BIOLOGICAL SCIENCES & ENGINEERING • PHYSICAL SCIENCES & ENGINEERING • SOCIAL SCIENCES • ARTS & HUMANITIES •

UNDERGRADUATE

RESEARCH SYMPOSIUM

SUMMER 2018

Griffis Hall | August 1, 2018

MISSISSIPPI STATE UNIVERSITY

JUDY AND BOBBY SHACKOULS HONORS COLLEGE

MISSISSIPPI STATE UNIVERSITY™
JUDY AND BOBBY SHACKOULS
HONORS COLLEGE

WELCOME

The Shackouls Honors College is pleased to sponsor the summer 2018 Mississippi State University Undergraduate Research Symposium. Prizes for academic areas are being partially supported by Phi Kappa Phi. The Shackouls Honors College has provided summer research support to some of the students presenting with additional funding from the Mississippi State University Office of Research and the National Strategic Planning & Analysis Research Center (nSPARC). Other students are being supported by the National Science Foundation and the National Institutes of Health.

We view the encouragement and support of undergraduate research for all students to be part of our core mission. Just as a good liberal education broadens the mind, provides students with a common core of knowledge, and familiarizes them with the basic methodologies of the various academic disciplines, undergraduate research allows students to dive deeply into important ideas and topics in a rigorous and creative way, paving the way for future intellectual work and exploration whether in the academy, business, or other life arena. Enjoy the student posters and presentations and come away knowing more than when you entered our doors.

Dr. Seth F. Oppenheimer
Professor of Mathematics
Director of Undergraduate Research
Shackouls Honors College

Mississippi State University: Our State's Land-Grant Research Flagship

We are honored to welcome you to Mississippi State University's Summer, 2018 Undergraduate Research Symposium. Undergraduate students are an integral part of the multi-faceted research underway at Mississippi State.

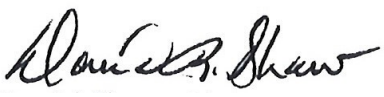
Every day, our faculty, staff, and students are conducting fundamental to applied research that provide innovative solutions, creative works, and new scholarship that address pressing local, state, regional, national, and global needs.

As a result of this work, MSU is the leading institution in our state for research that falls within its land-grant mission. Strengths across all colleges and research centers have led to our institution being categorized by the Carnegie Foundation as a "high research activity" institution. The Carnegie Foundation has also recognized Mississippi State with its Community Engagement Classification.

Pursuing research opportunities is a critical part of academic life on our campus, and our students are recognized for their commitment to discovery, creation, and exploration in our labs, studios, library, research farms, and beyond. We are pleased that members of our faculty are committed to providing undergraduates with meaningful roles in the overall research enterprise, and promoting interdisciplinary research as an important component of scholarly activity.

Undergraduate research gives our students opportunities to apply classroom knowledge to new areas of interest, and helps them develop skills, collaborate with faculty and peers, and gain confidence. It is exciting to see the results of their efforts on display at today's symposium.

Again, welcome to the symposium, and thank you for your contributions to and interest in research at Mississippi State University.



David R. Shaw, Ph.D.

Vice President for Research and Economic Development

THE HONOR SOCIETY OF
PHI KAPPA PHI

The Honor Society of Phi Kappa Phi (PKP) has a long and distinguished history. Currently, there are over 300 chapters of PKP scattered all across the world, from Maine to Hawaii and the Philippines, and from Alaska to Puerto Rico and beyond. During the 1996-97 academic year, PKP celebrated the 100th anniversary of the founding of The Honor Society of Phi Kappa Phi, and we are now in the second century of its recognition of - and service to - learning. The MSU chapter is in its 66th year of membership. Due to PKP's prestigious recognition and support of learning, the MSU Chapter is proud to also financially support the Summer 2018 Undergraduate Research Symposium in Griffis Hall at Mississippi State University. As President, I am honored that Phi Kappa Phi has been asked and is able to support this event as I have tremendous respect for undergraduate research at MSU. This symposium displays that research at its best!

Thanks,

Dr. Jessica Tegt
President

Summer 2018 Undergraduate Research Symposium Schedule

Poster Session: Griffis Hall (1st, 2nd, and 3rd Floors)

1:00 pm - 3:30 pm

4:00 pm: Award Ceremony - Griffis Hall, 4th Floor Forum (Room 401)

Moderator:

Dr. Seth F. Oppenheimer, Professor of Mathematics, Director of Undergraduate Research, Shackouls Honors College, Mentor, Provost Scholars, Mississippi State University

Featured speaker:

C. Lashan Simpson, Assistant Professor, Biomedical Engineering, Agricultural and Biological Engineering, Mississippi State University

Subject Area Awards:

Kathy Prater, Research Associate II (L, P, S), T.K. Martin Center for Technology and Disability

Dr. Christopher Snyder, Professor of History and Dean of the Shackouls Honors College, Mississippi State University

This symposium would not be possible without the hard work of the judges who work under time pressure to try to determine which excellent project is just a bit more excellent than the others. If you see a judge, thank him or her.

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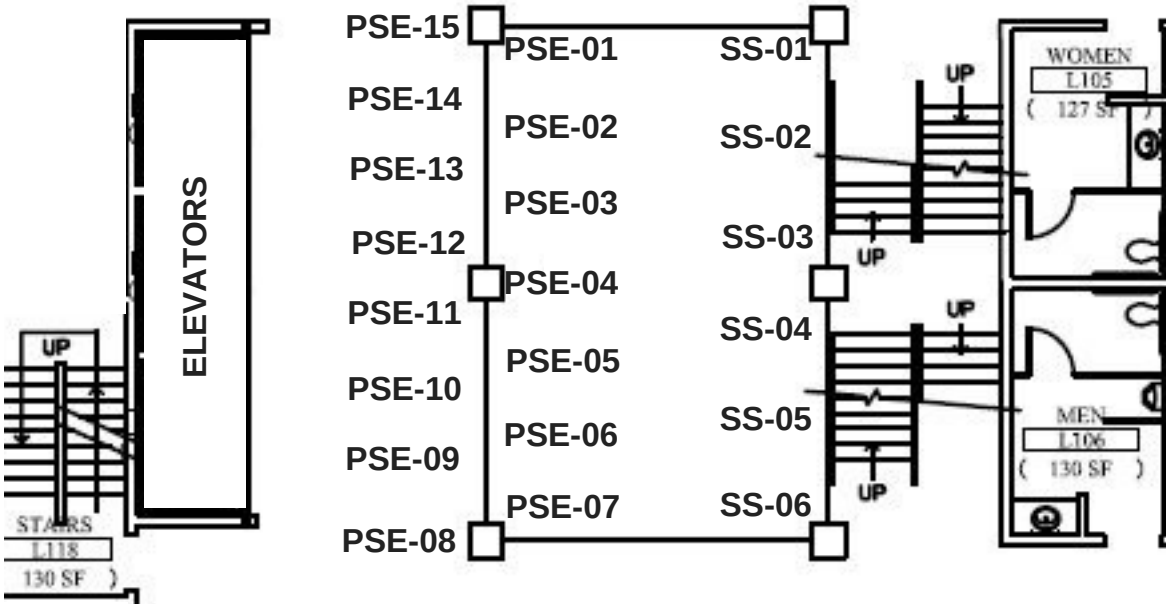
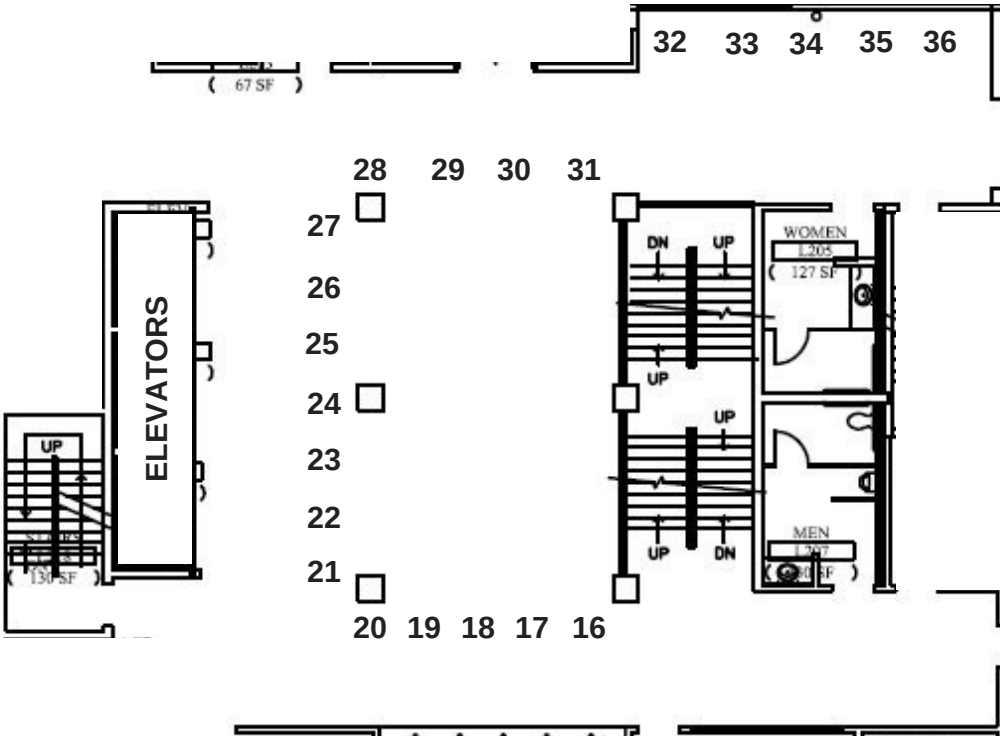
3rd Floor:	**Biological Sciences & Engineering (BSE)**

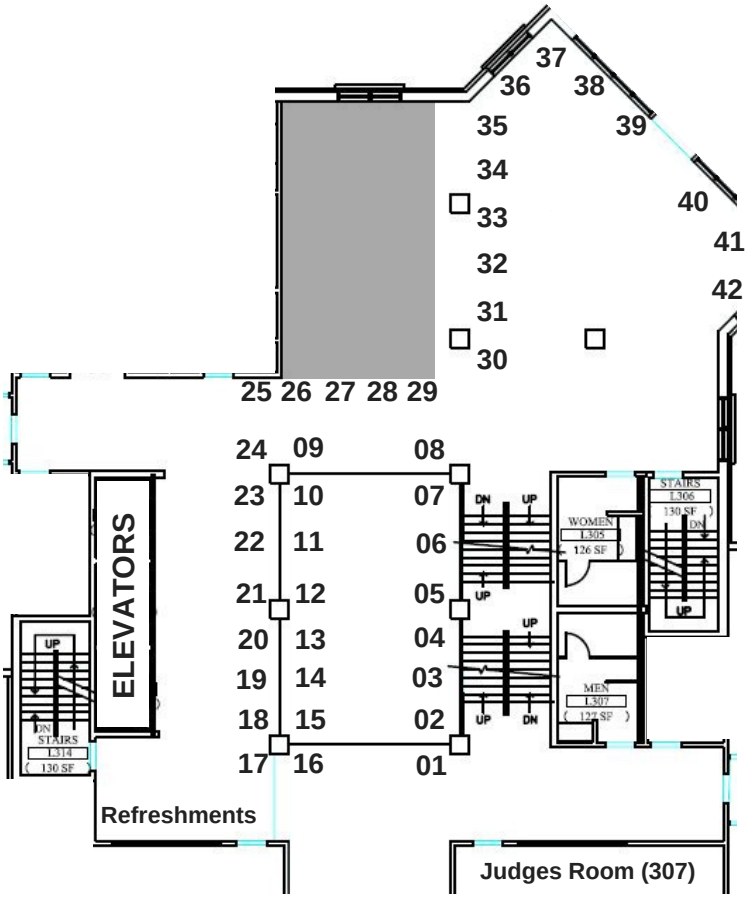
First Floor - Social Sciences (SS) and Physical Sciences & Engineering (PSE)



Second Floor - Physical Sciences & Engineering (PSE)



Third Floor - Biological Sciences & Engineering (BSE)



Abstracts

PSE-01
Name: Suman Adhikari
Major: Computer Science
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Bryan Jones, Electrical and Computer Engineering

A modular plugin-in architecture for CodeChat
The CodeChat plugin transforms source code into a web page, allowing software developers to view their source code as a beautiful and descriptive document by adding headings, formatting, hyperlinks, images, and diagrams. However, this plugin requires use of a little-known text editor, Enki. To broaden its impact, this project presents the creation of a modular plug-in architecture for CodeChat, enabling its use with a variety of text editors. This approach bridges the services CodeChat provides, which are provided in the Python programming language, to the variety of programming languages which various text editors require. To accomplish this, this project (1) employs Apache Thrift, which provides scalable cross-language service development; (2) develops a CodeChat server to provide the needed services; and (3) creates a JavaScript plugin client for Visual Studio Code, a free and popular cross-platform text editor.

BSE-01
Name: Nathan Allgaier
Major: Chemistry
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Joseph Emerson, Chemistry
Co-Author: Kayla McConnell

Thermodynamic Investigation into to Zinc(II) and Copper(II) binding to hCAII
Human carbonic anhydrase II (hCA II) is a metalloenzyme that utilizes a mono-nuclear zinc(II) ion in its active site. The zinc(II) ion is coordinated by three histidines, and has one hydroxyl group to complete the tetrahedral coordination mode, and this metal center is buried within the folds of the protein. This metalloenzyme plays a key role in the hydrolysis of carbon dioxide in the blood and helps to regulate blood pH. Although hCA II binds one zinc(II) ion, it has been observed to bind two copper(II) ions in intro. Using a number of biophysical techniques, including thermal and chemical denaturation, we thoroughly unraveled these complex ion equilibria demonstrating the fundamental interactions that spur on these coordination events. This data give insight into the stability of hCA II, but also demonstrates a method to better understand the structural role metal ions play in stabilizing metalloproteins throughout living systems.

PSE-02
Name: Robert Balducci
Major: Kinesiology, Clinical Exercise Physiology
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Adam Knight, Kinesiology, Center for Advanced Vehicular Systems
Co-Authors: Jeff Simpson, Harish Chander, Ethan Stewart, Trace Lee, David Macias

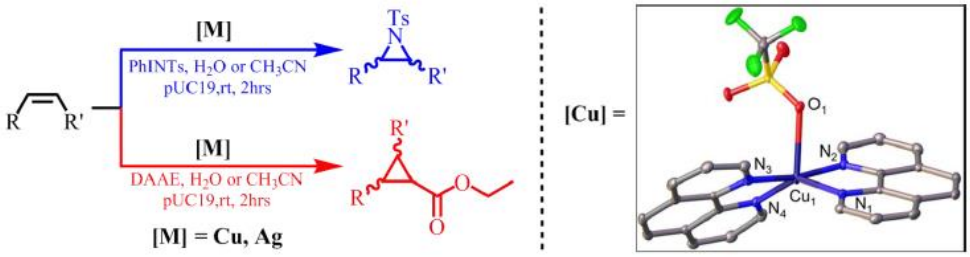
Influence of unexpected and expected ankle inversion perturbations on the latency of the peroneus longus and peroneus brevis
Lateral ankle sprains frequently occur when landing unexpectedly on an uneven surface, causing excessive inversion of the ankle. The purpose of this study was to examine muscle activation of the peroneus longus (PL) and peroneus brevis (PB) during unexpected and expected inversion perturbations. Twenty one healthy participants with no history of a lateral ankle sprain completed the study. All participants performed a step-down task where they stood on a 24 inch high platform, stepped down 12 inches onto another platform with their testing limb, and then stepped down another

12 inches onto the ground. A flat platform and a tilted platform that was rotated 25° in the frontal plane to safely replicate the mechanism of a lateral ankle sprain were used. Surface electromyography (EMG) was used to measure the latency of the PL and PB during the unexpected and expected perturbations. The participants performed a maximum of 10 step-down trials in which the titled platform was randomly used in place of the flat platform without the participant's knowledge and treated as the unexpected perturbation. Then, participants performed a step-down trial onto the tilted platform, but this time they were given verbal instruction that they would be landing on the tilted platform, which was treated as the expected perturbation. Latency of the PL and PB, measured in milliseconds (ms), was calculated from the raw EMG signal during the unexpected and expected perturbations. Paired samples t-tests were used to compare the latency of the PL and PB between landing conditions. Results revealed no difference in the latency of the PL ($p=0.513$) or PB ($p=0.427$) between landing conditions. Different motor programs are used when an inversion perturbation is expected, but in the present study, knowledge of the inversion perturbation did not alter PL or PB latency.

PSE-03
Name: Ashlee Bartlett
Major: Chemistry
Home University: Spring Arbor University
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Joseph P. Emerson, Chemistry
Co-Authors: Dr. Henry U. Valle, James D. Cope, Sydnee D. Elmore, Daniel K. Wolgemuth, Dr. Joseph P. Emerson

Transition-Metal Complexes for Olefin Aziridination and Cyclopropanation: Towards Asymmetric N- and C- Transfer Catalysts

Aziridines and cyclopropanes are valued as important building blocks for the synthesis of a wide range of active compounds. The development of more efficient and cost-effective catalysts for the atom transfer reaction with olefins is a continuously growing area of research in both organic and inorganic chemistry. Transition metal complexes which catalyze reactions of olefins with nitrenes and carbenes are very well developed efficient approaches to the direct synthesis of aziridines and cyclopropanes. As part of our efforts in the catalytic formation of C—C bonds, herein we show the development of efficient copper(II) and silver(I) catalysts that exhibit high reactivity in forming cyclopropanes and aziridines from a range of olefins. These catalytic systems have also shown a propensity to conduct these atom-transfer reactions in aqueous solutions, affording the opportunity to use bio-macromolecules like DNA to induce enantio-selectivity.



