# ARKANSAS STEM POSTERS @ the Capitol

"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*

## March 9, 2021

## Highlights

- **Over 50 students**
- **From 17 Arkansas colleges and universities**
- **Presenting 32 different presentations of original work**
- **Encompassing all aspects of natural science and math**


STATE
ARKANSAS STATE
UNIVERSITY


1871
UNIVERSITY OF
ARKANSAS


1890
HENDERSON
STATE UNIVERSITY


OUACHITA
BAPTIST UNIVERSITY


1876
HENDRIX


ARKANSAS
TECH
UNIVERSITY


UNIVERSITY OF
CENTRAL
ARKANSAS


UALR
UNIVERSITY OF ARKANSAS
AT LITTLE ROCK


UNIVERSITY
of ARKANSAS
AT PINE BLUFF
1873


UAM
THE UNIVERSITY OF ARKANSAS AT MONTICELLO
MONTICELLO • CROSSETT • MCGEHEE


LYON
COLLEGE


JOHN BROWN
UNIVERSITY


CENTRAL
BAPTIST COLLEGE


PHILANDER
SMITH COLLEGE
EST 1877


UAFS
UNIVERSITY OF ARKANSAS
FORT SMITH


UAMS
UNIVERSITY OF ARKANSAS
FOR MEDICAL SCIENCES


HARDING
UNIVERSITY

# ARKANSAS STEM POSTERS@ the Capitol

Student presenter (school) …..page with abstract

# Analysis of Microbial Organisms and Their Interactions Within a Unique Cave System in Central Tennessee

K. Wheeless, L. Camp, A. Huseman, B. Horton

Henderson State University - Biology

Most biological communities on Earth depend on the products of photosynthesis, however, a few unique environments, like deep-sea hydrothermal vents and hypogenic caves, thrive in its absence depending instead on chemoautotrophs. This study analyzes samples of microbial communities collected from an area known as the “Petroleum Passage” in a cave in Central Tennessee. The passage contains a pond with a sandy bottom ringed by bands of colored sand that produces globules of a tar-like substance. To date, nine samples have been analyzed using a technique that allows DNA base sequences of organisms in a sample to be read and compared to a database to determine the identities of organisms present. This analysis revealed 593 different bacteria and Archaea including unique species that metabolize sulfur and methane compounds, those previously associated with deep sea thermal vents, and others that degrade hydrocarbons. Specifically, the yellow sand ring had several unique bacteria including some from the order Ardenticatenales, previously isolated from hydrothermal fields in Japan. The results of standard water chemistry techniques and hydrocarbon analysis are being processed, but there are plans to identify salamanders present in the cave and to obtain more targeted samples. The results of this survey could not only provide insight into this cave’s formation and microbial species in extreme environments on Earth, but also those potentially living within subterranean Mars.

# Stress Modulation of the Antidepressant Effect of Ketamine Mediated by Ventral Hippocampal Parvalbumin Interneurons in Mice

K. Deck

John Brown University - Biology

Ketamine is a fast-acting, long-term antidepressant that functions in individuals who find other treatments ineffective. We investigated the role of parvalbumin-expressing interneurons (PV INs), a subtype of GABAergic interneurons, in both depression-like behavior and the antidepressant effect of ketamine under two stress conditions in mice. Depression-like behavior is modeled by immobility time in forced swim test (FST). First, mice were subjected to mild stress (MS) for one week or unpredictable chronic stress (UCS) for four weeks. On the day of the test, mice received ketamine (KET) or saline (VEH) one hour before FST. After fixed brain extraction and slicing, we marked PV INs and perineuronal nets (PNNs) a specialized extracellular matrix that forms around PV interneurons. Consistent with previous data, no difference was observed in immobility time across groups. Immunohistochemical analysis of the ventral hippocampus showed a significantly greater amount of PNNs in KET after FST that had undergone UCS, but a smaller amount in KET exposed to MS, comparing to VEH and no FST, respectively. In addition, in mice that had undergone UCS, a significantly smaller number of PV INs, were observed in VEH after FST, comparing to no FST and KET. This implies that ketamine may have a protective role for PV INs, diminishing depression-like behavior during FST. Here, the stress modulated antidepressant effect of ketamine may be mediated by PV INs and PNNs in the ventral hippocampus.

# Turning Up the Heat: Thermal Tolerances of Fishes in the Kings River, Arkansas

W. Newman, C. Garrett

University of Central Arkansas - Environmental Science

The Kings River in northwest Arkansas is host to a diversity of fishes and other aquatic organisms vulnerable to disturbances, including increased temperatures due to climate change. This study aimed to quantify the upper thermal tolerance of 23 species of fishes in the Kings River, spanning six families (Cyprinidae, Catostomidae, Fundulidae, Cottidae, Centrarchidae, Percidae). Critical thermal maximum (CTM) protocol was employed for this experiment using Loss of Equilibrium as the endpoint. We collected fishes, held them in flow-through nets in the river overnight, and tested them within 24 hours on-site in a temperature-controlled circulating water bath. We acclimated fishes and tested them in river water starting at temperatures naturally experienced in the river (25-28°C). A total of 229 individuals were tested ranging from 4 to 16 individuals per species. Species with restricted ranges (endemic to the Ozarks) had an overall lower (36.3°C + 0.23SE) CTM compared to species with more widespread distributions (37.6°C + 0.13SE; t-test $P<0.001$). Species inhabiting run habitat (36.5°C + 0.21SE) had a significantly lower CTM compared to those inhabiting pools (37.6°C + 0.14SE) and riffles (37.7°C + 0.21SE; ANOVA, $P<0.001$). On average Cottidae (34.9°C) and Cyprinidae (36.8°C) had the lowest CTM, with Centrarchidae (39.0°C) and Fundulidae (40.8°C) tending to have the highest mean value.

