased the FPL64176 contraction by 50%, the presence of the endothelium had no effect. Therefore, the E2-induced VGCC downregulation is endothelium-independent. Overall, these results provide mechanisms associated with the protective effects of E2 against vascular dysfunctions in premenopausal women. Support: Grant #P20 GM103429-11.