PSE-04
Name: George Barton
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Colleen Scott, Chemistry

Unprecedented Synthesis of N,N'-dialkyl-3,6-dimethyl diketopyrrolopyrrole (di-Me-DPP) and N,N'-dialkyl diketopyrrolopyrrole(DPP) Core

DPP has become a promising candidate building block in applications in organic semi-conductors materials (OSC), such as organic field effect transistors (OFETs), organic photovoltaic (OPV) and organic light emitting diodes (OLEDs) as well as

fluorescent sensors. During the past ten years, around 150 scientific papers and more than 200 patents are annually published on topics related to DPPs. Nevertheless, theoretic studies and industry applications of this type of materials are still significantly limited to its conventional synthetic method.
The electron-deficient, N'-dialkyl-3,6-dimethyl diketopyrrolopyrrole (di-Me-DPP) the flanked methyl groups that is well-suited for constructing C-C double bond by Knoevenagel condensation with aryl-monocarbaldehyde or aryl-biscarbaldehyde. Due to the lack of DPP-flanked aromatic groups that are congenital in DPP compounds synthesized by the conventional way, various direct functionalization of the core, such as C-H activation, can be fully imagined. One example is the installation of vinyl groups flanked with DPP ring extending the pi-conjugated system, through the transition-metal-free C-H approach in contrast with the ubiquitous transition-metal coupling ways. We have developed the first synthetic route to di-Me-DPP. This synthesis uses radially available starting materials and mild synthetic conditions. In our presentation, we will discuss our synthetic route and the transition-metal-free C-H Knoevenagel condensation to produce vinyl groups flanked with DPP rings.

PSE-05
Name: Parshuram Bhusal
Major: Mechanical Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Tonya Stone, Mechanical Engineering, Center for Advanced Vehicular Systems
Co-Author: Dr. Ted Dickel

An Atomistic Study of the Deformation Behavior of Bulk Single Crystalline Titanium Alloys
The unique and novel properties of titanium alloys, which include low density, high tensile strength and toughness (even at extreme temperatures), excellent corrosion resistance, and bio-compatibility make these alloys widely usable for many industries, such as military, aerospace, automotive, and biomedical applications. For most applications, titanium is alloyed with aluminum and vanadium to create an alpha-beta-phase stabilized titanium that is easier to fabricate. Although this alloy is widely used, there are limited molecular dynamics (MD) studies, with published studies limited to alpha-Ti and Ti-Al nanowires. In the current study, we performed MD simulations on bulk single crystalline Ti, Ti-6Al, and Ti-4V to take a closer look at effect of alloying on the tensile properties and deformation mechanisms of these material systems. The models were subjected to uniaxial tensile loading, up to a maximum 0.2 strain. We report on the effect of model size, crystal orientation, and strain rate on the stress-strain response and the plastic deformation mechanisms during structure evolution. This work presents the first attempt to use MD simulations to understand the effect of alloying elements on the deformation mechanisms during the structure evolution of single crystalline Ti, Ti-6Al, and Ti-4V systems to assist the production of nanodevices, light-weight products, and high temperature engineering products.

BSE-02
Name: Tedrick Binder
Major: Computer Science
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: T.J. Jankun-Kelly, James Worth Bagley College of Engineering
Co-Author: Christian Hall

Kill the Rainbow
Kill the Rainbow is a web-based application designed to provide a means of better displaying and perceiving biological data. Kill the Rainbow's goal is to do its namesake and remove the rainbow color map from computational visualizations. When looking at other tools that fall under the same umbrella, they tend to be focused on creating an aesthetically pleasing color pallate, rather than helping to decide the best way to showcase the data. I joined this project as it was already in development and worked to update the software for compatibility and version control. In addition to that, I studied a variety of other programs to pinpoint their strengths and weaknesses. In the future, I will continue the development of the tool, adding whatever features we deem fit and continuing to work on maintaining the quality and health of the project.

SS-01
Name: Rachel Booth
Major: Psychology
Project Category: Social Sciences
Faculty Advisor, Affiliation: Andrew F. Jarosz, Psychology

The Read Scare: Reading Stereotype Threat in College Aged Males

Pansu et al. (2016) demonstrated that third grade boys had poorer reading scores when they were placed under a negative reading stereotype threat (ST) than boys not under a stereotype. The link between ST and working memory has been well studied – for example, Beilock, Rydell, and McConnell (2007). There was an interaction between ST and high demand problems, demonstrating that ST took a toll on WMC. Their results indicated that WMC resources are depleted by ruminations over the perceived stereotype and that depletion in WMC leads to a decrease in women's math solving abilities. The authors predicted if ST caused decreased reading scores among males, then high WMC men under ST would score lower on the reading task than high WMC men in the control group, with low WMC men unaffected by the manipulation. In contrast, women's reading scores would not be affected no matter the group. Both male and female college students completed reading comprehension and vocabulary tests, then two forms of working memory tasks in either a ST or control condition. A total of (n = 43) completed all the tasks correctly for this study. A General Lineal Model with gender and condition as fixed variables and working memory as a covariate found a main effect of gender with males outperforming females, ($F(1,42) = 6.168$, $p = .017$). There was also a condition and working memory interaction ($F(1,42)= 6.552$, $p = .014$) where gender did not matter($F(2,42) = .377$.) indicating that both males and females reacted to the stereotype. High WMC men under ST did score lower than high WMC in the control condition, but so did women. Due to the scarcity of studies examining stereotypes that place female performance above male, a follow-up study examining females' responses to other male stereotypes is needed to clarify the results.

BSE-03
Name: Katarina Boulet
Major: Chemistry
Home University: SUNY Geneseo
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Nicholas Fitzkee, Chemistry
Co-Authors: Becca A. Hill, Y. Randika Perera, Nicholas C. Fitzkee

Using Two-Dimensional NMR to Understand How Protein Mixtures Interact with Gold Nanoparticles

Gold nanoparticles (AuNP) have numerous medical applications, including drug and gene delivery, chemo- and photo-therapy, biosensing, and bioimaging. When exposed to biological fluids, AuNPs will interact with proteins in solution, and those proteins will compete for binding to the AuNP surface. Being able to quantify competitive binding in protein mixtures will help us understand how and why proteins bind onto the surface of AuNPs. This knowledge could potentially allow scientists to use protein-nanoparticle binding to better target specific cells in the body. Nuclear magnetic resonance (NMR) has been used extensively to study many biological molecules in solution. Recently, our group has explored using two-dimensional ^{1}H-^{15}N HSQC NMR spectra to study protein interactions with various nanoparticles. In this study, we used this technique to quantify AuNP binding versus time for a mixture of GB3 and Ubiquitin, two small model proteins. GB3 and Ubiquitin signals were resolved by HSQC and sampled at 15 min time points. An external standard of ^{15}N urea was used to quantify absolute binding relative to a standard mixture of GB3 and Ubiquitin in the absence of AuNPs. Binding was observed to be fast, with the majority of interactions occurring in the 3 minute dead time of the experiment. This result differs from a previous study, where GB3 was able to displace Ubiquitin over an 18-hour period. These earlier studies were performed using a simpler one-dimensional NMR approach, and we are currently working to determine the source of the discrepancy.

PSE-06
Name: Benjamin Boyd
Major: Industrial Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Linkan Bian, Industrial and Systems Engineering
Co-Authors: Mojtaba Khanzadeh, Wenmeng Tian

ARL Project
The objective of this research is to determine whether or not interrupting the build of a part created with laser powder bed fusion (LPBF) process has any effect on the mechanical and micro-structure properties of the part. In this specific study, we are investigating the effect of an interruption during build on surface integrity of the part. To begin with, identical parts (e.g., dog-bone, cylinder) are being created using selective laser melting (SLM), and in the middle of the part, the build is interrupted. Subsequently, the build process is continued until the part fabrication is finished. While the printing processes, thousands of point cloud data on the part are collected by using a coordinate measuring machine (CMM). Point cloud data is recorded in multiple paths on each of the four surfaces of the part (i.e., North, West, South, and East). There are two major challenges: 1) Complex time and direction interdependence exists in the collected data and current engineering knowledge is not sufficient to describe all the variability; 2) the point cloud data suffers from a large data volume, a low signal-to-noise ratio, and an ill structure data. To tackle these challenges, multilinear principal component analysis (MPCA) approach is used to extract low dimensional features and residuals. Subsequently, change-point detection methods are applied by leveraging shift in mean square error, mean, and standard deviation to detect changes in extracted low dimensional features and residuals, respectively. Lastly, real-interruption compared to the detected via change-detection methods to illustrate the effectiveness of the proposed approach, and the accuracy of interruption time detection is validated.

PSE-07
Name: Benjamin Brainerd
Major: Mechanical Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Matthew Priddy, Mechanical Engineering

Automated Generation and Deformation of Octet Trusses Using 3D Modeling Software
With the increasing popularity of additive manufacturing (AM), three-dimensional lattice structures can now be created with greater ease. These lattice structures consist of a repeating pattern of identical unit cells. Three-dimensional lattice structures are desired by the aerospace and biomedical fields because of the need for high strength, low weight structures. One such lattice structure is the octet truss, which has a unit cell comprised of 36 cylindrical struts. The octet truss is a stretch-dominated lattice, meaning it is more resistant to compressive loads. Previous studies involving the octet truss have revealed that several deviations from the original model may exist in the AM printed structure. The most common deviation is an error in strut diameter of the truss. Python-based CAD software is used to automate the process of geometrically modeling the ideal truss and then altering the diameter one or more struts to determine the degree of loading redistribution and overall change in mechanical response of the octet truss. Abaqus, a finite element analysis software, is used to simulate uniaxial compression loading of the octet truss. The results of these simulations will help predict the performance of the printed structure while accounting for the difference between the ideal and printed geometries.

PSE-08
Name: Kice Brown
Major: Chemistry
Home University: Mississippi College
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Keith Hollis, Chemistry

Synthesis, Characterization, and Photophysics of Novel CCC-NHC Pincer Pt Complexes

This summer, novel CCC-NHC pincer platinum complexes have been synthesized. These compounds are so important due to their special photophysical property, making them great candidates for use in organic light emitting diodes (OLEDs). These complexes are much more photostable with UV irradiation under an ambient atmosphere than the commercially available emitters: tris(8-hydroxyquinoline)aluminum (Alq_3), tris[2-(4,6-diflurophenyl)pyridinato-C^2,N]iridium(III) ($Ir(dfppy)_3$), (8-hydroxyquinoline)zinc (Znq_2), and lithium tetrakis(2-methyl-8-hydroxyquinolinato)boron (LBMQ). They are also much more energy efficient when compared to their LED and incandescent counterparts. The synthesis is accomplished through three steps: (1) a copper-coupling reaction to synthesize the ligand core; (2) an alkylation or arylation reaction to synthesize the ligand precursors with different arms; (3) a metalation and transmetalation of the ligand precursors to synthesize CCC-NHC pincer platinum complexes. These compounds have been synthesized for their potential use in OLEDs, because these complexes emit light under long-wave UV radiation. Our research has focused on how synthesizing different ligand precursors affect the light that is emitted by these complexes. By altering the backbones or arms of the ligands, we can observe differences in the light emitted. These properties of the CCC-NHC pincer complexes could allow for new innovations in the OLED display markets.

BSE-04
Name: Kaylee Bundy
Major: Biological Engineering
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Jean Feugang, Animal and Dairy Sciences

Impact of Liposomes on Boar Semen Quality Post Freezing

Sperm cryopreservation freeze-thawing methods of boar is very inefficient and unreliable leading to decreased sperm function and survival. An egg yolk extender is widely used but risks contamination and may compromise samples. Liposomes are spherical vesicles made up of a phospholipid bilayer, extensively used for drug transport and administration. Liposomes may be an improved method of preservation due to biological capabilities and phospholipid membrane. This study was completed to determine how liposomes would affect the cryopreservation of boar sperm. Boar semen samples were harvested from four different boars over a period of days. Half of the sperm from each boar was frozen with a liposome extender and the other half was not. The sperm samples were later thawed and tested for viability and motility. Motility testing was analyzed using the CEROS II motility analysis software. Viability testing for the samples was run through two kits on a Guava easyCyte flow cytometer, ViaCount and MitoDamagae, in order to count the cells and determine the viability of the mitochondria, cellular membrane, and cell death. All the data was collected and compared between the treated and control samples. The CEROS II software showed virtually no difference in motility between samples. The ViaCount and MitoDamage software displayed a slight increase in viability in most samples treated with liposomes and no change in percentage of apoptotic cells. The data shows slight improvement in overall sperm viability when frozen with the liposomes. It appears the liposomes did not harm or significantly improve the preservation process.

PSE-09
Name: Joshua Burcham
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Todd Mslna, Chemistry
Co-Author: Danielle Pitre

Popcorn: The Future of Biochar?
Biochar is a material made from the pyrolysis of carbon waste, and is frequently used to adsorb heavy metals, such as lead and copper, from water systems. The biochar used in this project was made through the pyrolysis of popcorn at 400°C for 1 hour. Adsorption studies were performed to determine the optimum amount of biochar dosage for lead adsorption. The best biochar dosage was found to be 0.035 g, and will be used for all further adsorption studies.

PSE-10
Name: Sydney Canaday
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Todd Mlsna, Chemistry
Co-Author: Achala Liyanage

Removal of heavy metals from contaminated water using modified rubber tire
With continued worldwide economic and industrial growth, used rubber tire waste has emerged as a serious issue around the world. The management of this waste is a matter of growing concern. In this study, recycled ground rubber tire (GRT) particles were used to remediate contaminated water. GRT was then modified using chitosan to produce a potentially low-cost adsorbent for removal of heavy metals, copper and lead, from contaminated water. Surface chemistry for both the modified and unmodified GRT were analyzed using Fourier-transform infrared spectroscopy, scanning electron microscopy/energy dispersive X-ray spectroscopy, and scanning electron microscopy. Adsorption studies were carried about at 298 K, pH values ranging from 2 to 10, with contact times ranging from 5 minutes to 24 hours, and with different initial adsorbent concentrations. These treated solutions were then analyzed using atomic absorption spectroscopy. The kinetic data was fitted using pseudo- first and pseudo-second order models. Results show that pseudo-second order equations correlate best to absorption data for both copper and lead. Results have shown that the chitosan modified GRT can improve adsorption which suggests that this adsorbent can be used as an effective and low-cost material for heavy metal removal from waste water systems.

BSE-05
Name: Jordan Coggins
Major: Biochemistry
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Justin Thornton, Biological Sciences
Co-Authors: Natalene Vonkchalee, Allison Matthews, Andrew Camilli, Keun Seok Seo, Jason Rosch

TnSeq Screening for Novel Antibiotic Importers in Streptococcus pneumoniae
Streptococcus pneumoniae (pneumococcus) is a Gram-positive bacterium that asymptomatically colonizes the human nasopharynx and is also capable of causing invasive disease including pneumonia and meningitis. Antibiotic resistance is increasing significantly and finding novel ways to treat infections is therefore crucial. Due to the inability of many antibiotics to freely diffuse through the bacterial cell wall, we *hypothesized that certain antibiotics may be imported by specific transporters normally used to transport other substrates*. To test this hypothesis, we have utilized a *magallan6* transposon mutant library of strain D39 to screen for mutants capable of growing on various antibiotics. We isolated several pneumococcal mutants capable of growing at concentrations of fosfomycin and azithromycin well above the minimum inhibitory concentration (MIC) for this species (~16µg/mL) and (~0.13mg/ml). Growth of a fosfomycin mutant, Fos1, was not affected by concentrations up to 500µg/mL as determined by 24 hr growth curves.

Azithromycin resistant mutants AZ5 and AZ6 were able to grow at 20ug/ml. Chromosomal DNA flanking the transposon insertion sites was sequenced and revealed SP1208 (uridine kinase) as the gene interrupted in Fos1, and pullulanase in AZ5 and AZ6, respectively. We are currently creating deletion mutants in these two genes to confirm the phenotype and plan to extend this research to identify transporters for additional classes of antibiotics. Identifying compounds that can induce expression of such antibiotic transport/modification systems will allow us to dramatically increase the concentration of the antibiotics within bacteria, thus overriding resistance mechanisms and resurrecting antibiotics rendered useless against many drug-resistant pathogens.

BSE-06
Name: Shawndasia Collins
Major: Biological Sciences
Home University: Spelman College
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Cyprianna Swiderski, Equine Medicine, Clinical Sciences
Co-Authors: Kensey Thomas, Christa Frodella, Andrew Perkins, Andrew Claude, Alison Eddy, Cathleen Mochal, Jacquelyn Bowser

Generation of De Novo Lung Transcriptomes for Investigating the Pathogenesis of Pasture-Associated Severe Equine Asthma.

Equine pasture asthma (EPA), a form of severe equine asthma, affects horses grazing pastures under hot humid conditions. EPA is common in southeastern states including Mississippi, which is ranked #1 for human asthma related mortality. We have demonstrated that horses with EPA have clinical and histologic similarlities to severe and neutrophilic forms of human asthma, along with airway hyperresponsiveness of a magnitude that is diagnostic of severe human asthma, making them a relevant animal model for investigating human asthma. Hypothesizing that differences in gene expression, splice variants, SNPs, indels, and compound mutations can contribute to the pathogensis of EPA, we constructed transcriptomes that could be used to investigate these differences from Illumina RNA-sequencing reads (150 bp paired end) derived from video assisted thorascopic lung biopsies of EPA horses (N=6) and non-diseased controls (N=6). Diseased and non-diseased horses were biopsied in a paired fashion at two time points, according to timing of clinical asthma exacerbation and remission in diseased horses. Using CLC Genomics Workbench (Qiagen), RNA-seq reads were trimmed and quality filtered, then assembled de novo to create transcriptomes for diseased and non-diseased horses corresponding to the timing of asthma exacerbation and remission in diseased horses. These transcriptomes enable contrasting gene expression in poorly annotated portions of the equine genome while identifying other variations in protein coding that are poorly suited to identification using conventional RNA-sequencing analysis. To facilitate EPA investigation and its utility as an animal model of severe human asthma, this resource will be made publicly available.