# Identifying Factors Required for RNA Polymerase II to Overcome Obstacles during Transcription Elongation

S. Wiegel, M. Nester

Hendrix College - Biology

The genetic material, DNA, serves as an instruction manual for cells, which are the basic units of life. DNA molecules within cells contain genes, many of which are copied into molecules called mRNAs in a process known as transcription. These mRNAs are then translated into proteins, which carry out functions in cells necessary for many processes, including survival. During transcription, the enzyme that copies DNA into RNA, referred to as RNA Polymerase II (Pol II), encounters many roadblocks as it travels across genes. These roadblocks include proteins that inappropriately bind the DNA along genes, and we hypothesize that Pol II enlists other factors to help it overcome these roadblocks. The goal of my project is to generate an experimental system that can be used to identify these factors. In this poster, I describe the first steps in the generation of this experimental system. We study this process through a model system known as budding yeast, which offers a powerful experimental platform to study fundamental cellular processes. Since the transcription process and many proteins involved in transcription are highly conserved between yeast and human cells, these investigations will provide insights into human biology as well.

# Estimating Irrigation Inputs from Changes in Water Table Level using a Water Balance Approach

K. Trinh

University of Arkansas—Fayetteville - Engineering

As the population continues to grow, global food production must increase, causing irrigation water usage to rise. Therefore, it is important to monitor water usage, particularly when an irrigation flowmeter is unavailable. A field water balance was created for a selection of rice fields in East-central Arkansas in 2018 and 2019. From those, irrigation inputs are deduced from the water balance alone. First, irrigation data was collected for each field during the growing season either with flowmeters or written records from the farmer. Each field also had sensors that collected water table level (WTL) data. Next, other water inputs and outputs like precipitation and evapotranspiration (ET) were collected from two modeled sources. The remaining outputs—levee seepage, deep percolation, and runoff—were assumed to be zero. The first water balance was for a production-scale field that is zero-grade with no drainage. The results indicate that the water balance can fairly predict irrigation on days when the WTL is positive. The model underpredicted irrigation by approximately 50% for both years, likely due to draining factors that were originally considered negligible. However, with more research, these factors can be properly assessed and included as necessary to ensure more accuracy. Farmers and scientists will both be able to use this approach to track water usage and compare different irrigation methods to determine which practice conserves the most water while maintaining yield.

# Development of HOSU3, a Novel Dihydroorotate Dehydrogenase Inhibitor for Acute Myeloid Leukemia

K. Morris

Hendrix College - Biology

Acute myeloid leukemia (AML) is a bone marrow disease that has a devastating prognosis due to resistance to treatment and likelihood of relapse. Previous studies demonstrated that the inhibition of the cellular enzyme dihydroorotate dehydrogenase (DHODH) may be a possible therapeutic target as it reduces rapid proliferation of cancerous white blood cells. Here, we introduce a promising novel DHODH inhibitor, HOSU3, which demonstrates antileukemic activity, favorable pharmacokinetics, and can be administered orally. The effectiveness of HOSU3 was tested through a number of assays and shows promise as an effective target for cytotoxicity and differentiation of AML. In the future, combination studies will be investigated for possible synergistic effects.

# Biomass-derived Nanofiltration Membranes for Drinking Water Purification

O. Rodriguez

University of Arkansas—Little Rock - Chemistry

To combat climate change and environmental pollution, biomass has been used to produce biofuels by pyrolysis, resulting in about 30-40% biochar in the residues. Biochar contains a variety of carbon nanostructures that can act as a platform for the synthesis of various functionalized carbon materials. This work uses cheap biomass, mulberry leaves (silkworm food material) and silkworm waste to synthesize efficient filtration nanomembranes for hormone purification in drinking water. The biomasses are pyrolyzed at 500-700 °C to form carbon nanostructures, which are then treated with concentrated H2SO4 and H2O2 to make them water-soluble. The resulting, neutralized suspensions are then used to form nanomembranes by vacuum filtration. The structures of the nanomembranes will be examined by various analytical methods such as FTIR, XRS, and SEM. For water purification, the nanomembranes are evaluated for efficiency and permeability by conducting filtration of impure water containing hormone 17-a-Ethynylestradiol, which will be analyzed with LC-MS. The membrane structure-filtration relationship will be systematically investigated. The discovery of highly efficient filtration nanomembranes will allow for the next generation to have an effective, low-cost, earth-abundant, and environmentally friendly water filtration system, useful for combating climate change and environmental pollution. The training from this project will well prepare the student for her future career as well.

# In Vitro Analysis of the Antibacterial efficacy of Nanostructured Reverse NiTi Archwires for Orthodontic Applications

C. Penthala

University of Arkansas—Little Rock - Biology

A looming concern in dental and orthodontic care is the risk of developing cavities and fluorosis, with more than ninety percent of Americans having had a cavity, from plaque bacteria making it imperative we find a solution for this health crisis. This study investigates a novel approach to curtailing the growth of plaque bacteria by inhibition. Previous research studies with E.coli have shown a reduction in cell growth on nanostructured metal surfaces. Our study hopes to mechanically modify the nickel titanium (NiTi) wires, used in braces, to induce antibacterial properties. The NiTi wires will be subjected to a facile hot water treatment method to forge surface nanostructures for mechanical inhibition of bacterial cell membranes, reducing cell proliferation. The nanostructured wires will be tested against untreated, control NiTi wires in vitro through a modified kirby-bauver method and via bacterial broth incubation. SEM studies will be conducted before and after in vitro studies for characterization and evaluation purposes. Our study offers a novel, simple, cost-effective solution to mitigate critical complications in dental and orthodontic care with no known hazards to biocompatibility. Most importantly, we hope this study brings awareness and encourages prospective researchers to pursue novel solutions to the crisis plaguing dental and orthodontic care.

# Quantifying Potential Urban Heat Islands in Fayetteville, Arkansas

C. Schuler

University of Arkansas—Fayetteville - Engineering

The goal of this project is to understand the potential for devising a method to measure urban heat islands (UHIs) in Fayetteville, Arkansas. The UHI effect occurs when urban environments experience higher temperatures than surrounding areas due to large impervious areas that trap heat and tall buildings that obstruct winds. As more people migrate to urban centers and global warming increases, understanding UHI effects will only become more important. The objectives of the study were to calibrate three temperature sensors to a standard thermometer; build three weather stations to monitor air temperature and relative humidity; deploy the weather stations throughout Fayetteville to analyze UHIs in the fall and winter months; and consider possibilities of extending UHI analysis in the future. Already, I have found that temperature calibration improves measurement accuracy. Weather stations will be deployed in locations of varying impervious coverage throughout Fayetteville, producing a gradient from low to high urban impervious influence. My next steps are to use the data collected to determine the feasibility of extending this UHI analysis across northwest Arkansas. The data provided by UHI studies will encourage municipalities to consider these effects when forming development strategies. This research will also increase understanding of UHIs in northwest Arkansas, which could serve as a catalyst for a more comprehensive study in Fayetteville and surrounding cities.

# Identifying The Effects of DJ-1 Protein Mutants on Mitochondrial Dynamics in Dictyostelium discoideum

H. A. Kim

University of Central Arkansas - Biology

Parkinson disease (PD) is a neurodegenerative disorder which shows symptoms such as rigidity, tremor, and postural instability. Mitochondrial dysfunction is linked to PD progression, though it is poorly understood. DJ-1 is a protein that has been linked to PD and appears to work with mitochondria to protect the cell. Appropriate mitochondrial structure ensures these organelles are functional, and this structure is regulated by two major processes: mitochondrial fission and fusion. Disruption of fission or fusion not only alters mitochondrial structure, it promotes cell and neuron death. Here we present our results of the effect of two DJ-1 mutants on mitochondrial fission and fusion and discuss the relationship with PD prognosis. Ultimately, this work will allow us to clarify the effect of DJ-1 on mitochondrial dynamics and predict its role in mitochondrial dysfunction and contribute to understanding the PD.

# Analysis of the Deer Population of Hobbs State Park

J. Morrison

University of Arkansas—Fayetteville - Engineering

White Tailed deer (Odocoileus virginianus) are the only deer species native to Arkansas, playing an important role in the local ecosystem. Deer populations have been rising throughout the United States and within Arkansas. Overpopulation can lead to poor herd health, overgrazing, increased vehicle collisions and transmission of diseases. Monitoring and managing deer populations is important for the health of the environment, as well as for human health.

This study used wildlife population analysis methods to estimate the White-tailed deer population of Hobbs State Park. Regular surveys of the deer have been carried out by the park, but a method of estimating the total population has not been used. The data available from previous spotlight surveys reveals that deer sightings at Hobbs decreased from 2010 to 2016, but a distance sampling approach will be needed to estimate the total deer population. This method involves finding the relationship between the number of deer spotted and the distance from the viewer. This is used to estimate the number of deer that were not spotted during the survey. The recommendation and implementation of distance sampling surveys at Hobbs State park will allow for an estimate of the total population and help Hobbs State Park to monitor and manage their deer population.