SS-02
Name: Margaret Conner
Major: Educational Psychology
Project Category: Social Sciences
Faculty Advisor, Affiliation: Kasia Gallo, Counseling, Educational Psychology and Foundations

Sexual Education in Religious Institutions

Religious institutions have long served as sources of sexual education for adolescents. Sexual education includes information on sex, sexually transmitted infections (STI's), sexuality and pregnancy. STI's and teen pregnancy have been on a steady rise in America. A review of literature was conducted to analyze the effectiveness of sex education programs in religious institutions. Some researchers tracked post-program rates of premarital sex while others investigated how knowledgeable adolescents felt after participating in a sex education program. Literature also reported parents' thoughts on what should be taught in sex education programs, how often they discuss sex with their children and even recalled their own sexual education programs and evaluated their own confidence levels regarding sexual education. In other studies, adolescents were asked how comfortable they were discussing sex with adults or peers both before and

after sexual education programs and how likely they were to participate in premarital sex, both safe and unsafe. Results suggested that sexual education programs offered through religious institutions did not prevent premarital sex. Since adolescents who felt comfortable discussing sex with their parents were the least likely to engage in premarital sex, further studies should research the effectiveness of sexual education programs where parents and adolescents attended the program together. It is vital that sexual education programs become more informative for adolescents so that the rate of STI's and teen pregnancy in America start to decline.
Keywords: Sex education, religion, religious institutions, information, sexual diseases, adolescents, parents

BSE-07
Name: Anna Crawford
Major: Biological Engineering
Project Category: Biological Sciences and Engineering
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Co-Authors: Katie E. Heath, Jessie M. Barra, Samuel I. Blum

The Effect of Aquaporin Expression in the Activation of Autoreactive T-cells in Type 1 Diabetes
Type one diabetes (T1D) is an autoimmune disease in which insulin-producing pancreatic β-cells are destroyed by immune cells including autoreactive T-cells. One mechanism of β-cell lysis involves oxidative stress produced by invading immune cells that can damage β-cells and act as an intercellular signal to enhance diabetogenic T-cell responses. As we previously demonstrated, an increase in oxidative stress is necessary for the activation of an autoreactive T-cell response in T1D. Hydrogen peroxide, a reactive oxygen species, is a signaling molecule that is taken up by aquaporins, a water and hydrogen peroxide transport channel in the cell membrane of T-cells. Therefore, we hypothesize that enhanced aquaporin expression results in an increase in autoreactive T-cell activation. To test this hypothesis and investigate the role of aquaporins in T1D, we utilized the Non-Obese Diabetic (NOD) mouse which develops spontaneous autoimmune diabetes and two mice that exhibit a delay in T1D including the Non-Obese Diabetes-Resistant (NOR) mouse and the NOD.*Ncf1*^{m1J} mouse which is incapable of producing superoxide, a precursor to hydrogen peroxide. Immune cells from NOD, NOR, and NOD.*Ncf1*^{m1J} mice were purified and stimulated with concanavalin A for 12, 24, 48, and 72 hours, and then analyzed by real time PCR to determine aquaporin 9 expression. Upon analysis, stimulated NOD T-cells exhibited a 37-fold decrease (p <0.0005) in aquaporin 9 expression in contrast to non-stimulated T cells, and the diabetes-resistant NOR strain exhibited a 1.9-fold increase (p < 0.0062) in aquaporin 9 expression following stimulation when compared to NOD mice. Additionally, ELISAs (enzyme-linked immunosorbance assays) were used to analyze activation via production of IL-17A and IFN-γ, both proinflammatory cytokines. Future studies will examine protein expression of aquaporins in stimulated CD4 and CD8 T-cells as well as during the progression to spontaneous autoimmune diabetes via Western blot.

PSE-11
Name: Ryan Denney
Major: Aerospace Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Heejin Cho, Mechanical Engineering
Co-Author: Coralie Rose

Material Properties Testing of HEPA Filter Media: Post Isothermal Accelerated Aging
The Institute for Clean Energy Technology at Mississippi State University actively engages in the testing and analysis of nuclear grade High Efficiency Particulate Air (HEPA) filters and filter media. This study analyzes non-nuclear grade media before and after isothermal treatment that simulates accelerated aging via thermal degradation to the multiple protective coatings applied to the borosilicate glass fibers. The study utilizes material properties techniques such as tensile strength, water repellency, and thickness to provide quantitative data before and after thermal treatment at 60°C (140°F) and low relative humidity. The goal is to determine viability of the protective coatings after experiencing thermal degradation. This investigation aids in constructing a timeline for the effective use of HEPA filters due to failure of their component materials over a period of time or storage processes. The data from this study has the potential to

extend the regulation lifespan of HEPA filters, thereby decreasing money spent on new filters without sacrificing public safety.

BSE-08
Name: Mason DeOrnellis
Major: Computer Science
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Marilyn Warburton, Biochemistry and Molecular Biology
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Pathway Association Study Tool (PAST)
Background: *Aspergillus flavus*, a fungus that infects corn plants, produces a harmful carcinogen known as aflatoxin, which causes severe health problems in humans and animals. Corn contaminated with aflatoxin must be destroyed and losing corn crops is economically devastating due to corn's high versatility and demand. Through a method called genome-wide association study (GWAS), scientists have identified genes linked to aflatoxin accumulation resistance. However, GWAS results does not identify all genes for a trait, due to low statistical power and lack of suitable analysis tools, and it has difficulty pinpointing genes with big effects on the trait of interest (i.e., aflatoxin resistance). To remedy this, metabolic pathways consisting of multiple genes that work together are being analyzed to increase statistical power and identify resistance mechanisms. A program was created that filters GWAS results, links single nucleotide polymorphisms (SNPs) to genes, assigns those genes to pathways, and creates rugplots showing information about significant pathways. However, that program has been coded in a mixture of R and Perl; consists of multiple scripts which must each be started manually using the output of the previous script; and runs unacceptably slowly. Because of these difficulties with the program, it is not being used by scientists in other labs.
Methods: A new implementation of these scripts is being entirely coded as a freely available R package that utilizes R's multiple statistics-based functions to efficiently filter and format SNP data. The package easily reads GWAS datasets, links SNPs to genes using linkage disequilibrium data, and assigns those genes to pathways using online databases. Finally, it assigns significance to pathways and produces rugplots showing significant pathways and their genes.
Results: The end product will be a user-friendly package that efficiently reads and runs pathway analysis on GWAS data in multiple formats for different plant species and traits.

PSE-12
Name: Austin Cole Edwards
Major: Chemistry
Home University: Georgia Southern University
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Jason Street, Sustainable Bioproducts
Co-Authors: Cody Wainscott, Bryan Mitchell

Co-pyrolysis of biomass, micronized rubber, and low-density polyethylene
Pyrolysis has potential to be an economically attractive route to an alternative energy source. It is capable of producing three products with different capabilities: bio-char, bio-oil, and product gases. Bio-oil is the main focus of this study and, using biomass, rubber, and/or plastics, bio-oil can be synthesized under an inert atmosphere yielding a diverse hydrocarbon composition similar to that of crude oil. In this study, an auger reactor was designed and utilized in the co-pyrolysis of southern pine, waste rubber using in tire manufacturing, and a specialized polymer waste used in food packaging (0.00% ash, 0.27% nitrogen, 0.01% sulfur, 57 ppm chlorine, 0.02 ppm mercury, 11760 BTU/lb). To further upgrade the quality of the bio-oil, nickel oxide (NiO) was used as a catalyst in-situ during the pyrolysis process. Downstream from the reactor was a catalyst bed housing sodium carbonate (Na_2CO_3) supported on aluminum oxide (Al_2O_3) as well as ultrasonic transducers. Although much research has been investigated on the use of the catalysts, no literature can be found on the use of ultrasonic transducers to substantially increase the number of collisions between molecules. Gas chromatography coupled with mass spectrometry was utilized to determine composition of product

gases and of the bio-oil. Bomb calorimetry was used to determine the calorific value of the bio-oil and Karl Fischer titrations were carried out to determine water content.

BSE-09
Name: Joe Emerson
Major: Physics
Home University: Ohio Wesleyan University
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. George Popescu, Institute for Genomics, Biocomputing & Biotechnology
Co-Authors: Norbert Bokros, Dr. George Popescu

Performance analysis of a gene family classification method for plant kinome identification

Gene families are defined by structural and evolutionary relationships and often display a common evolutionarily conserved function among family members. These qualities make this system of classification useful in many areas of functional and evolutionary genomics. Currently, plant gene family classification relies on the construction of hidden Markov models constructed from model organisms such as *Arabidopsis thaliana* or using curated datasets to search for gene homology. There is a lack of standardized methods for determining gene families which often leads to discrepancies in gene classification. We propose a new measure integrating homology identification, motif conservation, phylo-genomic, and integrated expression analyses to define gene families. The process requires minimal manual curation of datasets. An analysis of the MAP3K gene family from seven different plant species, five previously examined and two unexamined, was performed using this process. Results showed that our method outperformed other recent efforts for the identification of gene families in these species. Furthermore, the analysis provided new insights into the evolutionary development and function of the MAP3K gene family in the species examined.

PSE-13
Name: Erin Farmer
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Todd Mlsna, Chemistry
Co-Authors: Chanaka Navarathna, Narada Bombuwala Dewage

Adsorptive removal and photocatalytic degradation of Rhodamine B (Rh B) using Fe-MOF/magnetic-biochar composites

Fe MIL-53 Metal-Organic Framework (MOF) has been impregnated into a magnetic biochar (MBC) hybrid. This trifunctional (adsorptive, degradative and magnetic) dual hybrid adsorbent (MOFMBC) has used for the removal of Rhodamine B (Rh B), a colorant which is widely used in textile, printing and tanning industries, is also associated with deleterious health effects. Batch sorption studies were performed at various initial pHs, initial Rh B concentrations and temperatures in-order to determine the pH, kinetics, thermodynamics and for optimum sorption capacity. Adsorption followed pseudo-2^{nd} -order kinetics and MOFMBC exhibited a considerable ability to adsorb Rh B with Langmuir adsorption capacity of 55 mg/g at pH 6, 200 rpm agitation and 25 °C. MOFMBC was extensively characterized by SEM, TEM, XRD, FT-IR, BET, Elemental Analysis and XPS. Electrostatic and π-π stacking interactions are thought to play a significant role in the sorption mechanisms. Hexavalent chromium (Cr^{6+}) and Rh B can co-exist in tannery and printing waste water, which can trigger the photo degradation of Rh B into CO_2 and H_2O in the presence MOFMBC. Hence, the regeneration of MOFMBC can be minimized in real world applications.

BSE-10
Name: Rachael Feeney
Major: Animal and Dairy Sciences (Pre-Vet)
Project Category: Biological Sciences and Engineering
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Responses of Reproductive Male Ambystoma tigrinum to Female Pheromone Water and Female Presence

Plethodontid salamanders release reproductive pheromones to attract mates; however, it is unknown if other salamander families release reproductive pheromones. Ambystomids, such as tiger salamanders (*Ambystoma tigrinum*) have not been studied for their potential to communicate through reproductive pheromones. The current study of *A. tigrinum* analyzes male behavior in response to female pheromone water (FPW) and to the physical presence of a female.

Female *A. tigrinum* (n=12) were soaked in water for one hour in order to create FPW. Males (n=12) were exposed to both FPW and control water samples. For thirty minutes, male sexual behaviors such as snout-raising, approaching FPW, or coming in contact with FPW were documented by ethogram. Determining if the physical presence of a female elicited more male sexual behaviors than FPW, was conducted in a subsequent trial, in which a different female than the one that created the FPW was introduced to the male. Male sexual behaviors were documented for thirty minutes with the added presence of a female. Additional male-female sexual behaviors were documented such as holding-down, nudging, head-rubbing, and mounting.

The presence of a female compared to FPW did not increase male sexual behavior. On average, reproductive males were 53% more responsive to FPW than control water. In trials involving the physical presence of a female, males were 52% responsive to the female. These data support the hypothesis that *A. tigrinum* release reproductive pheromones and that they can be released into water to attract males.

BSE-11
Name: Drew Ferrell
Major: Biochemistry
Project Category: Biological Sciences and Engineering
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GO Enrichment for Significantly Reversibly Oxidized Cysteines in Arabidopsis thaliana

Modern high throughput screening methods generate big omics data. Analyzing this data manually has become increasingly unreasonable due to its sheer size. Hence, methods, such as Gene Ontology (GO) enrichment, have become a standard tool in such analysis. Our lab previously developed a computational method identifying cysteines significantly reversibly oxidized. Here, we further extend this computational method with the addition of GO enrichment using the controlled vocabulary from the Gene Ontology Consortium. In addition to testing for statistically significant GO categories, we calculated the log fold enrichment for each significant GO category by comparing its occurrence in the significantly reversibly oxidized cysteines and the entire genome. As an extension to this traditional GO enrichment, we superimposed experimental dynamics. We assigned experimental mean log fold changes (LFC) from cysteines associated with a GO term. Each GO term also has an associated frequency of positive and negative LFC of the cysteines. We applied this method to significantly oxidized cysteines from *Arabidopsis thaliana* plants infected with Pseudomonas syringae DC3000 avrrpt2. The comparison between 8 hours and 8 hour control had GO terms involved in molecular function and were enriched for (among others) unfolded protein binding and protein binding involved in protein folding. Cysteines in these categories had an average LFC which was positive, with a frequency approaching all being oxidized.

PSE-14
Name: Emily Freeman
Major: Chemistry
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Project Category: Physical Sciences and Engineering
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Co-Author: Chathuri Gamlath M.

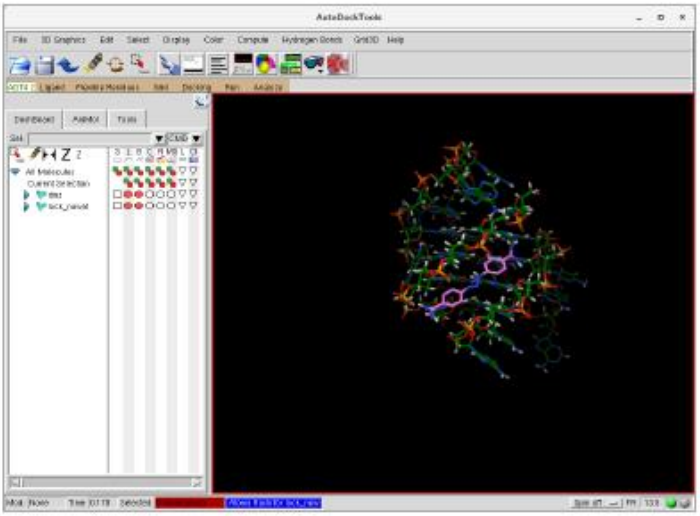
Biochar from pyrolyzed coconut shells: silver nanoparticle modification and antibacterial assessment

Antibacterial agents are crucial in preventing illnesses from spreading throughout populations. Bacteria can spread in a multitude of ways including through wastewater. According to the CDC and FDA, the recent deadly E coli outbreak from romaine lettuce was linked to a canal containing water contaminated with E coli. Antibacterial agents can be used in water purification to aid in removing harmful bacteria from our wastewater and drinking water supplies. As bacterial resistance increases, research on improved antibacterial materials has also increased. Silver and silver nanoparticles are known antibacterial agents. Silver nanoparticles are considered a useful alternative to silver ions because they have extraordinary antibacterial properties. Biochar, a byproduct of bio-waste pyrolysis, has proven to be an effective low-cost absorbent for the removal of heavy metals from aqueous solutions due to the high porosity of the material. This research utilizes this aspect of biochar to provide an adequate matrix and stabilizer for the synthesis of silver nanoparticles. Biochar can also contain some antibacterial properties that will be enhanced with the addition of silver nanoparticles. In this project, coconut shell biochar is used as a high surface support in order to assess silver nanoparticles antibacterial effects using gram positive and gram negative bacteria. Engineered biochar will be characterized by TEM (transmission electron microscopy), SEM (scanning electron microscopy), and BET surface area and pore volume analyzer.

BSE-12
Name: Justin Giles
Major: Biological Sciences
Home University: Tougaloo College
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Steven R. Gwaltney, Chemistry
Co-Author: Jerrano Bowleg

The Binding of the Drug DMZ with the Oncogene Bcl-2

This research project aims to determine diminazene aceturate's (DMZ's) possible binding locations to DNA upstream of the oncogene B-cell lymphoma 2 (Bcl-2). The significance of working with Bcl-2 is its ability to delay apoptosis and reduce the effectiveness of cytotoxic drugs. Bcl-2 can be located at the end of telomere which is a sequence of nucleotides found at the ends of chromosomes for protection. The protein telomerase is overexpressed in cancer cells and causes proliferation of cancer cells by adding nucleotides to the telomere. Although Bcl-2 is needed for cell survival, overexpression of the gene is correlated to the proliferation of cancer cells. One property of the Bcl-2 promoter region is a guanine rich sequence of nucleic acids, which has the ability to form a secondary structure of DNA called a G-quadruplex. Research on DMZ shows it has a high affinity for binding to G-quadruplexes, and this study seeks to identify the best binding location and the dynamics associated with the interaction between Bcl-2 and DMZ. The study simulates the possible interactions between DMZ and three Bcl-2 G-quadruplex structures — Bcl2-3-5-3, Bcl2-3-6-2, and Bcl2-3-7-1 — using Autodock and Amber. VMD and Chimera were used for visualization purposes. The binding of DMZ to Bcl-2 not only stabilizes the G-quadruplex but also prevents the telomerase from acting on the telomere. Consequently, DMZ's structure could potentially serve as a basis for chemotherapeutic drug therapy by preventing the further hybridization of cancer cells.