# Increased HIF Expression in Macrophages Does Not Influence Leishmania major Parasite Burden

H. Wanjala

University of Arkansas—Little Rock - Biology/Medical Sciences

Cutaneous leishmaniasis is a disease characterized by skin lesions caused by obligate intracellular Leishmania major parasites. In leishmanial lesions, lymphangiogenesis, or the formation of new lymphatic vessels, promotes resolution and helps control lesion inflammation. Vascular endothelial growth factor-A (VEGF-A) released by dermal macrophages stimulates lymphangiogenesis in lesion sites. Hypoxia and proinflammatory cytokines increase the activation of transcription factors known as hypoxia inducible factors (HIF) which can induce the expression of VEGF-A. However, multiple HIF isoforms exist including HIF-1α and HIF-2α and both isoforms can induce VEGF-A expression. We have shown macrophage VEGF-A production is dependent on pan-HIF signaling during L. major infection in vivo, but it is not known which HIF transcription factor isoform activates VEGF-A expression during leishmaniasis. To characterize the contribution of HIF factors to VEGF-A during L. major infection, we created an in vitro system to mimic the leishmanial lesion environment. We exposed bone-marrow derived macrophages (BMDMs) to dimethyloxalylglycine, a HIF stabilizing agent, following infection with fluorescent L. major parasites. We quantified L. major burden through microscopy and performed enzyme-linked immunosorbent assays (ELISAs) on the supernatant fluid of the BMDMs to measure VEGF-A production. Our findings show that HIF stabilization alone is not sufficient to decrease L. major burden in BMDMs.

# Application of ionic materials in organic solar cells

H. Krehbiel

University of Arkansas—Little Rock - Chemistry

The world's energy consumption is constantly increasing with growth in population; the vast majority of this energy is being used in the form of nonrenewable sources such as petroleum, coal, and natural gas. Many reports claim that the current rate of consumption, fossil fuels will be completely wiped out within in the next 50 years. Because of this impending fate, researchers have sought out new and renewable ways to harvest energy. Solar energy has gained much attention due to its magnitude of energy harvesting potential and since the process itself produces no greenhouse emissions. The most popular kind of solar cells on the market today are silicon cells which have an average efficiency for commercially available cells of about 14-19%. However, these cells are extremely expensive and energetically demanding to produce. Thus, much recent effort has been on development of organic solar cells where the silicon portion of the cell is replaced by an organic semiconductor. I propose to develop novel, ionic materials for application in due-sensitized solar cells (DSSCs). I will characterize the molecules in solution as well as in thin film and will analyze the energetics and electrical/physical properties of the materials.

# Anti-inflammatory mechanism of arachidin-3, a natural product from peanut

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Arkansas State University - Biology/Medical Sciences

Stilbenoids are a non-flavonoid class of polyphenols that are important for their potential medicinal applications. Resveratrol is one of the well-studied stilbenoids and several studies have described its anti-inflammatory, antioxidant and cardioprotective activities. Resveratrol derivatives, such as the prenylated stilbenoid arachidin-3, are produced in peanut and are potentially more bioavailable than resveratrol. Despite their importance to human health, the molecular mechanisms underlying the bioactivities of arachidin-3 are still poorly understood. To address this issue, we are using lipopolysaccharide (LPS)-treated RAW 264.7 mouse macrophages to understand the anti-inflammatory molecular mechanism of arachidin-3 in vitro. Arachidin-3 was produced in elicitor-treated peanut hairy root cultures and purified by HPLC. Our results suggest that arachidin-3 is not toxic to the cells at low micromolar concentrations. Arachidin-3 also reduces IL-6 production in LPS-treated cells. Furthermore, cell imaging assays showed that arachidin-3 acts by inhibiting LPS-induced NF-κB activation and attenuating high mobility group box 1 (HMGB1) protein signaling in the RAW 264.7 cells. Western blotting results suggest that arachidin-3 can regulate MAPK pathway activation. These studies will increase our understanding of the molecular mechanism mediated by arachidin-3 and carry important translational implications for the application of prenylated stilbenoids as anti-inflammatory compounds.

# Wildlife among us: preliminary results from the first two seasons of the Central Arkansas Urban Wildlife Project

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Hendrix College - Biology

Urban green spaces are increasingly being recognized for their importance as habitat for wildlife. However, the species that use these urban areas and the environmental conditions that predict wildlife species presence varies widely from city to city. The Urban Wildlife Information Network (UWIN) is a collaboration among researchers who employ standardized methods to run wildlife camera studies in cities across North America. In the summer of 2020, Arkansas Game and Fish Commission and Hendrix College teamed up to launch a UWIN study in central Arkansas. Thirty cameras were set in urban parks in Little Rock, North Little Rock, and Maumelle within 2 km of the Arkansas River, stretching from Pinnacle Mountain to David D. Terry Lock and Dam. These cameras captured motion triggered photographs of animals for the months of July and October. We detected a total of 22 species across both seasons with 20 in July and 20 in October, and species richness for individual parks ranged from 5-14. The top five most commonly detected species were: eastern gray squirrel, raccoon, fox squirrel, Virginia opossum, and white-tailed deer. Preliminary results suggest that a variety of wildlife in central Arkansas are using urban parks – from golf courses and playgrounds to more natural areas – for habitat. These results suggest even the most urban parks can be valuable to wildlife. They also highlight the value of connecting urban dwellers with the wildlife that live in their neighborhoods.

# COVID-19 Diagnosis Using Chest X-rays and Transfer Learning

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Arkansas State University - Molecular Biosciences

For this project, we used a transfer-learning approach to develop a model capable of diagnosing COVID19 from chest x-ray. For this project we compiled a dataset of 112120 negative images from the Chest X-Ray 14 and 2725 positive images from public repositories. Features were extracted from the images using a CheXNet trained on Chest X-Ray 14. The output layer and penultimate layer were used, giving a total of 1038 raw features. The feature data was split into five folds for cross-validation. Multiple downstream models, including logistic regression and random forest and XGBoost with and without principal components analysis, were tested using cross-validation to evaluate recall, precision, and f1-score. These models were compared to a pre-trained deep-learning model for evaluating chest x-rays called COVID-Net. Our best model was XGBoost with principal components with a recall, precision, and f1-score of 0.692, 0.960, 0.804 respectively. This model greatly outperformed COVID-Net which scored 0.987, 0.025, 0.048. This drastic improvement in performance is most likely due to the expanded dataset used in the training of our model compared to the dataset used to train COVID-Net. This model, with its high precision and reasonable sensitivity, would be most useful as “rule-in” test for COVID19. Though it outperforms some chemical assays in sensitivity, this model should be studied in patients who would not ordinarily receive a chest x-ray before being used for screening.

# Peptoid-Based Biosensors

M. Olsen

University of Arkansas—Fayetteville - Engineering

Viral pathogen detection is an essential part of health care. Established detection methods like PCR and ELISA can be slow, expensive, and occasionally unable to distinguish between cross-reacting species. Electrochemical sensors are an alternative diagnostic platform that offer rapid, direct pathogen detection via a change in current associated with target analyte binding. Peptoid-functionalized nanoparticle coatings may increase the specificity and speed of these interactions. Preparation of modified gold nanoparticles (AuNPs) involves the exchange of citrate stabilizing molecules for thiol-containing peptoids. This surface modification is complicated by the tendency of AuNPs to aggregate upon citrate layer dislocation. Several peptoids of varying size and sequence were observed to promote AuNP aggregation. Nanoparticle size, solvent, solution pH, and biological blocking buffers impacted peptoid-induced AuNP aggregation; temperature, exposure to light, and mixing had minimal effects. A successful AuNP functionalization method was developed with an intermediate Tween monolayer to provide steric stabilization after citrate displacement. Green fluorescent protein (GFP) was then used as a proof-of-concept to demonstrate functionality of the bound peptoid. Fluorescence measurements indicated potential binding of GFP to modified AuNPs, albeit at low levels. GFP conformational changes due to AuNP surface curvature may be responsible for the limited fluorescence observed.

# A Systematic Review of the Nutrition Focused Physical Exam in Assessment of Malnutrition: A Focus on the Elderly

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Ouachita Baptist University - Nutrition & Dietetics

Background—The Nutrition Focused Physical Exam (NFPE) is a comprehensive physical exam performed by a Registered Dietitian (RD). The NFPE is most often used to diagnose malnutrition, nutrient deficiencies, and nutrient toxicities. Nutritional interventions that are successful in treating elderly malnutrition need to be employed to slow the increasing rate of malnutrition.
Objective—To systematically review the use of the NFPE in the assessment of malnutrition.
Methods—Five electronic databases were searched (ProQuest, EBSCOhost, PubMed, JSTOR and Google Scholar) for studies published from June 2010-July 2020.
Results—A literature search resulted in 50 articles. Five of the research studies' subjects were 65 years of age and older, one study focused on athletes, four studies' subjects were pediatric patients, 15 studies addressed the general public, and the remaining 25 articles focused on educating others about the NFPE. The NFPE was identified as being more successful and accurate at diagnosing malnutrition and deficiencies. The literature search for malnutrition resulted in 24 articles.
Conclusions—The NFPE is a valuable resource recognized and proven to be an effective screening for malnutrition. Articles found that pertained to diagnosing malnutrition often used several approaches to diagnosing, including anthropometric measures, interviewing, and lab testing. However, the review also contained diagnoses that include only one type of assessment.

# Incorporating immersive learning into Biomolecular Engineering Laboratories using Virtual Reality

M. Wilkerson, V. Maldonado

University of Arkansas—Fayetteville - Engineering

The sudden move to remote learning in the past year has highlighted the need for distance learning materials that are effective in conveying knowledge and skills, particularly in STEM areas where hands-on experience is essential to the curriculum. Recent studies indicated a high percentage (66%) of students who do not favor the current methods of remote delivery. Virtual Reality (VR) is a technology that could help bring students into the classroom in a more engaging way. In this work, the hypothesis that VR would increase student's engagement with the course material that results in improved understanding and retention of the presented information and experimental procedures was tested. This study used a 3D VR camera to record procedures for a laboratory component that can be watched using a VR headset through students' mobile devices. The first three pre-recorded lab videos were presented as traditional 2D videos to be watched on a desktop computer. The remaining labs were presented to students in a VR format. Quizzes and surveys were used to compare the learning gains and student engagement between the two methods of remote delivery. The results showed that students responded to having high levels of engagement with the VR videos compared to the regular 2D videos. Additionally, the quiz scores for the VR videos were higher. In conclusion, VR videos were more effective than 2D videos in delivering the lab material when a remote setting is the only available option.