PSE-15
Name: Cintly Guzman Hernandez
Major: Chemistry
Home University: University of Tennessee at Chattanooga
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Todd Mlsna, Chemistry
Co-Authors: Andre Orr, Glenn Crisler, Timothy Shauwecker, J. Casey Johnson, Darrell Sparks, Todd Mlsna, Ashli Brown

Too Much Green in the Stream
Phosphorous plays an important role in the development of plants as it is one of the three main plant macronutrients. Phosphorous is present in soils and is often included in plant fertilizers to encourage plant growth. However, plants may not be able to utilize all the phosphorous from fertilizers and the excess phosphorous makes its way into waterways through run-off. An overabundance of phosphorous in water has created eutrophication problems in many places such as the Gulf of Mexico, Chesapeake Bay and the Great Lakes, affecting marine life.
One possible solution to help prevent eutrophication is to create a treatment wetland system to remove phosphorus prior to entering the water. The forebay of such a system can be designed for optimal phosphate removal. The purpose of this study is to determine whether to use designer biochar (Al-Mg treated) or slag (a byproduct of the steel making process) as a phosphate-binding filter in the runoff treatment system. Both biochar and slag are relatively inexpensive and have phosphate-retaining characteristics. The merits of comparison are capacity, kinetics, and ability to retain phosphate in ambient temperatures/ pH levels of 5-8 normally found on the field.

PSE-16
Name: John Gwin
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Edwin Lewis, Chemistry
Co-Authors: Savannah J. West, Nagham Alatrash, Frederick M. MacDonnell

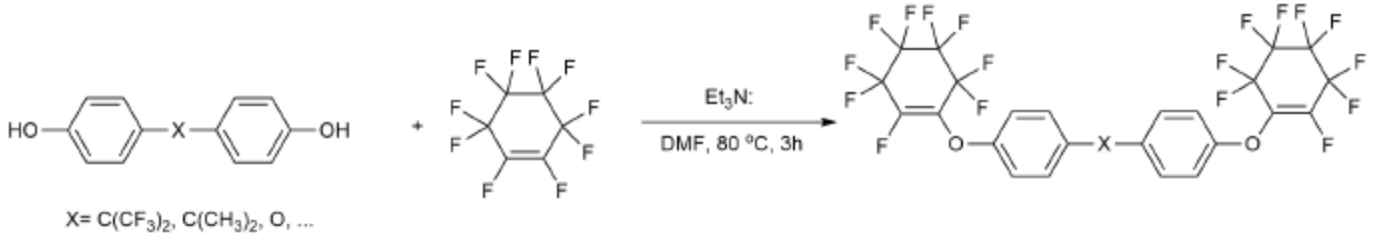
The Effects of Chirality on Binding $[(phen)_2Ru(tatpp)Ru(phen)_2]^{4+}$ to G-quadruplex, i-Motif and B-DNA
Platinum-based anticancer drugs have recently had problems surfacing within the drug development community that have promoted a greater interest in ruthenium-based compounds. These new drugs display less toxicity and a lower potential for cellular resistance. Ruthenium (II) Polypyridyl Complexes (RPCs) that contain the large planar and redox-active tetraazatetrapyrido-pentacene (tatpp) ligand cleave DNA in the presence of reducing agents in cell-free assays and show significant tumor regression in mouse models of human non-small cell lung carcinoma xenografts.

Isothermal titration calorimetry, circular dichroism, and differential scanning calorimetry were used to study the thermodynamics and structural changes associated with the complexation of $[(phen)_2Ru(tatpp)Ru(phen)_2]^{4+}$ (4^{4+}) to various DNA structures. We tested the racemic, ΛΛ and ΔΔ 4^{4+} isomers with the short and long looped mutants of the c-MYC NHE-III_1 promoter sequence G-quadruplex and i-Motif structures as well as a 25 base-pair duplex DNA sequence. Past research has proven that 4^{4+} will bind to the exposed G-tetrad faces of the quadruplex in a 2:1 mole ratio of RPC:G4-DNA, but that the RPC will only bind to the i-Motif structure in a 1:1 mole ratio. When binding to duplex DNA, the RPC can potentially intercalate between every other base-pair, meaning a total of 12 could bind to the 25 base-pair B-DNA sequence. Of the pure isomers, ΔΔ 4^{4+} binds tighter to the G-quadruplex, but the ΛΛ isomer binds tighter to the B-DNA. Further, we suspect that the i-Motif structure will bind each isomer with approximately the same affinity. These preferences are due to the different way the end phenanthroline ligands interact with the G-tetrad faces, the grooves of the duplex strand and the i-Motif structure.

PSE-17
Name: James Hankemeyer
Major: Chemistry
Home University: St. Thomas University
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dennis Smith, Chemistry
Co-Author: Ganesh Narayanan

Synthesis and characterization of perfluorocyclohexenyl aryl ether homo and co-polymers

Perfluorinated polymers demonstrate outstanding thermal, optical, and barrier properties, however, they also exhibit poor processability and are typically expensive. To overcome these drawbacks, while maintaining their outstanding properties, our research focused on the synthesis and characterization of perfluorocyclohexene (PFCH) aryl ether homo- and copolymers. This was achieved by the polycondensation of decafluorocyclohexene with inexpensive commercial bisphenols, such as bisphenol-A, bisphenol AF, and biphenol, as well as custom-synthesized bisphenols. In addition to commercial bisphenols, non-commercial bisphenols bearing bulky aromatic core were synthesized and characterized using nuclear magnetic resonance (NMR) spectroscopy (1H and 13C-NMR) and high resolution-mass spectrometry (HR-MS) techniques, which were subsequently utilized for polycondensation reaction with decafluorocyclohexene. These perfluorinated polymers typically exhibited high thermal stabilities (~400 °C) and high glass transition temperatures (>150 °C), with the possibility of latent cross-linking which is expected to provide additional thermal stability. In addition, greater control in the thermal behavior, especially the glass transition temperatures of the PFCH aryl ether polymers, were observed by using bisphenols with aromatic cores for polycondensation with decafluorocyclohexene. With the possibility of modulating physico-chemical, thermal, and optical properties, another aspect of our research focused on fabricating free-standing films which can be utilized for optical, electro-optical, proton exchange membranes, and protective coatings. A general schematic to prepare the perfluorinated polymers as mentioned in this abstract is shown below:



PSE-18
Name: Wesley Harrison
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Joseph Emerson, Chemistry
Co-Author: Sydnee Elmore

Enantioselectivity in Aziridine and Cyclopropane Synthesis via DNA-Based Hybrid Porphyrin Catalysts
Enantioselectivity in aziridine and cyclopropane synthesis from olefins has been a growing area of interest due to promising synthetic applications for medicinal and organic chemistry. Porphyrin-based catalysts have been known to work well for aziridinations and cyclopropanations; however, most of the catalytic systems developed using porphyrins are symmetric and provide racemate mixtures in the final products. Our work is aimed at modulating these catalytic systems by inserting the porphyrin catalysts into the chiral biomolecule, namely DNA, to enhance enantioselectivity. By using the chiral DNA-based hybrid catalysts, we aim to achieve enantioselectivity in both aziridine and cyclopropane synthesis under sustainable conditions. Here we describe our efforts to explore both reagent (N- and C-atom transfer agents) and substrate scope of aziridination and cyclopropanation reactions catalyzed by Mn-, Fe-, and Co-$TMPyP_4$-based DNA hybrid catalysts in aqueous and semi-aqueous solutions.

PSE-19
Name: Mary Heili
Major: Chemistry
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Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Veera Gnaneswar Gude, Civil and Environmental Engineering
Co-Author: Umesh Ghimire

Energy-efficient Electrochemical Desalination
There is a growing need for energy-efficient desalination of seawater. Zinc|ferricyanide desalination batteries have been shown to produce high rates of desalination at a small scale while simultaneously producing electrical energy. The zinc|ferricyanide battery consists of an anode chamber containing a zinc electrode and a $ZnCl_{2(aq)}$ electrolyte, a cathode chamber containing a graphite electrode and an electrolyte of $K_3[Fe(CN)_6]_{(aq)}$ and $K_4[Fe(CN)_6]_{(aq)}$, as well as a central chamber containing simulated seawater to be desalinated. We attempt to deepen our understanding of this electrochemical process and improve upon the design of this desalination battery in order to produce high desalination rates with larger volumes of seawater at low specific energy consumption. A mechanistic study has been developed to evaluate the variables of impact, which include electrolyte concentrations, surface area of the electrodes, resistance across the electrodes, the type of ion exchange membranes, and the volumes of electrolyte solutions relative to the volume of the seawater. Results obtained from our preliminary studies will be discussed.

SS-03
Name: Katrina Henn
Major: Forestry/Urban Forestry
Project Category: Social Sciences
Faculty Advisor, Affiliation: Dr. Jason Gordon, Forestry

Post-disaster Response to The Community Forest: Challenges and Opportunities
The community forest offers many diverse benefits to residents, such as air pollution mitigation, water quality improvement, and energy savings. However, it can also be a cause for concern during and after major storms due to increased risk for tree part and whole tree failure. Tree hazards impact utility services, transportation access, storm water drainage, and life and property of residents. This project sought to identify and describe the major challenges and opportunities for Mississippi cities regarding post-disaster response to their community tree canopy. Response includes, for example, risk reduction through pruning and tree removals, working with volunteers and interagency cooperation,

establishing a maintenance plan, replanting, or doing nothing. The project employed open-ended interview questions with city planners, publics works officials, utility directors, parks directors, arborists, urban foresters, foresters, and other residents who have an interest in community tree care. Overall, attitudes towards the community forest were positive with participants placing high value on urban trees and their benefits. As well, local utility companies, cleanup crews, and volunteers were generally well-regarded with how well and quickly they handled cleanup and tree planting. Although some municipalities demonstrated plans for replanting after storms, many did not. While natural regeneration was observed in almost every community surveyed, assessment of natural regeneration as an effective means of reestablishing the community forest was mixed. Further, while some of the remaining timber after a storm was salvaged and sold or used for firewood, the majority of it was taken to a landfill, which increases landfill costs and wastes the wood resource. Implications for policy and educational efforts are discussed.

BSE-13
Name: Paige Hinton
Major: Mathematics
Home University: South Dakota State University
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Michelle Zhou, Mathematics and Statistics

Information Ratio Test for Detecting Gene-Environment Interaction
Gene-environment interaction (GEI) is a variation in disease outcome due to a difference of genotypes interacting with environmental factors. Investigating GEI is essential to understanding the mechanisms of certain diseases. In genetic studies, it is challenging to detect GEI due to the large number of potential interactions for testing and unobserved confounders with which the genetic markers might interact. It shows that the presence of GEI leads to heterogenous variance of quantitative traits among different genotypes. This motivates us to design a statistical tool for identifying GEI interaction via testing for heteroscedasticity. We consider a class of information ratio (IR) statistics, which was originally proposed to detect heteroscedasticity of error variances in linear regression models. We extend this method to detect GEI, and then to determine which candidate genetic markers interact with environmental factors. We conduct extensive simulation studies to assess the performance of the proposed method in terms of controlling for Type I error and the power of the test. In addition, we compare our method with the existing Levene's test.

BSE-14
Name: Blade Hodges
Major: Agricultural Engineering Technology & Business
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Mary Love Tagert, Agricultural & Biological Engineering

Understanding In-Field Soil Moisture Variability
There have been numerous studies on soil moisture as it pertains to irrigation in Mississippi, but more work is needed in the agricultural region known as the Blackland Prairie, located in the northeastern part of Mississippi. In the Blackland Prairie region, it is not economical to access groundwater over most of the region due to the depth of the aquifer, so many producers use surface water for irrigation. In addition, center pivots are the most common method of irrigation application. Soil moisture sensors have been shown to conserve water usage while maintaining yields on irrigated fields, helping to better time irrigation applications with crop water needs. However, questions remain unanswered regarding the use of sensors in the Blackland Prairie region: 1) How many sensor sets are needed over a given area, and 2) Where is the best placement of sensors within a field? There are many variables that can affect soil moisture, including topography, soil heterogeneity, and the variability of vegetation. The study is being executed on a sprinkler irrigated soybean field near Brooksville, MS, in the Blackland Prairie region. Soybeans were planted in the 15-ha field on May 4, 2018, and a 55-m grid was developed for the field. The grid resulted in 44 point locations under the pivot, and two Watermark 200 SS GMS soil moisture sensors were placed at all points between May 23 and June 15, one each at depths of 12 and 24 inches, and connected to a datalogger which recorded hourly soil tension measurements. Data from the loggers was downloaded weekly, and plant height and LAI were measured weekly. Preliminary results show spatial

differences in soil moisture over time, with more variability when the soil profile is the driest. Future work will include soil texture analysis and correlation of these results to soil moisture.

PSE-20
Name: Colby Horner
Major: Aerospace Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Eric Collins, Center for Advanced Vehicular Systems

Meshing Requirements For Turbulence Modeling
Computational Fluid Dynamics (CFD) has become an indispensable tool for the design and analysis of aerospace vehicles. While CFD simulations are much cheaper to perform than wind tunnel testing, care must be taken to ensure that the simulations are accurately modeling the relevant physical phenomena while also making the most effective use of computational resources. Typically, greater accuracy can be obtained by spatially refining the computational mesh; however this also increases the computational costs and can lead to greater delays in simulation turn-around time. This situation is exacerbated in cases where fluid turbulence must be considered as the relevant length scales are often problem dependent and can vary widely over the region of interest.
The objective of this research is to examine the mesh resolution needed to sufficiently resolve the turbulent flow field around a NACA series airfoil at multiple angles of attack. For each angle, a series of increasingly refined meshes are generated and used to obtain a computational simulation of the turbulent fluid behavior. For each simulation, a series of metrics are computed to determine the accuracy of the numerical solution. As the mesh is refined and the computed solution asymptotically converges towards a reasonable approximation to the actual physical flow field, these metrics should also converge towards their optimal values. From these results, it should be possible to derive some heuristics for specifying desirable mesh resolutions (length scales) that can be used as a guide to striking the appropriate balance between accuracy and efficiency for future simulation efforts.

PSE-21
Name: Tianci Huang
Major: Aerospace Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Yu Lv, Aerospace Engineering

High Accuracy Computational Fluid Dynamics Interface Capturing Algorithm and Solver Development
Development of interface capturing methods has been an important research topic in the field of computational fluid dynamics (CFD), of relevance to accurate prediction and modeling of multiphase flows. Multiphase flows appear in a wide spectrum of engineering applications, such as fuel injectors, chemical reactors, petroleum reservoirs, ocean and geothermal systems. To enable more accurate and cost-efficient prediction of multiphase flows, new interface-capturing method built on the state-of-the-art numerical scheme is required.
This work presents a novel interface-capturing method based on the discontinuous Galerkin method. To make good use of the available computational resources, MPI-based parallel computing capability is developed. The MPI approach divides the computational domain and assign them to different processors. Data exchange between processors is required for accurate results, therefore, overlapped halo regions are allocated within each processor to store exchanged data. After the solver is parallelized, we couple our own algorithm with the solver and run fundamental interface cases including “disk in a vortical flow” and “Zalesak disk in a circular flow”. To validate the accuracy of the solver, we consider benchmarking against the Multidimensional Universal Limiter with Explicit Solution (MULES) method and isoAdvector method, both of which represents the state-of-the-art interface-capturing methods and are enabled in the OpenFOAM software platform.
The study found that the new interface-capturing method provides more accurate results compared to the peers with comparable computational cost.

BSE-15
Name: Sarah Hyde
Major: Physical Education, Kinesiology
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Megan E. Holmes, Kinesiology
Co-Authors: Katherine Spring, Laura VanHorn

Relationship between sources of stress and health outcomes in adolescents

Research suggests stress contributes to the development of obesity and metabolic syndrome in adolescents. PURPOSE: The purpose of this study was to examine the relationships between the Adolescent Stress Questionnaire (ASQ) subscales and various health outcomes. METHODS: 7th and 8th grade students (n=126) took part in assessments for anthropometry, psychosocial stress, physical activity, and metabolic syndrome-related variables. Metabolic syndrome-related variables included BMI, waist circumference (WC) and a metabolic syndrome composite score. Stress was assessed using all 10 subscales of the ASQ, which represented common sources of stress for this age group (i.e., stress of home life, school performance, school attendance, romantic relationships, peer pressure, teacher interaction, future uncertainty, school/leisure conflict, financial pressure and emerging responsibility). RESULTS: Mean age approximated 13.4 years. Mean BMI was 21.7 kg/m² which approximates the 75th percentile and 38% of the sample were overweight. Mean WC was 73.5 cm. Only four ASQ subscales were significant predictors of BMI [peer pressure (β= -.27, *p*=.048), teacher interaction (β= .29, *p*=.048), future uncertainty (β= .31, *p*=.011), and financial pressure (β= .30, *p*=.012)]. Future uncertainty (β= .33, *p*=.009) was the only significant predictor of waist circumference. The metabolic syndrome model was not significant. DISCUSSION: This study examined the relationship between sources of stress in adolescence and three indicators of current health status. Much of the previous research on adolescent stress has focused on identifying sources of stress, rather than examining the overall influence these stress-related factors can have on health outcomes. Results from this study suggest many sources of adolescent stress may contribute to various metabolic syndrome-related health outcomes. Significant predictors accounted for approximately 8-10% of the variance in BMI and WC in this sample, and thus deserve consideration in future efforts to address childhood obesity.