# Determination of Fatty Acid Concentrations in Algae

R. Jacks, J. Rodriguez

University of Arkansas—Monticello - Chemistry

Algae are of scientific and commercial interest due to their ease of culture and high fatty acid content. Fatty acids have a vast array of applications, from omega-3 fatty acids as a nutritional supplement during embryonic development to utilizing the energy released during breakdown of fatty acids for alternative fuel sources. It is reasonable to assume that different strains of algae contain different types and concentrations of fatty acids. Of interest is the fatty acid content contained within various algal strains in the class Eustigmatophyceae. Since Eustigmatophyceae is easily cultured and produces fatty acids, they are sought after as a possible resource for these materials. Additionally, fatty acid concentrations may be used in the classification of newly discovered algal samples, as the biochemical data may be supplemental in determining the respective phylogeny for these new strains. Algal strains were collected and isolated from a number of sources, including Lake Chicot and Lake Monticello. Preliminary results show differences between algal strains via relative fatty acid concentration.

# Da Give Bloods: Supporting Blood Donation Through AI

D. Butler, S. Baily, K. Bass

Philander Smith College - Computer Science

Da Give Bloods is a web and text-based platform that uses a chatbot to recruit blood donors for hospitals, blood banks, and blood donation centers. The platform allows health workers to submit requests for blood donations and for blood donors to receive those requests via direct messages on a variety of social media and SMS platforms. The purpose of this research project is to determine if a chatbot developed using natural language processing can support blood donation and decrease blood shortages.

# Extraction and Analysis of Medicinal Biomolecules in Witch Hazel

A. Glover, L. Taylor, L. van Dee

University of Arkansas—Monticello - Chemistry

Dating back millennia, plants have been used for their medicinal properties. Witch hazel (Hamamelis virginiana) is commonly known to calm skin irritants and commercially used in dermatological topical agents. As a native to plant it is readily available, and due to its biological activity, it presents itself as an interesting study. For this reason, we have begun to extract and analyze the active compounds found in witch hazel, and determine the quantities of each. Once this data has been analyzed, more studies will be done on the medicinal functions they have and the practicality of using them.

# Beyond Right or Wrong: Designing User-Friendly Autograders From Instructors' Model of Feedback

D. Butler

Philander Smith College - Computer Science

Enrollment in introductory computing courses escalates, despite the challenges novices face when learning to program. Automated feedback tools ("Autograders") can help alleviate the burden on instructors by analyzing student solutions and programmatically delivering feedback. However, instructors struggle to adopt autograders, develop auto-graded assignments, and make automated feedback on par with manual feedback.

In this paper, we interviewed 7 Computer Science faculty with varying levels of teaching and autograding experience. Our interview protocol explores how instructors mentally model and deliver feedback to students, in addition to their experiences and perceptions of autograders. Analyzing our results, we found that instructors had a range of feelings about automatic feedback, but saw opportunities for these systems to enhance their instruction, including opportunities to systematically identify student issues and progress and exercise skills more frequently. The faculty raised interwoven questions, concerns, and feature requests around basic and advanced code evaluation capabilities in autograders. Synthesizing our findings, we developed a holistic model of feedback and identified issues, needs, and suggestions relating to the design of autograding tools. We hope these resources will improve autograders and help support instructors' adoption.

# NO Reduction by the Repair of Iron Center Enzyme, YtfE

M. Bandy

Hendrix College - Chemistry

To protect against bacterial infections, mammalian cells produce reactive nitrogen species (RNS) that kill the bacterial pathogens by damaging proteins, lipids, and DNA. Proteins that contain ironsulfur (FeS) clusters are particularly susceptible to damage by nitric oxide (NO), a common RNS. FeS clusters are found ubiquitously in nature and have a wide range of functions that underlie essential biological processes including transcriptional and translational regulation, DNA replication genome maintenance, and metabolism. Disruption of FeS activity leads to inactivation of proteins and eventually cell death. However, bacteria have evolved systems that protect against damage from NO and can restore function to damaged FeS clusters, thus it is essential to understand the mechanisms by which bacteria protect against damage from NO. One essential bacterial response system utilizes a non-heme diiron enzyme, YtfE, that facilitates the direct repair of FeS centers following exposure to oxidative or nitrosative stress. Two functions for YtfE have been identified: (1) reduction NO to N2O, protecting the bacteria from nitrosative stress, and (2) repair of damaged FeS clusters, restoring function to the protein. Here, we explore the mechanism of NO reduction by YtfE using electron paramagnetic resonance spectroscopy and enzyme kinetic studies. Kinetic rates indicate that YtfE does not reduce NO efficiently, suggesting that this may not be the primary function for the enzyme.