PSE-22
Name: Jacob Istre
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Xin Cui, Chemistry
Co-Authors: Chaminda Lakmal Hetti Handi

Styrene Derivatives as Building Blocks for Ring-Opening Synthesis of N-Heterocycles

Styrene and its substituted derivatives are relatively simple and abundant petroleum products that can easily be harnessed for uses in synthesis. One of these uses, a ring-opening synthesis, has been explored in our work with 1,2-disulfonyl diazetidines as a substrate precursor for tosylformaldimine. The core of the work focuses on the use of diazetidines and styrenes to produce N-heterocycles that can be useful for pharmaceutical purposes and other similar research. Due to the potential reactivity of diazetidienes, my work in particular has focused on an alternative substrate (ditosylaminal), which is less volatile and also theoretically acts as a precursor for the tosylformaldimine. Using the same optimized conditions from the diazetidine trials (60 degrees C, 12 hour reaction time, dichloroethane as solvent), I reviewed the effectiveness of the aminal substrate with multiple styrene derivatives. During the summer research, I attempted multiple methods for deprotecting the tosyl compounds produced by this reaction, but as yet none of them have succeeded. This research will continue.

BSE-16
Name: Paulino Jarquin
Major: Biological Engineering
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Steve Elder, Agricultural & Biological Engineering
Co-Authors: Preston Smith, Mark Mosher

The Potential for Punicalagin to be used as an Injection-based Therapy

Current there are too few choices to mitigate articular cartilage damage in a non-invasive manner, which is critical to avoid long and drawn out surgeries. An injectable drug formulated from punicalagin, a compound extracted from pomegranate, is a viable treatment method to slow the degradation of cartilage. We speculate that the ability of punicalagin to bind to the surface of cartilage can protect and maintain cartilage to reduce continued degradation that occurs naturally. The purpose of this study was to explore the potential for punicalagin to be used as an injectable drug to stop erosion of cartilage. We first tested punicalagin's ability to resist corrosion. This was done by devising an experiment in which porcine cartilage plugs were exposed to a 10mg/mL solution of punicalagin, then put in collagense and compared to a control. The results of this experiment demonstrated a statistically signifigant difference between the control and punicalagin exposed cartilage pieces. Another test was then done to ensure that punicalagin did not change the natural coefficient of friction properties of cartilage. Similarly to the previous experiment, porcine cartilage plugs were exposed to a 10 mg/mL solution of punicalagin. The cartilage pieces were then underwent coefficient of friction testing, which showed that punicalagin did not significantly alter the surface properties of the cartilage. With the success of the past experiments, we then went on to an *in vivo* experiment in a rat model. We made an injectable drug with the same concentration of the previous experiment, and tested it on the rat's knees that were induced with arthritis. The rats were injected twice a week, for five weeks. At the end of the experiment the rat's knees were dissected for histology, as well as vital organs for testing. Testing of tissue and knees is currently ongoing.

BSE-17
Name: Cameron Keeton
Major: Biochemistry
Home University: University of Louisville
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Todd Mlsna, Chemistry
Co-Authors: Narada Bombuwala Dewage, Chanaka Navarathna

Biochar Adsorbent with Enhanced Hydrophobicity for Oil Spill Removal

The Deepwater Horizon oil spill in the Gulf of Mexico was a catastrophic event that led to thousands of deaths in aquatic organisms and seafowl populations as well as a net loss of billions of dollars across several industries. Because of these severe impacts, this oil spill jumpstarted scientific research on effective ways to clean oil spills. Current methods used to clean oil spills are oil skimmers, in situ burns, polymer rafts, and oil adsorbents. These methods can be costly, involve complex synthetic procedures, or result in secondary environmental impacts. This research utilizes biochar, a waste product of bio-oil production, as an oil adsorbent. Biochar is a cheap and readily available, highly porous, carbonaceous material. Oil is a hydrophobic compound so will be attracted to hydrophobic oil adsorbents. To enhance the hydrophobicity of biochar, it can be decorated with lauric acid, which is a long chain saturated fatty acid. This decoration allows the biochar to float on the oils surface, as well as increases the biochar's ability to bind oil. Also, biochar can be made magnetic through the deposition of iron oxides on the biochar surface, allowing it to be easily retrieved by using an external magnet. This research is testing the ability of raw and decorated biochars to absorb oil through the creation of artificial oil spills. This is done by placing 0.25 grams of biochar on the created oil spill and leaving the biochar for an hour to equilibrate with the oil. Optimal conditions, such as pH, time, and oil mass were determined throughout the study. The results of this study show the oil adsorption on raw biochar is not pH dependent and equilibrates in under an hour. Furthermore, lauric acid decorated biochar was discovered to adsorb more oil than raw biochar.

PSE-23
Name: Maleen Kidiwela
Major: Geosciences
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Varun Paul, Geosciences

Influence of Geomagnetic Fluctuations on Temporal Atmospheric Water Vapor Variability

The Geomagnetic field is responsible for regulating and shielding the earth from incoming solar and cosmic radiation. The shielding capacity of the magnetic field depends upon Earth's own magnetic variability as well as the solar wind variations. Analysis on temporal variation of the geomagnetic field indicates that it currently is 10 percent weaker than what it was in 1845. As a result of the growing concern towards how this may affect life on earth, many satellites and ground stations were established in order to quantitate the geomagnetic variability. While the methods of geomagnetic observations had been grown exponentially, it's influence on the atmosphere remains unexplored. This study focuses on identifying and understanding a potential relationship between geomagnetic fluctuations and temporal water vapor variability. The experimentations were conducted using a theoretical and an experimental approach. Within the theoretical approach, daily geomagnetic variations and atmospheric water vapor levels were analyzed in locations, Stennis - MS, Fredericksburg- VA, O'Neals - CA, Boulder - CO, and Deer Park – WA from 2013 through 2016. The experimental approach was conducted by simulating a cloud within the tank and three dimensionally analyzing the movement of water vapor within the tank when an external magnetic field was induced. The daily correlation between specific humidity and the standard deviation of the y component of magnetic field was identified to be >50% in all of 5 selected locations. The long-term pattern analysis between the standard deviation of x, y components of magnetic field and specific humidity shows a very similar trends with 86.31% correlation and approximate lag time of 30 days. This theoretical result was further established through the induced magnetic cloud chamber that showed signs of change in the movement of cloud when magnetic field was induced with varying fluctuations.

BSE-18
Name: Austin King
Major: Computer Science
Home University: University of Memphis
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Henry Wan, Basic Sciences
Co-Author: Dr. Lei Li

Identifying with-in host evolution mechanisms of foot-mouth disease in cattle using Next-Generation Sequencing technology

Foot-and-mouth disease (FMD) is a viral disease that causes oral and pedal vesicles in livestock and poses an economic threat to farmers and livestock owners across the world particularly in parts of Africa and Asia. The agent that causes FMD is FMD virus (FMDV) and is known to be highly contagious and to rapidly affect other livestock capable of contracting the disease. In this study, we used Next-Generation Sequencing (NGS) technology to analyze emergences of mutations and polymorphisms in a group of FMDVs taken from tissue samples in different parts of cattle and from different days post infection (dpi). We then visualized those mutations and polymorphisms by temporal and spatial order to identify potential temporal patterns or tissue tropisms of polymorphisms. With our results we aim to identify issue dependent patterns or temporal patterns of amino acid polymorphisms from NGS data. We also aim to identify a deeper resolution of analyzing evolution pattern from NGS data rather than from the consensus sequences. Since FMDV has one of the highest mutation rates and there are constant mutations of FMDVs already out in circulation, it is extremely difficult to control and end this disease. However, by analyzing amino acid polymorphisms of FMDVs from NGS data we can better understand how FMDVs evolve and see how they evolve earlier on. This could help create a stronger anti-vaccine for the disease and help prevent economic and resource losses to the agricultural industry.

SS-04
Name: Miller Kinstley
Major: Agricultural Information Science
Project Category: Social Sciences
Faculty Advisor, Affiliation: Dr. Laura Greenhaw, School of Human Sciences
Co-Author: Dr. Melissa Moore

You Are What You Eat; Examining Purchasing Decisions of Restaurateurs

Consumer preferences in the retail market for specialty agricultural products have been thoroughly studied. However, little research has examined buying behaviors of the middle-man between the producer and consumer; restaurants. The purpose of this research was to understand the drivers of restaurateurs' purchasing decisions and specifically identify important marketing terms that influence those decisions. Research objectives were (a) describe how purchasing decisions are made by restaurants and (b) describe food product characteristics sought by food service establishments.
Research participants were purposefully selected for maximum variation, including geographical location, size, and type. The single inclusion criterion was that the menu contained a "niche" agricultural product term (e.g. organic, locally grown, cage-free, etc.) that referred to the production process, not dish preparation. Ten semi-structured qualitative interviews were conducted. A seven question moderator's guide was utilized. Interviews were audio-recorded and transcribed by the researcher. Open-coding was used for initial analysis of transcriptions. Two researchers coded the transcripts independently, noting recurring ideas and concepts. Codes were compared and themes identified and described.
Two prevalent themes were 1) Restaurateurs strive to develop and maintain a consistent, authentic identity; and 2) Restaurateurs build relationships to establish and support community. Participants in this research concerned themselves with purchasing locally grown products, and providing fresh, high-quality food to customers. Most did not purposefully included niche marketing terms on their menu, indicating that all or nearly all of their items fit one or more of those terms and as such, there was no need to identify them specifically. Establishing an identity as a restaurant that "does right" and uses local products to craft high-quality cuisine took precedence in decision-making. Additionally, participants did not target a specific consumer or market segment. In fact, they focused more on building community with local farmers as well as similar local-focused restaurants.

BSE-19
Name: Lyndsey Kowalczyk
Major: Wildlife & Fisheries Science/Pre-Veterinary
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Andrea Varela-Stokes, Basic Sciences; John Stokes, Basic Sciences

A Guinea Pig Model for Spotted Fever Rickettsiosis due to Rickettsia parkeri

Mice have been employed as models for the human immune response to infectious disease for decades. However, results can potentially mislead the investigator due to differences in immune systems. On the other hand, guinea pigs and humans share genetic similarities in both their innate and adaptive immune system, making the guinea pig a more suitable model. Further, unlike mice, the large size of guinea pigs allows for blood collection for multiple assays, at multiple times in a longitudinal study. In this pilot study using guinea pigs, we developed a flow cytometric assay and analyzed the clinical and immune response to *Rickettsia parkeri*, a tick-borne agent of spotted fever rickettsiosis (SFR). Gulf Coast ticks were placed on two of three guinea pigs for transmission of *R. parkeri*. Guinea pigs received a primary exposure and a secondary exposure to *R. parkeri*-infected ticks 31 days later. During the study, clinical signs exhibited by the guinea pigs were recorded. We extracted DNA from blood and ear skin samples, which were collected once a week, and performed TaqMan qPCR to determine if the guinea pigs were infected with rickettsiae. Blood was also used in a six-color flow cytometric assay to identify and quantify immune cell populations. Preliminary qPCR data showed evidence of infection in exposed guinea pigs. Clinical signs included lethargy during the initial tick exposure, slight elevations in body temperature, and development of an area of necrosis (eschar) at the tick bite site. Based on these data, we show that the guinea pig is a more rational model to demonstrate clinical disease with SFR. We are currently expanding our flow cytometric assay to 8 colors by using labeled nucleic acid probes for a more in-depth picture of the immune response in guinea pigs. Further enhancements to the guinea pig model of SFR will follow.

PSE-24
Name: Cody Layne
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Todd Mlsna, Chemistry
Co-Author: Amali Herath

Removal of chromium from aqueous systems by potassium hydroxide activated biochar

Biochar has become a popular topic of research in sustainable chemistry due to its uses in agriculture and pollution reduction. Biochar is a porous, carbon rich material that can be easily modified through chemical treatment to adjust its surface area and pore size. Maximizing these two parameters is important as they have been shown to increase biochar's ability to remove unwanted contaminants from water, such as chromium ions. Chromium, especially chromium (VI), is a toxic metal which affects the respiratory system, and is a common industrial waste in metal plating, the manufacturing of dyes, and leather and wood treatment. Fast pyrolysis Douglas fir biochar (DFBC) was activated with potassium hydroxide by soaking it at room temperature in a solution of KOH dissolved in distilled water. The mixture was then thermally treated in a muffle furnace at 500 °C, under nitrogen flow. The resulting KOH treated biochar (KDFBC) was then ground to particle sizes between 0.1 and 0.5 mm and characterized though scanning electron microscopy, transmission electron microscopy, energy dispersive X-ray spectroscopy, and point of zero charge analysis. BET surface area calculations showed that KDFBC (1049 m^2/g) had a higher surface area than that of DFBC (535 m^2/g). Batch sorption studies for chromium ions were carried out at pH values ranging from 2 to 11 at a chromium concentration of 75 ppm, with varying mixing times. The amount of chromium adsorption by the two biochars was determined by analyzing the saturation of color in the filtrate by UV-Vis spectrophotometry. Multiple adsorption isotherm models were used to calculate the maximum adsorption capacity of chromium by KDFBC, and it was found that KOH treated biochar exhibited higher adsorption capacity towards lead than that of normal biochar.

PSE-25
Name: Trace Lee
Major: Physical Education, Kinesiology
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Adam Knight, Kinesiology, Center for Advanced Vehicular Systems
Co-Authors: Jeff Simpson, Harish Chander, Ethan Stewart, Bo Balducci, David Macias

Muscle activation of the ankle musculature: A comparison of unexpected and expected single leg landings on a tilted surface

The purpose of this study was to examine ankle muscle activity during unexpected and expected inversion perturbations. Twenty three participants with no history of a lateral ankle sprain completed the study. Participants performed a step-down task, starting on 24 inch high platform, stepping down 12 inches onto another platform with their testing limb, and then stepping down another 12 inches onto the ground. Two platforms were used: a flat platform and a tilted platform rotated 25° in the frontal plane to safely replicate the mechanism of a lateral ankle sprain. Muscle activity of the tibialis anterior, medial gastrocnemius, peroneus longus, and peroneus brevis were measured using a Noraxon wireless electromyography (EMG) system. Each participants' maximum voluntary isometric contraction (MVIC) was measured for each muscle. A maximum of 10 step-down trials were performed onto the flat platform, with one trial randomly selected to use the inverted platform without the participants' knowledge (unexpected trial). Immediately following the unexpected trial, participants performed another step-down trial onto the tilted platform in which verbal instruction was given to participants of the platform they would be landing on (expected trial). Mean muscle activity of each muscle was normalized to each participants MVIC from 200 ms prior to (pre-landing) and 200 ms after landing (post-landing). Paired samples t-tests were used to compare muscle activity pre-landing and post-landing between unexpected and expected landing conditions. Results showed significantly greater tibialis anterior activity for the expected condition than the unexpected condition during the pre-landing period ($p=0.031$), while muscle activity of the peroneus longus was significantly greater during the unexpected condition in comparison to the expected condition during the post-landing period ($p=0.017$). These results indicate different motor control strategies are used when a potentially injurious perturbation is expected.

BSE-20
Name: Stephanie Leedom
Major: Biological Sciences
Home University: Millersville University
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Mark Welch, Biological Sciences
Co-Authors: Anna Jackson, Mallory McKinney, Giuliano Colosimo

Tenderly Tucked Tidelands and Tropical Terrain: The Impact of Life History on Measures of Population Diversity in *Spartina alterniflora*, *Juncus roemerianus*, and *Cyclura lewisi*

With an ever-increasing human population, anthropogenic disturbance impacts a growing number of habitats that provide key ecosystem services. Decreased species diversity across all biological kingdoms remains an inevitable consequence. For the purposes of habitat maintenance and restoration, it is important to maintain or restore genetic stock to a healthy state capable of surviving a range of environmental conditions, especially for species that play pivotal roles in their ecosystems. Conservation efforts must be concerned with allelic richness, linkage disequilibrium (LD), and effective population size (N_e) because these parameters should correlate with the adaptability of populations. Here, we consider these relationships in two native salt marsh plants, *Spartina alterniflora* and *Juncus roemerianus*, for the restoration of compromised salt marshes along the Mississippi Gulf Coast and in the founder population of the endangered Grand Cayman Blue Iguana, *Cyclura lewisi*, an important seed disperser for dry Caribbean forest species. Using standard DNA extraction and polymerase chain reaction (PCR) methods followed by genotyping at 21 neutral microsatellites, we were able to estimate allele frequencies, LD, and N_e. Our preliminary results for *S. alterniflora* indicate the presence of a population with higher genetic diversity when compared to other native populations from the Mississippi, Louisiana, Alabama, and Florida Gulf Coast, and we expect to locate a population of *J. roemerianus* that is similarly robust. In *C. lewisi*, inferences from measures of relatedness among individuals and potential hybridization with closely related species will be of considerable value when selecting individuals to cross. Information gathered from this study of populations with dissimilar modes of reproduction (clonally or sexually in *S. alterniflora* and *J. roemerianus* and sexually in *C. lewisi*) highlight ways in which the life histories of different species can influence allelic richness, LD, and N*e*, ultimately limiting the adaptive responsiveness that should be anticipated from populations of concern.

BSE-21
Name: Alexis Lewis
Major: Biological Sciences
Home University: Albany State University
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Heather Jordan, Biological Sciences
Co-Author: Laxmi Dhungel

Investigating role of mycolactone in polymicrobial interaction of Mycobacterium ulcerans with Pseudomonas aeruginosa

Buruli ulcer disease (BUD) is a necrotizing skin lesion caused by *Mycobacterium ulcerans* (MU). The disease has been reported in over 33 countries worldwide and is mainly endemic in West Africa. The disease is called a 'mysterious disease' due to its unknown mode of transmission and ecology. The major virulence factor of MU is mycolactone, a lipid toxin whose genes are encoded on the large plasmid pMUM001. It has been suggested that mycolactone was acquired during evolution from its *M. marinum* progenitor. Mycolactone is immunosuppressive and is responsible for painless characteristics of BUD. Studies have shown that BUD is colonized by pathogens such as *Staphylococcus aureus* and *Pseudomonas aeruginosa*, which are well known to cause skin and soft-tissue infections, with characteristic pathology. However, the inability of these pathogens to cause any disease pathology in BUD is intriguing and suggest mechanisms of MU to attenuate pathogenesis of these bacteria. Experiments in our lab have shown the ability of mycolactone to downregulate expression of *S. aureus* virulence genes such as *agr*, *SaeR* and *hla* without inhibiting its growth. Hence, the aim of this study was to investigate the effect of mycolactone on growth of another co-colonizing pathogen, *P. aeruginosa*, and its virulence genes *las* and *rhl*. These virulence genes are involved in quorum sensing mechanisms, mechanisms responsible for bacterial cell- to- cell communication. To obtain the objective, mycolactone was added to *P.*

aeruginosa in early log phase and compared the *las* and *rhl* gene expression and biofilm formation with control. Measuring mycolactone effects on *P.aeruginosa* quorum sensing genes is important for understanding the role of normal flora in determining BUD pathogenesis. Further, it will provide insight into polymicrobial interactions of MU within its natural environment and during infection of human host. The study will also aid to understand BUD treatment outcomes.

BSE-22
Name: Olamide Lewis
Major: Biochemistry
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Renita Horton, Agricultural & Biological Engineering
Co-Author: Joey Reed

Using an in vitro model to investigate food insecurity in the United States

Food insecurity is a growing issue in the United States, according to the United States Department of Agriculture, approximately 14% of American households are food insecure. In Mississippi, it is estimated that 18.7% of households are considered food insecure. The poor diets that result from food insecurity can lead to a number of health complications such as increased rates of iron-deficiency anemia, acute infection, and cardiovascular diseases.

This study aims to create a biomimetic vasculature chip containing simplified branching geometries that mimic the mechanical and structural properties of the native vasculature. This chip is composed of enzymatically crosslinked gelatin. Microbial transglutaminase, an enzyme that catalyzes crosslinking between lysine and glutamine residues, is used to thermally stabilize gelatin thus allowing this chip design to withstand cell culture conditions (37°C). Additionally, mTG allows for mechanical tuning to closely match *in vivo* mechanical properties. Using soft lithography techniques, the crosslinked gelatin is used to create a model vascular network. Briefly, the gelatin/mTG solution is poured onto a polymer mold. Once the gelatin hydrogel is formed, the polymer mold is removed. The molded gelatin is then bound to a gelatin coated cover glass, creating the gelatin based microvascular model. Endothelial cells will then be seeded into the channels and allowed to form a confluent monolayer, the engineered vasculature. The monolayer will then be exposed to a nutrient deficient microenvironment. Genetic, morphological, and functional changes will be assessed to determine the effects of a nutrient deficient diet on the model vasculature. This study will help to identify mechanisms that contribute to cardiovascular disease using a biomimetic vasculature platform.

BSE-23
Name: Norman Lewis II
Major: Biochemistry, Molecular Biology
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Carrie K. Vance, Biochemistry, Molecular Biology, Entomology, & Plant Pathology
Co-Authors: Allison R. Julien, Andrew J. Kouba, Jean M. Feugang

Non-invasive invo quantum dot imaging

Due to their sensitivity to biological contaminants and rapid large reproductive output, amphibians are a useful model species for studying novel biological procedures. Currently, the search for an efficient method of minimally invasive, non-lethal imaging of living systems has led to interest in the application of Quantum dot nanoparticles (QDs). Fluorescent QDs have great potential as a tool for biological imaging. Male Fowler's toads were administered both hormonally conjugated quantum dots and non-targeted quantum dots (QDot 655) as a method of tracking nanoparticle movement through the toad's body. The In-Vivo Imaging System (IVIS) was used to observe the movement of QDots at various time intervals. Fluorescent signal from conjugated nanoparticles remained localized near the point of injection, while the unconjugated QDots diffused further over the body cavity. Following IVIS imaging, various organs were removed from the subjects in order to confirm the presence and aggregation of QDots compared to unconjugated QDots in these organs using a fluorescence microscope. This study provides vital insight into the pattern of distribution of unconjugated and conjugated QDs in respect to in-vivo imaging, and further advances the understanding of nanotechnology as an efficient minimally invasive, non-lethal method.

BSE-24
Name: Lauren Lindsey
Major: Biological Sciences
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: E. David Peebles, Poultry Science
Co-Authors: Katie C. Elliott, Seyed A. Fatemi, Peter O. Ishola, Patrick D. Gerard

Relationship between Incubation and Embryo Temperature in Broiler Chickens

The standard temperature to incubate broiler hatching eggs has traditionally been 37.5°C. However, incubating eggs containing highly selected modern strain broiler embryos at 37.5°C may be too high due to their increased growth rate and associated production of metabolic heat. The purpose of this experiment was to determine if lowering incubation temperature has a direct effect on the body temperature of fast growing modern strain (Ross 708) broiler embryos throughout incubation, and if it impacts hatching performance. This was accomplished by telemetric technology, using temperature transponders that were aseptically implanted in the air cells of Ross 708 broiler hatching eggs. From 0 to 12 days of incubation, all eggs were incubated under standard conditions in a common incubator. Between 12 and 18 days of incubation, 120 eggs received transponder implants, with 30 eggs incubated in each of four incubators: two at 37.5°C and two at 35.6°C. Transponder readings were recorded thrice daily with a wireless probe. Fertile egg hatchability was 100% and 93.3% in the 37.5°C and 35.6°C treatment groups, respectively. Mean hatch time was delayed 9 hours at the lower temperature, and embryo temperature was significantly ($P \leq 0.0001$) lower in the 35.6 than in the 37.5°C treatment group. A significant ($P \leq 0.0001$) positive correlation existed between incubation and embryo temperature in the 37.5°C treatment group, but did not exist ($P = 0.4553$) in the 35.6°C treatment group. Nevertheless, embryo temperature in both treatment groups increased similarly over time during the 12 to 18 day incubation period. Incubating Ross 708 eggs at 35.6°C may be economically advantageous in commercial hatcheries, but a short delay in hatch time may be realized along with a greater dependence on the energy reserves in the egg to maintain embryo body temperature.

PSE-26
Name: Qiuhong Lu
Major: Chemistry
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Colleen Scott, Chemistry
Co-Author: Nazanin Mokhtarpour

Synthesis and evaluation of electron deficient siloles for application as n-type materials

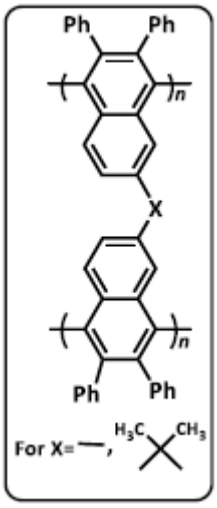
Organosilicon compounds play an important role in chemistry as vital synthetic precursors for many organic reactions, drug candidates, and organic materials. These compounds have long been demonstrated to be efficient materials for use in organic electronic devices as light emitting diodes (LEDs) and sensors due to their aggregation-induced emission (AIE) properties. Recently, they have been shown to have applications as biological probes and in cellular imaging. The significance of siloles and silole-containing polymers are well documented in the literature; however, there still remains a challenge in the efficient synthesis of these compounds. We have been investigating the synthesis of siloles and silole-containing polymers with interesting optoelectrical properties for applications in electronic devices. Our interest in siloles and silole-containing polymers for photovoltaics and organic light emitting diodes (OLEDs) is due to their low band gap and strong emissive properties. The lowing of the band gap is a result of the interaction between the σ*-orbital of the silicon-alkyl bonds and the π-orbitals of the butadiene backbone, which leads to a lowering of the LUMO orbitals. We have recently demonstrated that our polymers performed as good p-type or hole transport materials.

This project investigates the synthesis of electron deficient silole-containing molecules for use as n-type or electron transport materials in organic devices. The major goal for this summer research is to address the synthetic challenges for electron deficient siloles. We will present our findings on the 4-step preparation of the electron deficient silole precursors and our evaluation of their ability to undergo the ring forming reaction to make electron deficient siloles.

PSE-27
Name: Joy Massey
Major: Chemical Engineering
Home University: Tuskegee University
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dennis W. Smith, Jr., Chemistry
Co-Authors: Ketki Shelar, Behzad Farajidizaji

Synthesis and Characterization of Bis-ortho dinylarene-derived Glassy Carbon Polynaphthalene Microstructures for Composites

A major goal of this project is to synthesize high-carbon content polynaphthalene networks that are suitable for diverse applications, including composite applications. As this polymer has high carbon content with extreme thermal and oxidative stability, it is an ideal turbostratic carbon matrix that can be used in carbon-carbon composites. To achieve this, selective o-bromination of bisphenol, followed by quantitative triflate esterification, and palladium-mediated Sonagashira-coupling on phenylacetylene were carried out resulting in the formation of enediynes. Subsequently, polynaphthalenes were prepared from enediynes by thermal intra-molecular Bergman cyclopolymerization. Suitable temperature range for the polymerization reaction was determined by the detection of polymerization exotherm using differential scanning calorimetry (DSC, 10 °C/min). The physico-chemical properties of the synthesized intermediates (enediynes) and polynaphthalenes were characterized by nuclear magnetic resonance (NMR) spectroscopy (^{1}H, ^{13}C, ^{19}F-NMR), infra-red (IR), and ultraviolet visible (UV-Vis) spectroscopy. The molecular weights (M_n and M_w) and polydispersity index (PDI) of the synthesized polynaphthalene networks were characterized by gel permeation chromatography (GPC). Thermal gravimetric analyses (TGA) carried out in both nitrogen (N_2) and air demonstrated exceptional thermal stabilities at high temperatures (900 °C). We are currently investigating the carbonization of BODA-derived polynapthalenes at 1000 °C, to obtain glassy-carbon microstructures, which are suitable for optical and electronic micro devices, in addition to carbon-carbon composites



BSE-25
Name: Jillian Masters
Major: Microbiology
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Jonas King, Biochemistry, Molecular Biology, Entomology, & Plant Pathology

Effects of aging on immune gene regulation in *Aedes aegypti*

Aedes aegypti is a mosquito that vectors several arboviruses of public health significance, including Mayaro virus, Chikungunya virus, Dengue virus, and Yellow Fever virus, among others. Identified by white markings on its legs and a lyre on the upper surface of the thorax, *A. aegypti* is found in tropical and temperate regions alike throughout the world,

including the United States. Only the female mosquitoes take a blood meal, a necessary component for laying eggs. Few studies have been published on accurately aging *A. aegypti*, fewer still on accurately aging mosquitoes caught in the wild. These studies have relied on morphological techniques as well as next generation sequencing based methods. These studies have suggested that immune cells and the general function of the immune system changes with some predictability as mosquitoes mature. The goal of this ongoing study is to obtain accurate data with which to age-grade mosquitoes in the wild, with a starting point of studying immune genes of mosquitoes reared in a standard laboratory setting. The study presented observes changes of eight immune genes in *A. aegypti* as the population ages. Two separate groups of mosquitoes were reared under standard laboratory conditions, with one group having a blood meal at day 5 of the rearing sequence and the other group having only a 10% sugar solution throughout the rearing period. All immune genes were measured using SYBR green qRT-PCR. Several genes of interest include VIR-1, PIWI4, and PPO1, which all change in variable amounts as the mosquitoes age. Specifically, PIWI4 increases throughout the experiment in the blood-fed population. Additional results will be presented.

PSE-28
Name: Sarah McClain
Major: Biological Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Xin Cui, Chemistry

Modular Design and Synthesis of Bioinspired Ruthenium Half-Sandwich Catalysts
New ruthenium half-sandwich catalysts are being developed for selective transformations, new synthetic routes, the study of C-H functionalization, and as possible anti-cancer drug candidates. These new catalysts have around ten synthetic steps involving palladium-catalyzed cross coupling and metalations. Due to the palladium catalysts used in most reactions, a nitrogen atmosphere is required for the reactions to be successful. Afterwards, an aqueous workup, silica column chromatography, and various NMR analyses are required for purification and identification. Each ruthenium catalyst has a carbon backbone that can be altered as needed and used as a ligand to attach the ruthenium center. Throughout the summer, work has been done to create these ligands and catalysts while also focusing on optimizing key steps in these syntheses. A novel route was optimized to build the ligand backbone, which will replace a rather difficult step of creating a boronic acid substrate onto the carbon backbone. This is a key step in determining the length, and later, selectivity of the ruthenium bonds. This step as optimized with no ligand, a reaction time of 4 hours at 100°C, and tetrahydrofuran as the solvent. This new reaction allows for a higher ^{1}H NMR percent yield, lower cost, and easier purification. New catalysts will continue to be synthesized and will later be tested as anti-cancer drug candidates.

BSE-26
Name: Erin McDevitt
Major: Biochemistry
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Trey Howell, Basic Sciences, College of Veterinary Medicine
Co-Authors: Aren Worrell, Darian Young, George Howell III

Exposure to the organochlorine compound trans-nonachlor alters macrophage activity
Type 2 diabetes, characterized by insulin resistance and chronic activation of the immune system, is increasing in prevalence world--wide. Numerous studies have shown correlation between exposure to pesticides and the development of type II diabetes. It is also well documented that with the activation of the immune system in obesity comes an increase in inflammatory M1 macrophage activity within adipose tissue;; however, the effects of pesticides on this mechanism of obesity have not been extensively examined. Therefore, the present study was designed to look into the effect of the organochlorine metabolite trans--nonachlor on immune system activity with a focus on macrophage function. The effects of various concentrations (0 to 20uM) of trans--nonachlor on lipopolysaccharide (LPS) activated and non--LPS activated J77A4.1 macrophages was examined. Indices of macrophage function included phagocytosis, ROS (reactive oxygen species) generation, mitochondrial membrane potential, and cytokine expression. Exposure to trans--nonachlor produced a decrease in mitochondrial membrane potential with

increasing trans--nonachlor concentration and a resulting increase in ROS generation with increasing concentration, as well as an increase in macrophage phagocytosis corresponding with trans--nonachlor concentration. Additionally, expression of *Tnf* and *Il6* increased following trans--nonachlor exposure while expression of Nos2 decreased. This present data suggests that the organochlorine metabolite trans--nonachlor may increase macrophage activity, which in turn may promote chronic inflammation and insulin resistance and lead to the development or exacerbation of type II diabetes.

BSE-27
Name: Maggie Mills
Major: Biochemistry
Home University: University of North Carolina Chapel Hill
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Sorina Popescu, Biochemistry, Molecular Biology, Entomology, & Plant Pathology; Dr. George Popescu, Institute for Genomics, Biocomputing & Biotechnology
Co-Author: Thualfeqar Al-Mohanna

Determining the Dimerization Mechanism of TOP1 and TOP2

In plants, exposure to environmental stressors such as pathogens, drought, high salt concentrations, and intense sunlight induce a stress signaling response that leads to an oxidative burst and apoptosis. Previous studies indicate that salicylic acid plays an important role in this response by inhibiting peptidase function of two thimet oligopeptidases, TOP1 and TOP2, by causing them to dimerize. Recent studies also imply that dimerization involves intermolecular disulfide bonds; however, the mechanism itself and specific cysteine residues involved are still unknown. To determine which cysteine residues are active in dimerization, point mutations were first prepared for each cysteine residue in TOP1 and TOP2 by site-directed mutagenesis. In each of these mutants, a single target cysteine was mutated to an alanine in order to retain similar structure while preventing formation of disulfide bonds. These mutants and controls were then exposed to various combinations and concentrations of reductants and oxidants in vivo, and the TOP proteins were subsequently purified. First, a screening for significant changes in monomer-to-dimer ratios will be performed using Western blots of native-PAGE gels for each mutant and control. We expect to identify TOP1 and TOP2 mutants that show significantly reduced amounts of dimer under oxidative stress when compared to the controls and other mutants, which will indicate that these cysteines have active roles in dimerization. We will use computer modeling and simulations to interpret the results of our SDM screen results and to relate structural changes (e.g. cysteine mutations, dimer formation, and protein folding changes) to TOPs activity (e.g. peptidase activity, thiol switching, and redox signaling). This combination of screening, modeling, and simulation will provide further insight on the dimerization mechanisms in TOP1 and TOP2.

BSE-28
Name: Mirghani Mohamed
Major: Biological Sciences
Home University: University of Connecticut
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Bindu Nanduri, Basic Sciences, College of Veterinary Medicine
Co-Authors: Mirghani F. Mohamed, Sarah Schmidt, Mary F. Nakamya, Moses B. Ayoola, Leslie A. Shack, Bindu Nanduri

Impact of impaired polyamine transport and synthesis on pneumococcal growth under pH stress

Streptococcus pneumoniae, a gram-positive bacterium and a commensal of human nasopharynx can cause invasive infections such as pneumonia, meningitis and sepsis, and poses a significant risk to human health. The bacterium's antibiotic resistance and serotype variance proves to complicate the effectiveness of therapeutic strategies. Polyamines, small cationic molecules present in both eukaryotes and prokaryotes, provide pleiotropic means of survival for cells such as combating acidic stress. Any impairment in de novo synthesis pathways or transport of polyamines like putrescine, spermidine, and cadaverine can be fatal for the organism. To better understand the impact of impaired polyamine synthesis (ΔcadA, ΔspeE) and transport (ΔpotABCD) on pneumococcal response to pH stress, growth curves of wildtype

strain (TIGR4), and isogenic deletion strains ΔpotABCD, ΔcadA and ΔspeE were generated in a culture medium of THY+5% yeast broth at different pH over a 24-hour period. Growth kinetics of all strains were analyzed by Growthrates 2.1 software. Our results show that the growth of polyamine metabolism impaired strains was affected by low pH compared to TIGR4. These observations indicate that polyamines modulate acidic resistance mechanisms in pneumococci. Quantitative reverse transcription PCR (RT-qPCR) will be used to analyze the expression of genes from TIGR4, ΔcadA, ΔpotABCD, and ΔspeE inoculated at low pH. With RNA as the starting material, we will analyze the variation in the expression of genes that contribute to acidic tolerance from each strain.