# Temperature-Dependent Macrophage Activity in Rainbow Trout

D. McGrevey

University of Arkansas—Fayetteville - Biology

Fever is an essential component of the immune response, enhancing immune responses and giving the human body advantages over pathogens. Macrophages are often the first cells that come in contact with pathogens. They are important for directly destroying pathogens via phagocytosis, but they also produce cytokines that initiate adaptive immunity and direct the production and activity of other immune cells. The RTS11 cell line, derived from the spleen of rainbow trout, was utilized here for studies on the influence of fever temperature on its macrophage functions. Macrophage activity was stimulated using lipopolysaccharide, poly I:C, and peptidoglycan, mimics of or actual components found in viruses or bacteria known to stimulate macrophage activity. After subsequent exposure to a variety of temperatures, macrophage metabolism and activity was measured using protein synthesis and production of nitric oxide. Results from these experiments indicate that stimulations with poly I:C, lipopolysaccharide, or peptidoglycan can increase nitric oxide production and protein synthesis consistently at a fever temperature of 19°C, and more variably at 20°C. Additionally, even without stimulation, temperature of 19°C alone can increase nitric oxide production and protein synthesis in RTS11 macrophages. These results indicate that moving to a warmer part of the stream—a behavioral fever temperature—has a major effect on the activity of macrophages and therefore on the entire immune response.

# Exploring microwave synthesis methods to efficiently produce N-heterocyclic carbene compounds

A. Filson, L. Wade, A. Ramick, R. Rodriguez-Palacio

University of Central Arkansas - Chemistry

In recent years, there has been an increasing focus on the impacts of human industry on the world environment. Commonly, the proposed solution is a complete transition to renewable forms of energy. However, with more power needed to sustain our growing society, a reliable source of energy will be needed as well. Through the creation of N-heterocyclic carbene (NHC) ligands, it is possible to create catalysts that participate in carbon dioxide reduction. What this entails is that carbon dioxide released from industrial processes can be recaptured and converted into fuel or other resources. This process allows for the continued use of fossil fuels without the net addition of carbon dioxide into the atmosphere. Moreover, these NHC ligands have applications outside of carbon dioxide reclamation as antibacterial topical medicines and in drug delivery systems. The focus of this work is to describe the synthesis of one such NHC using a microwave reactor. In particular, this work focuses on 1-methyl-benzimidazol-2-ylidene-3-(2-pyridine), or Mebim-py. Synthesis using a microwave reactor has proven to be faster and more efficient than previously conducted experiments. Synthesis using reflux has taken upwards of 18 hours, whereas synthesis using a microwave reactor has taken as little as 10 minutes.

# Instilling entrepreneurial mindset learning in a second-year biomechanical engineering course

D. Gomez, K. Hill, L. Hedgecock

University of Arkansas—Fayetteville - Engineering

The engineering community is facing new realities such as global competition, automation, and technologies that are rapidly evolving. Due to these new realities, entrepreneurial ventures are vital to innovation and economic growth. For engineering graduates to have more value in the rising competition in the job market, they must be equipped with skills that enable them to identify opportunities, understand market forces, and commercialize new products. To tackle this, entrepreneurial-minded learning (EML) was implemented in a biomechanical engineering course. The course included a semester-long project consisting of three modules. Each module tested certain EML skills. To see the impact of EML qualities, there were two versions of the project where one lacks EML concepts. We hypothesized that EML will enhance students' engagement and problem-solving skills while instilling the entrepreneurial mindset. The results obtained through surveys and students' interactions with the instructional team indicate EML groups shared a deeper interest in the biomedical engineering degree and the capability of applying course concepts to open-ended and under-defined problems. Further, the students were able to demonstrate possession of skills that are linked with the EML mindset such as investigating the market and communicating an engineering solution in terms of societal benefits. These results will be used as a basis to transform the curriculum of other Biomedical Engineering courses.

# A Cysteine-free hyperstable Human Fibroblast Growth Factor (cf-hFGF1) - Characterization of its structure and bioactivity

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Human fibroblast growth factor (hFGF-1) is a mitogenic signaling protein that plays crucial roles in multiple physiological processes including embryo development, cell differentiation, cell proliferation, angiogenesis and wound healing. The research interest lies in its untapped potential for pharmaceutical applications. However, its potential is inhibited due to undesirable characteristics which include its low thermostability, high chance of degradation and dependability on the anticoagulant glycosaminoglycan, heparin, for its receptor binding affinity and stability. Site-directed mutagenesis studies have been conducted on hFGF1 that support methods of increasing the stability of hFGF1 without the need for heparin. This research project will focus on a complete tri-mutation of the three cysteine residues found in hFGF1. These Cys residues contain highly reactive thiol R-groups which are prone to oxidation and the formation of allosterically inhibiting disulfide bonds that can form when these residues are exposed that negate proper refolding of the denatured protein. A cysteine-free form of hFGF1 (cf-hFGF1) will be analyzed for differentiations in protein stability, conformational changes, heparin-binding affinity and cell proliferation activity when compared to hFGF1. Data accumulated from this project that supports this mutated protein as an independently stabilized form of hFGF1 could advance this protein's potential for sustainable medical applications.