PSE-29
Name: Buckston Morgan
Major: Chemical Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor Name: Santanu Kundu, Chemical Engineering

Double Network Hydrogel using Acrylic Acid

Hydrogels attract great attention due to their soft and wet nature, similar to that of biomaterials. Recent innovations in several tough hydrogels show their potential as structural biomaterials, such as cartilage. In order for tough hydrogels to be used in biomedical applications, their required mechanical properties such stiffness, strength, toughness, damping, fatigue resistance and self-healing, along with biocompatibility are considered for every application. In this study, hydrogels were synthesized batch-wise with acrylic acid, methacrylamide, and poly-propylene glycol diacrylate. Sodium dodecyl sulfate was introduced to the polymer network to reduce the swelling, an issue presented in a water environment. The acrylic acid and methacrylamide is added followed by potassium persulfate in order to randomly co-polymerize the monomers at 75 °C. The resulting material displayed both hydrophilic and hydrophobic interactions, as well as a high tensile strength. The gel formations were physically characterized by Fourier Transform Infrared spectroscopy analysis and UV-Vis spectroscopy. Mechanical properties of the hydrogel were examined using shear rheology and tensile modulus analysis.

SS-05
Name: Alexis Murrell
Major: Civil Engineering
Project Category: Social Sciences
Faculty Advisor, Affiliation: Cliff Mckinney, Clinical Program, Psychology
Co-Author: Erica Szkody

Parental Attachment and Emotional Regulation on Affect after a Social Exclusion Task

Parental attachment influences emotion regulation and social attachment. Previous studies have examined the unified construct of parental attachment without examining the differential impact of maternal and paternal attachment. When individuals are socially excluded, individuals with emotion regulation difficulties may experience higher negative affect than individuals with fewer difficulties. Emotional regulation strategies are influenced by parental attachment through socialization of coping mechanisms. This study examined how parent-child attachment (reported by emerging adults) was associated with emerging adults' emotion regulation difficulties, as well as their positive and negative affect after a social exclusion task. Secure maternal attachment and emotional regulation difficulties were indirectly associated with negative affect after the social exclusion task. Results suggest that parental attachment can be a point of intervention for individuals affected by social exclusion. Further results and implications will be discussed.

PSE-30
Name: Shanika Musser
Major: Civil Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: John Ramirez-Avila, Civil and Environmental Engineering
Co-Authors: James Grafe, Sandra Ortega-Achury

How Do Grassed Riparian Zones Affect Stream Temperature?
The types of riparian zones along stream corridors can affect stream health. Forested headwater streams have particularly strong interactions with their riparian zones. The reduction in riparian cover vegetation could result in higher stream temperatures, potentially altering fish and macroinvertebrate communities. A study is performed to evaluate how the transition from wooded to grassed riparian zones affects stream temperature in two headwater tributaries of the Catalpa Creek. At stations along the tributary streams, parameters such as water temperature, dissolved oxygen, and pH were measured weekly with a YSI Sonde. Air temperature data was obtained from the Oktoc Weather Station. The results of this study will help determine whether implementing forested riparian zones along the streams would significantly benefit water quality in the Catalpa Creek Watershed.

BSE-29
Name: Thomas Nunn
Major: Biological Sciences
Home University: Centre College
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Mark Lawrence, Basic Sciences
Co-Authors: Hasan C. Tekedar, Salih Kumru, Andy D. Perkins

Comparative Genomic Analysis of Virulence Factors in the *Aeromonas genus*
Members of the *Aeromonas genus* are gram-negative, facultative anaerobic, rod-shaped aquatic bacteria with a plethora of known virulence factors. *Aeromonas* has been isolated from a wide array of sources: sediments, various foods, fish, drinking water, and humans. For instance, *Aeromonas hydrophila* is currently ravaging various aquaculture systems in the U.S. and China, resulting in large economic losses. Virulence factors are bacterial components that play an important role in infection. To identify virulence factors for specific species, we undertook a novel analysis of the entire available *Aeromonas genus* using current bioinformatic methods. To conduct this approach, 276 *Aeromonas genome* sequences were retrieved from NCBI and searched against VFDB (Virulence Factors Database) using the BLAST method. Unique virulence factors were identified for each *Aeromonas* species, as well as core virulence factors that are promising for development of a novel vaccine. In summary, the current research has potential to alleviate stress *Aeromonas* has caused to the global commercial aquaculture industry and decrease the risk of human infections.

PSE-31
Name: Andre Orr
Major: Chemistry
Home University: University of Tennessee at Martin
Project Category: Physical Sciences and Engineering
Faculty Advisors, Affiliation: Dr. Deb Mlsna, Chemistry; Dr. Todd Mlsna, Chemistry
Co-Authors: Cintly Guzman Hernandez, Glenn Crisler, Timothy Shauwecker, J. Casey Johnson, Darrell Sparks, Todd Mlsna

Phosphate in Soils: An Undergraduate Exploration According to Soil Texture and Amendment
Tackling real-world problems can make learning benchtop science more tangible and meaningful for students. Agricultural practices use fertilizers to provide three essential plant nutrients-N, P, and K. Just as applying fertilizer to gardens and farms helps crops grow, P lost through runoff and leaching entering lakes and rivers feed the growth of algae, bacteria, and other organisms. Water bodies require some nutrients to be healthy, but too much can be harmful causing eutrophication. Many states regulate the amount of phosphate allowed in their waters and require farmers to

abide by specific phosphate standards to remain in compliance with federal law. Researchers have been investigating the use of biochar, slag, and other binding agents for the sequestering of phosphate in the runoff.
The objective of this project was to design an undergraduate lab to show how phosphate is retained naturally in soils through the equilibrium processes with organic materials, and clay edges. Students in this lab would use the UV-Vis and the Beers Law calculation to determine the concentrations of phosphate present in a soil sample with and without amendments. Additionally, slag and biochar would be compared so students could see how these amendments can both a) increase the plant available fraction of phosphate and b) minimize its leaching from the root zone. The slag and biochar amendments are both phosphate specialized adsorbing materials that can be used as a method to not only limit runoff but to also limit the overall amount of phosphate that needs to be added to soils. This real word design experiment demonstrates the complexity and unpredictability of real issues, will stimulate critical thinking and allows students to think about solutions rather than just focusing on the problems.

PSE-32
Name: Sam Ozier
Major: Chemical Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Hossein Toghiani, Dave C. Swalm School of Chemical Engineering
Co-Authors: Dr. Tingyu Liang, Dr. Yizhi Xiang

Transient Kinetic Study of Ethane and Ethylene Aromatization over Zinc Exchange HZSM-5 Catalyst
Due to the current shale gas revolution, the production of natural gas components has received an increase, surpassing its consumption rate. The resulting growth of Natural Gas Liquids (NGLs) within the United States has decreased the prices of ethane and ethylene. With these compounds, efforts have been made to convert them into more lucrative chemical feedstocks. Using the present opportunity, prior research has been invested into the direct conversion of the natural gas products to benzene, toluene, and xylene (BTX). However, a detailed kinetic study of the reaction steps involved in these conversions has not been thoroughly invested. This paper observes the conversion of ethane and ethylene to aromatics over a zinc exchanged HZSM-5 catalyst via transient kinetic analysis in a flow reactor under atmospheric pressure. Based on quantitative back-transient decay analysis, the rate constants for the formation of BTX from their corresponding surface intermediates have been calculated for both reactions at different temperatures. According to the Arrhenius equation, the activation energies for the formation of benzene and toluene are 57 and 73 kJ/mol, and 53 and 44 kJ/mol, respectively from ethane and ethylene aromatization. Xylene's production is only minimal during ethane aromatization, but its relevant presence in ethylene's conversion provided cause for kinetic analysis. For the discussed reaction, the Arrhenius equation has determined the activation energy for xylene to be 35 kJ/mol.

PSE-33
Name: Jaylen Pennisson
Major: Biological Sciences
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Chanaka Navarathna, Chemistry
Co-Authors: Chanaka Navarathna, Charles Dotse

Adsorption of phosphates onto Mg/Al-sulfate/hydroxide impregnated Douglass fir. Biochar
The most common eutrophication causing nutrients are nitrates and phosphates that are found in fertilizers and detergents. Phosphate removal using Douglas fir biochar treated with NaOH and different ratios of Mg/Al sulfate (5 % w/w) has been studied. The composite with the highest phosphate adsorption at pH 7 and 25 °C was Mg/Al 2:1 at pH 13 (AMBC), and was subjected to several batch sorption experiments. Phosphate removal of the AMBC with different initial pH concentrations, contact time, equilibration temperature and initial concentration of phosphate was determined. The percentage of removal is found to gradually increase with the pH. The optimum pH was found to be 11 with 95 % phosphate saturation achieved in 15 minutes- following a pseudo-2^{nd}-order kinetics model. Sorption data was best fitted into the Sips isotherm model giving a 41.8 mg/g capacity at 25 °C and pH 11. The adsorption affinity was correlated with temperatures by using van't Hoff's plots, and sorption was determined to be of an endothermic and spontaneous

nature. Phosphate sorbed and virgin adsorbents were characterized by: BET, Elemental analysis, XRD, SEM, TEM, EDS, XPS and, TGA. The exhausted AMBC composite has a potential to recycle as a slow-release phosphate fertilizer which could be part of an environmentally friendly alternative agricultural management plan.

BSE-30
Name: William Pigott
Major: Wildlife & Fisheries Science, Conservation Law Enforcement
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Kristine Evans, College of Forest Resources
Co-Authors: Dr. Loren W. Burger, Isabella Durham

2018 Native Prairie Pollinator Plant - Experimental Plot Study (Prairie Wildlife, Clay Co., MS.)
Pollinators provide an important ecosystem service to agricultural producers in the U.S. Land conservation programs like the Conservation Reserve Program Conservation Practice 42 (CP42) (Pollinator Habitat) provide financial incentives to landowners to convert agricultural land into pollinator friendly plant species. Presently, Mississippi landowners enrolling in CP42 must use expensive seed mixes developed in other regions, with limited knowledge on their establishment feasibility in Mississippi soils. This study aims to 1) assess establishment rates of native plant species in the Black Belt Prairie region of Mississippi to ensure an efficient investment; 2) identify timing of blooms and blooming rates for plant species throughout the summer to ensure pollinator access across the season; and 3) examine the visitation rates of pollinator groups to target prairie plant species to determine preferred plant species. We used a randomized complete block design to evaluate 30 native pollinator plant species in $10m^2$ plots in 5 different blocks on fields in Clay County, MS from May – July 2018. We surveyed four 1 m2 subplots in each plot once and measured stem numbers of target plant species, and percent cover of the target species, grass, bare ground, and non-target forbs. We also conducted 5min visitation surveys for groups of insect pollinators on 2 subplots in one randomly selected plot with evidence of flowering weekly and recorded the number of unique visitations per blossom by monarchs, bumble bees, true butterflies, and other bees and wasps. Our analyses will include a mixed model regression with multiple comparisons with number #stems/m2 as the response variable, species and week as categorical fixed effects, and block as a random effect. Information on establishment rates, bloom times, and visitation rates will be pivotal to informing efficient and effective practice standards for pollinator practices under state and federal conservation incentives programs.

BSE-31
Name: Luke Redwine
Major: Computer Engineering
Project Category: Biological Sciences and Engineering
Faculty Advisor Name: Dr. Bryan Jones, Electrical and Computer Engineering

CodeChat
Much of programming lies behind a steep learning curve, which prevents many from entering the field of engineering. A large percentage of the problem lies within indecipherable walls of text synonymous with high-level programming languages. Literate programming allows programmers to provide an explanation of the program logic in a natural language like English with source code intermingled within a compilable file. While CodeChat, a tool which converts a program's source code to a web page, has been presented in earlier work, edits to the web page cannot yet be converted back to source code. This research focuses on providing this essential component. It contains tools for font size and style as well as changing the text. All changes made with the text editor are reflected in the source code. Directly editing the webpage vastly increases fluidity within the program and fosters the practicality of literate programming. CodeChat aims to become the word processor for programmers and to change the way programmers think about coding. By combining a programmer's thought process with their code in an easy to read manner, a programmer's skills can be quickly honed and greatly improved.

PSE-34
Name: Jacob Rogers
Major: Aerospace Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Donghoon Kim, Aerospace Engineering

Accurate and Cost-Efficient Indoor Positioning System Development for Autonomous Platforms
An indoor positioning system (IPS) is an effect way of localizing an object indoors since the Global Positioning System (GPS) is often unusable. This project is predominately concerned with the development of a low cost and accurate sensing system for autonomous platforms that operate indoors or in locations impenetrable by GPS signals. The ranging sensors chosen for the project are introduced and justified. The IPS constructed uses ultra-wide band (UWB) ranging sensors to provide the distance measurements needed for trilaterating the position of a tagged object. Without any research and modification, the UWB can locate the position of a tag within approximately ten centimeters of accuracy. This inaccuracy is a direct result of noise encountered by the UWB sensors; therefore, computational filtering is applied to the distance measurements to mitigate the noise. Experimental tests conducted to collect measurement data are discussed, and an appropriate filter is selected. Using the filtering algorithm, the noise is reduced thus yielding lower standard deviations and better localization. By increasing the accuracy of the UWB sensors through noise filtering, the IPS at hand becomes a more stable and robust environment.

BSE-32
Name: Marisa Ruane - Foster
Major: Biochemistry
Home University: Clarkson University
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Federico G. Hoffmann, Biochemistry, Molecular Biology, Entomology, & Plant Pathology
Co-Authors: Mary Clay Bailey, Amanda Coward Black

Carcinogenic mutations in the RAF paralogs map to highly conserved regions of the protein
The RAF (rapidly accelerated fibrosarcoma) gene family of kinase proteins is of biomedical interest because of their role in cancer and their potential as targets for cancer treatment. There are three RAF copies in most vertebrates, A-, B-, and C-RAF, all involved in signaling pathways related to cell proliferation. The RAS-RAF-MEK-ERK pathway is a signal transduction cascade which ultimately results in cell growth, differentiation, and survival. This pathway relies on the sequential recruitment and activation of each protein in the pathway, and RAF kinases play key roles in activating downstream proteins. Because mutations in these genes create potential for cancer to develop, they are referred to as proto-oncogenes. Interestingly, there are three RAF copies in vertebrates, while invertebrates have only one. We characterized when and how the vertebrate genes likely diverged into three separate, uniquely functioning paralogs using a combination of bioinformatic methods. The three paralogs have both overlapping functions (e.g. forming complexes with MEK to activate ERK) and essential non-overlapping functions (i.e. A-RAF and C-RAF have MEK-independent pathways to signal apoptosis), as made evident by mouse knock-out studies. Several tumors affiliated with RAF mutations have been identified, the vast majority of them in the BRAF gene, which is the prototypical paralog and the most potent ERK activator. In addition to understanding how vertebrate RAFs diverged, we also characterized the level of vertebrate variability at sites known to have amino acid substitutions which are associated with cancer in humans. We found that most cancer-associated mutations occur in the BRAF gene, and that they map to highly conserved regions of all three genes, which are in many cases arranged in clusters, which suggests these are relatively new mutations that affect critical functional domains of the protein.

PSE-35
Name: Kyle Ryker
Major: Aerospace Engineering
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Donghoon Kim, Aerospace Engineering, James Worth Bagley College of Engineering
Co-Authors: William Bell, Minjae Seo

Development of a Spherical UAV with a Pendulum Actuator System

Aviation science heavily relies on two concepts, thrust devices and control surfaces, to control the attitude and position of an aerial vehicle. The objective is to design and develop a spherical unmanned aerial vehicle (SUAV) exploring the possibility of controlling the center of gravity with a double gimbal pendulum system to maneuver the vehicle, and then to convert the systems to autonomy with a primary interest in autonomous operation indoors. A major issue with conventional UAVs is the potential for dangerous interaction between environment and the vehicle's structure. Quadcopters and other propeller dependent drones are susceptible to flipping or exposing fragile propellers to the environment. The SUAV seeks to eliminate this hazard by encasing the propeller in a harmless lightweight frame. In June, the current prototype of the SUAV was developed after analyzing a computer model to determine the feasibility of the concept. During July, the SUAV will be tested while manipulating the current design to improve the placement of the center of gravity. By the start of August, the SUAV will be able to hover while implementing minimal control surfaces for safe and efficient testing. Many variations for the pendulum system which controls the direction of thrust for the SUAV have been designed and tested with the importance of stability in mind. Future advantages to be developed include utilizing the spherical frame to roll the SUAV to readjust its heading for takeoff from an unrecoverable position.

BSE-33
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Major: Biochemistry
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Heather Jordan, Biological Sciences
Co-Author: Laxmi Dhungel

Investigating the Presence of *Mycobacterium ulcerans* DNA in environment samples from Buruli Ulcer endemic and non-endemic sites

Buruli ulcer disease (BUD), a necrotic skin disease, is caused by *Mycobacterium ulcerans* (MU). The disease has been reported in over 33 countries worldwide and is mainly endemic in West Africa. *M. ulcerans* is an environmental pathogen whose primary virulence determinant is a lipid toxin called mycolactone, which is encoded on a giant plasmid pMUM001. The disease is known as a 'mysterious disease' due to gaps in knowledge regarding MU reservoir and ecology, and unknown mode of transmission. BUD has been mainly associated with aquatic habitats. There are various postulated modes of transmission such as *via* insect vectors, direct contact with contaminated vegetation, aerosol, and entrance of the bacterium either through preexisting wounds or through skin puncture following environmental exposure. An environmental pathogen such as MU may cause disease in humans when susceptible hosts are exposed to the environment containing the pathogen. Studies have demonstrated presence of MU DNA in the saliva of water-dwelling invertebrates from family Belostomatidae that can bite humans. Hence, understanding the reservoir and source of MU in the environment is important to understand BUD pathogenesis. Our study focusses on detection of MU DNA in various environmental sources such as soil, water filtrand, macrophytes, and arthropods from family Belostomatidae collected from BUD endemic and non-endemic sites. We first isolated DNA from these samples, then performed qPCR targeting IS*2404*, an insertion sequence found in multiple copies on the MU chromosome and plasmid. Those positive were further analyzed for the presence of mycolactone through targeted detection of the enoyl reductase (ER) gene. Determination of the presence and abundance of MU DNA on environmental sample is important to determine the environmental niche or reservoir of MU, and for the development of effective prevention strategies.