# Designing a Passive Tracking Solar Panel System with Shape Memory Alloys to Power a Campus Charging Station

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Rotating solar panels that follow the sun's daily orbit maximize the amount of energy absorbed from the sun's rays. This experiment sets out to create a passive, single axis, solar tracker that utilizes shape memory alloys (SMAs) to allow the solar panel to track the moving sun. Sunlight focused onto rectangular Fresnel lenses, efficiently contracts the Alloys due to heat from the sun’s focused rays. The contraction of the Alloys rotates the solar panel and the lense so that the sunlight is incident on it normally throughout the day, optimizing the total energy absorbed. This project focuses on translating the contraction of the SMAs through a series of gears, to both the panel and the lens, in order to turn them. A housing was also constructed to allow for optimal operation-free from weather conditions. The end goal is to design a device capable of powering an outdoor charging station to be used by OBU students.

# Effect of Proline on Formation of Human FGF Amyloid-Like Fibrils

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Human Acidic Fibroblast Growth Factor (hFGF-1) is a 16kDa heparin binding protein that contributes to several cellular processes, such as cell proliferation and angiogenesis. However, in humans, when hFGF-1 amyloid fibrils accumulate and aggregate, a variety of neurodegenerative diseases can arise, such as Alzheimer's and Parkinson's diseases. As the non-polar surfaces of these protein molecules are exposed, beta-strands begin to form a well-organized shape, which are amyloid-like fibrils. These amyloid fibrils are insoluble. Proline is suspected to increase the solubility of these fibrils, thus decreasing their formation. This study examines the effect of proline on the formation of hFGF-1 amyloid-like fibrils by using various biophysical techniques. To begin, a heparin sepharose column is used to purify wtFGF-1. This purified protein is studied through techniques such as Thioflavin T (ThT) extrinsic fluorescence spectroscopy, ANS extrinsic fluorescence, circular dichroism spectrophotometry, and more. The promising preliminary results of this study show that both proline and hydroxyproline assist to decrease the formation of amyloid-like fibrils in human FGF-1. The concentration of proline that appears to have the greatest effect on the fluorescence of wtFGF-1 lies between 4M and 6M. By studying proline's effects on amyloid-like fibrils, important information will arise that could contribute to the prevention of and development of treatments for neurodegenerative diseases.

# Design and Implementation of 3D Printable Optomechanical Components

J. Coker

Hendrix College - Physics

Fluorescence spectroscopy is an analytical method, extremely useful in the fields of biochemistry and biophysics, which takes advantage of the fluorescent properties of a compound in order to measure various molecular characteristics of a sample. However, teaching the principles of fluorescence spectroscopy at the undergraduate level can be a challenge, largely due to the prohibitive cost of obtaining a sufficient number of commercial- or even education-grade fluorometers to be practical for use in the classroom setting. The goal of this project was to utilize 3D printing technology, open-source software, and an Arduino Uno to construct a functioning fluorometer capable of performing at the level of commercially available hardware. The Arduino-based fluorometer constructed, nicknamed the “Fluorino,” was found to perform comparably to an education-grade fluorometer. In conjunction with open-source design sharing, this will allow for educational access to a very commonly used analytical technique at a fraction of the usual cost, perfect for a university department operating on a limited budget.

# N-imidazolyl benzamides for the fight against malaria

C. Cline

Henderson State University - Chemistry

Malaria has been a major health concern for decades, continually causing human suffering and mortality despite global efforts to control the life-threatening disease.The search for new antimalarial drugs is crucial, but the criteria for new antimalarial drugs are demanding because they need to be safe, efficacious, affordable, and active against resistant malarial strains. Computer modelling studies suggest that fluorophenyl substituted and related N-imidazoylbenzamides have the potential to be effective antimalarial compounds. Progress on the synthesis of this and related compounds is reported. A convergent approach coupling a variety of N-phenyl substituted imidazolyls with various N-alkyl substituted benzamides appeared most logical and is underway.

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Event website at
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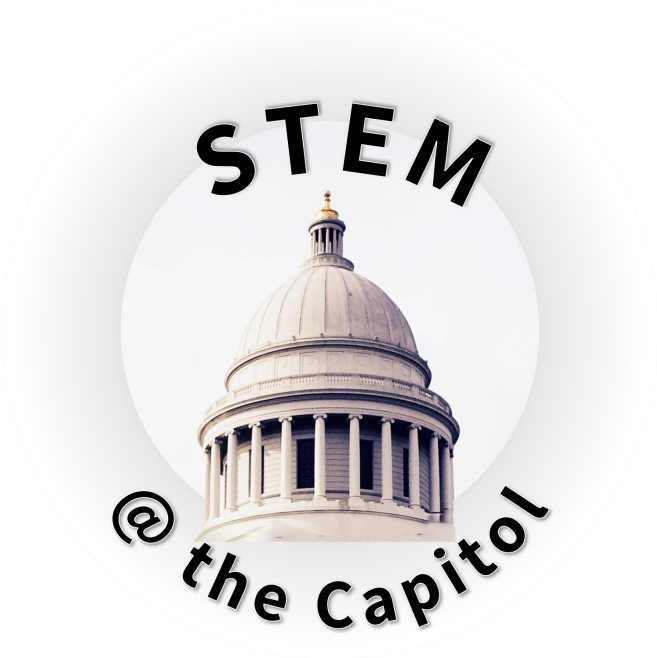


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