BSE-34
Name: Hannah Scheaffer
Major: Biochemistry
Project Category: Biological Sciences and Engineering
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Inhibition of CES1-catalyzed Prostaglandin D_2 Glyceryl Ester (PGD_2-G) Hydrolysis in Human THP1 Monocytes to Regulate Anti-Inflammatory Responses

Monocytic cells in human blood have important roles in host defense and contain the enzyme carboxylesterase 1 (CES1). CES1 plays a critical role in the metabolism of many molecules, including lipid mediators called prostaglandin glycerol esters (PG-Gs). During the breakdown of PG-Gs, glycerol and prostaglandins are liberated into the cell. The buildup of prostaglandins in cells can be harmful because they have been shown to play a role in inflammatory responses in the body. Our hypothesis is that by blocking the ability of CES1 to hydrolyze PG-Gs, the amount of prostaglandins found in cells will decrease. In our study, the goal was to determine whether an anti-inflammatory prostaglandin glycerol ester, PGD2-G, is catabolized by CES1 into PGD2 and glycerol, and to determine the degree to which the PGD2 production could be inhibited. A human monocytic cell line (THP1 cells) was treated with increasing amounts of small-molecule inhibitors that block CES1 activity, chlorpyrifos oxon (CPO), WWL229, and WWL113, followed by incubation with PGD2-G (10 uM). Organic solvent extracts of the treated cells were prepared and analyzed by LC-MS/MS to assess PGD2 levels. Also, THP1 monocytes with normal CES1 expression (control cells) and knocked down CES1 expression (CES1KD cells) were employed to show CES1's role in PGD2-G metabolism. It was hypothesized that PGD2-G could be hydrolyzed by CES1 and the production of PGD2 in the cells would decrease in an inhibitor concentration-dependent manner. We found that CES1 has a prominent role in PGD2-G hydrolysis in THP1 cells, accounting for about 50% of its hydrolytic metabolism, and PGD2 levels progressively decreased as the inhibitor concentration increased. The most potent inhibitor assessed was CPO and WWL229 was the least effective. These results suggest that anti-inflammatory effects caused by PGD2-G can be augmented by modulating CES1 activity with specific inhibitors.
[Research support was provided by the Shackoul's Honors College and NIH R15GM128206]

BSE-35
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Project Category: Biological Sciences and Engineering
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Co-Authors: Moses B Ayoola, Mary F Nakamya, Leslie A Shack, Andy Perkins

Impact of Impaired Polyamine Transport and Biosynthesis on Carbohydrate Metabolism and Identification of Genes Potentially Regulated by Polyamines in *Streptococcus pneumoniae*

Streptococcus pneumoniae bacteria naturally inhabit the human nasopharynx, yet cause millions of infections each year when other areas of the body are exposed to the pathogen. Current vaccines target the polysaccharide capsule but only recognize 13 of the 94+ serotypes. Polyamines interact with DNA, RNA, and proteins to regulate cellular processes such as capsule synthesis and carbohydrate metabolism. Impaired polyamine metabolism affects these pathways and impacts bacterial virulence. A wild type *S. pneumoniae* strain and strains deficient in polyamine transport (*ΔpotABCD*) and biosynthesis (*ΔspeE, ΔcadA*) were used to study the effect of impaired polyamine metabolism *in in vitro* growth assays. Using different carbohydrate sources in chemically defined medium, we were able to study the impact and connections between polyamine regulation and carbon source on pneumococcal growth. Our results show a difference in growth for strains with impaired polyamine synthesis compared to wild type bacteria when using fructose, lactose, mannose, or trehalose as a carbon source. Since the host environmental niche of *S. pneumoniae* is incredibly diverse and available carbon sources vary widely, these results could help our understanding of pneumococcal adaptation to the host in a polyamine dependent manner. Polyamines in *E. coli* affect translational regulation using genomic features such as Shine-Dalgarno sequences, inefficient start codons, and nonsense codons. We generated custom Python scripts to identify similar features in the *S. pneumoniae* TIGR4 genome that potentially undergo translational regulation by polyamines.

BSE-36
Name: Abbey Schnedler
Major: Animal & Dairy Sciences
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Courtney Crist, Food Science, Nutrition and Health Promotion
Co-Author: Dr. Byron Williams

Qualitative Analysis of Water Treatment Practices Utilized in Processing Facilities in Mississippi

Water is an important ingredient in processed meat products yet the only requirement and specification for water is that it be potable. The addition of phosphates in processed pork products improves pH, water holding capacity, and overall yield. However, the phosphate-meat functionality utilized in marination can be reduced due to its ability to pre-react to cations in potable water. While recommended that processors use reverse osmosis, deionized or distilled water for marination, there is not a current treatment practice adoption rate in Mississippi using these technologies. The objective of this study was to investigate processor's adoption of internal water treatment and determine if water composition has influenced differences in product quality and yield. To begin, assessments were conducted at meat processing facilities (PF) (n=6) in different geographical regions in Mississippi. A plant visit and qualitative survey were used to determine management of water and marination activities. All (n=6) facilities, regardless of size or product output, did not utilize any additional internal water treatment. Reviewers found that 50% (n=3) used municipal water and 50% (n=3) used onsite private wells. Plants (n=3) that utilized onsite private wells did not indicate any issues with water consistency or product quality and yield; however, two of the three plants that utilized municipal water indicated problems regarding yield and other operating concerns. One plant (n=1) stated it encountered product yield loss when potable water composition and source was changed. Future research will examine and develop cost-effective water treatment guidelines for meat processing facilities.

BSE-37
Name: Angeline Smith
Major: Biological Sciences
Project Category: Biological Sciences and Engineering
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Co-Authors: Kaylee Bundy, Eric Lucas, Shecoya White, Seong Bin Park

The Impact of Dietary Arginine on Boar Semen Quality

As early as the 1970s, scientists demonstrated how the inclusion of supplementary arginine into the diet improves virtually all aspect s of fertility in males. In humans, the addition of dietary arginine supplementation has been correlated to increased sperm count, m otility, and number of ejaculations. In animal studies arginine has elicited an improvement in motility, morphology, and sperm count. This experiment examined the impact of dietary arginine on quality of boar spermatozoa. Stored frozen boar semen straws were ta ken from a nitrogen tank, thawed using a water bath, and then samples were diluted using thawing solution. Samples were then loa ded into a Ceros II Analyser (Hamilton Thorne, MA, USA) and HT Casa II software was used to microscopically analyze sample motility. Samples were then analyzed in the Guava easyCyte flow cytometer (Millipore Sigma, MA, USA). Two kits, Via Count and MitoDama ge, were used for further analysis of semen quality. ViaCount displayed the number of viable spermatozoa versus dead. MitoDamag e kit quantified the number of sperm cells undergoing apoptosis and mitochondrial potential of sperm. Microscopic analysis of sper matozoa produced ununiform, varying ranges of motility in controls and arginine treated boars. This infers that differences were not caused by treated and untreated semen samples, but instead, differences seen amongst individual boars. ViaCount percentages for all samples were roughly identical. Although deviations were detected in the volume of cells per milliliter, this could be due to the n umber of previous ejaculations and sperm count variations between boars. MitoDamage produced favorable results for both the co ntrol and treated samples concerning apoptotic cells, membrane integrity, and mitochondrial potential, but no differences were bet ween the control versus the treated. Based on information gathered from control samples and arginine containing samples, arginine neither positively affected nor negatively impacted sperm quality. Works supported by USDA-ARS Biophotonics Initiative #58-6402-3 -018.

BSE-38
Name: Jamorious Smith
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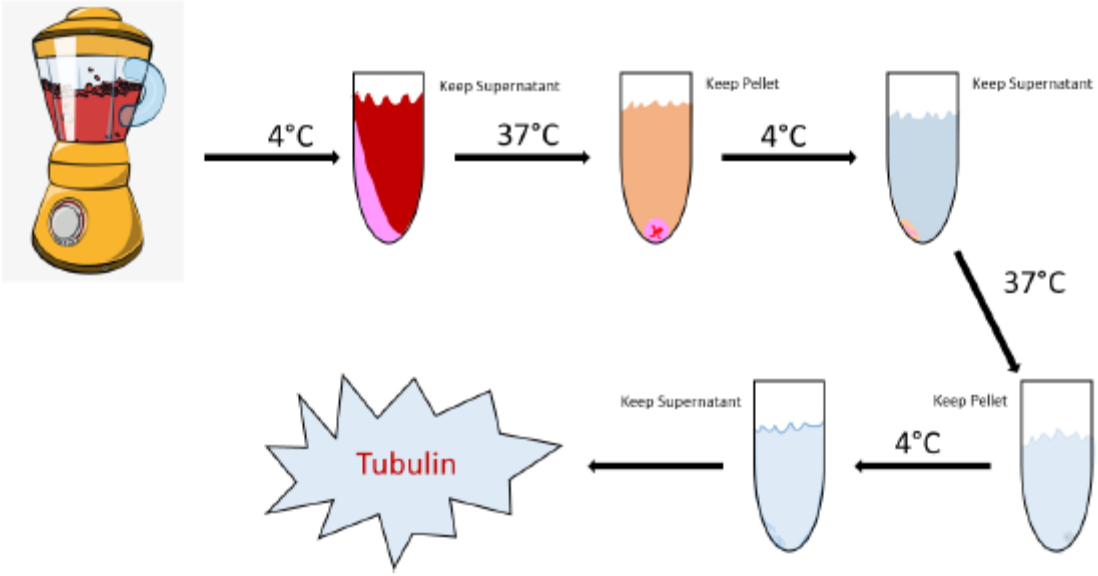
Co-Authors: Mary Beard, Savannah J. West, Edwin A. Lewis

Purification of Tubulin using the High-Molarity Popov protocol as a Replacement for HPLC Column Purification



Tubulin is a protein responsible for the formation of the mitotic spindle during mitosis. It forms microtubules whose dynamic instability makes it a substantial part of the cytoskeleton. Microtubules are used as a target for anti-cancer drugs because cancerous cells often have a high concentration of microtubules. Tubulin is typically purified from mammalian brain cells using centrifugation and high-pressure liquid chromatography (HPLC). The standard purification method involves using a phosphocellulose (PC) column, which is currently not commercially available. This method also requires time-consuming steps that significantly reduce the activity of the tubulin. Tubulin is commercially available but often very costly. This lab used a purification method which replaces the PC column steps with a series of high-speed centrifugations in a high-molarity buffer or in a depolymerization buffer. The quality of tubulin is verified after purification by gel electrophoresis and turbidity assays comparing it to purchased tubulin. The purified tubulin will be used for future experimentation to understand the thermodynamic binding properties of potential anti-cancer ligands at a much less costly rate.

BSE-39
Name: Kristy Terp
Major: Biological Sciences
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Dr. Richard Baird, Biochemistry, Molecular Biology, Entomology, & Plant Pathology
Co-Author: Dylan Tribolet

Vegetative Compatibility of Fungal Pathogen *Cryphonectria parasitica* from Infected American Chestnut Trees in the Appalachian Mountains

Almost 4 billion American chestnut trees (*Castanea dentata*) dominated the eastern United States over 100 years ago. In the early 1900's however, introduction of a virulent fungal pathogen *Cryphonectria parasitica* from Asia decimated the American chestnut tree. The pathogen caused the trees to be reduced to sprouts unable to grow above cankers created by the fungus. Known as chestnut blight, *C. parasitica* enters the tree through wounds and kills the vascular cambium by

infecting the bark. In the 1960's, a hypovirulent (HV) strain of *C. parasitica* was found to be limiting chestnut blight in Italy. Canker remission was made possible by injecting the dsRNA virus-like strains into the existing virulent cankers. This biological therapy led to the spread of the HV strains throughout Italy, prompting the same biological therapy to be used to control chestnut blight in America. However, a genetic system of vegetative incompatibility was preventing transmission of these strains in America. It was found that two or more genetically distinct alleles must be compatible in order for hyphal fusion to occur. Without this compatibility, the virulent strain cannot be converted into the HV strain, resulting in continuation of infection. In this study, focus was placed on 69 *C. parasitica* isolates harvested from the southern Appalachian Mountains. Compatibility was observed by plating two separate isolates in close proximity and observing growth patterns. The isolates either grew into each other by fusing their hyphae, indicating compatibility, or separately without fusion, signifying incompatibility. From there, compatibility groups were formed among the 69 isolates to give insight into which isolates could be crossed to eradicate the infection. Data found to date is consistent with a broad range of compatibility groups without complimentary genetically equal numbers of HV isolates, proving conversion of the virulent form to the hypovirulent form may have limited success.

PSE-36
Name: David Usher
Major: Computer Science
Project Category: Physical Sciences and Engineering
Faculty Advisor, Affiliation: Linkan Bian, Industrial and Systems Engineering

Machine Learning of Thermal Image Streams for Defect Prediction of Additive Metal Printing
Laser based additive manufacturing (LBAM) gives us the ability to create intricate parts without the need for molds or specialized equipment for each item created. This is accomplished by adding metal powder to a surface and melting it using a laser to create a solid metal piece. This process is repeated many times over layer by layer to create intricate parts for use in mechanical or structural systems. During the build process of LBAM, the melt pool (where material is being added) can show abnormalities in temperature, which can cause the part to be weaker or brittle. Identifying the cause of these anomalies should be easy, but due to the thermal data from a build being immense in size (as large as 60 gigs), a faster analysis method must be developed to determine the location of abnormal melt pools and find correlations with data from other builds to discover the cause of these occurrences.
To identify these abnormal melt pools, a Self-Organizing Map is utilized to quickly run through the collected data to identify the locations of such abnormalities. These findings are then analyzed to spot relationships between their locations and what build parameters caused them to develop. It is expected that abnormal melt pools will form near the edge of the build where the nozzle of the machine is finishing the current layer, as it is more exposed on its outside edge causing more energy to be required to create the melt pool. It is also expected that these spots will arise on the first layer of the build, where there is heat transfer to the plate the part is built on, causing that layer to cool faster and become porous.

BSE-40
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Home University: Tougaloo
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Joseph P. Emerson, Chemistry
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Thermodynamics of SczA and it's Interactions with Zinc (II) and DNA
Metal ions, like zinc(II), are trace elements required for life. However, maintaining metal ion homeostasis is challenging, where both high and low concentrations can lead to cell death. This problem is more complex for the respiratory pathogen Streptococcus pneumonia, which has to adapt to from the nasal pharynx, where it is benign, to other tissues, where it can become a life-threatening pathogen. To survive, S. pneumonia uses a series of metal-dependent transcription factors to modulate its physiology to respond to new growth media and micronutrient levels. SczA

(streptococcal czcD activator) serves as a zinc(II)-dependent transcription factor, where it binds zinc(II) ions and DNA to regulate the czcD gene, where the gene product of czcD prevents metal intoxication within the cell. The physical interactions between SczA and zinc(II) and its DNA binding domains are potential targets for drug development, where impacting these binding equilibria could lead to decreased viability for S. pneumonia. Here we report the thermodynamics associated with the complex equilibria between zinc(II) ions binding to SczA and its subsequent ability to bind to DNA using spectroscopic and calorimetric techniques.

BSE-41
Name: Dianna Wilson
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Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Te-Ming Paul Tseng, Plant and Soil Sciences
Co-Authors: Marilia Ferreira, Ziming Yue, Casey Barickman

Molecular Markers and Compounds Associated with Sweet Potato Allelopathy
Sweet potato ((*Ipomoea batatas* (L.) Lam.) is grown on over 27,000 acres across 160 farms in Mississippi, with an estimated value of $80 million. Unfortunately, majority of the sweet potato farms are exposed to problematic weeds that can cause yield reduction of up to 90 %. Despite the negative weed interference, herbicide options in sweet potato are limited, and only a few are highly effective on problematic weeds. To overcome these herbicide limitations and preserve sweet potato yield for Mississippi growers, there is a distinct need to find an alternative weed control strategy that can effectively reduce the weed pressure around the crop, and at the same time protect the quality of the storage roots. One promising weed control option is to use the weed suppressive ability already present in crop varieties, also known as allelopathy. From our greenhouse and field screening to identify allelopathic sweet potato varieties against Palmer amaranth, we found two out of 31 varieties that inhibited Palmer amaranth growth by up to 80%. All markers were found to be polymorphic. None of the SSR markers were identified to be unique to allelopathic phenotypes, but instead they were more strongly correlated to the variety origin. The HPLC analysis revealed 3 compounds, coumarin, chlorogenic acid and hydroxycinnamic acid, present in higher levels in allelopathic than compared to non-allelopathic phenotypes. The genetic diversity analysis shows higher gene diversity within the allelopathic than non-allelopathic population. Allelopathy promotes sustainable agriculture by increasing agricultural productivity while having minimal adverse effects on the environment. It increases crop productivity with minimal dependency on herbicides for weed control. Moreover, allelopathic crops can control weeds season long, thus reducing repetitive application of herbicides. The use of allelopathic crops will reduce the usage of herbicides for weed management, and therefore prevent further evolution of herbicide resistant weeds.

BSE-42
Name: Aren Worrell
Major: Microbiology
Project Category: Biological Sciences and Engineering
Faculty Advisor, Affiliation: Trey Howell, Basic Sciences
Co-Authors: Erin Mcdevitt, Darian Young

Exposure to the organochlorine pesticide metabolite oxychlordane and its effects on macrophage activity and function
Exposure to oxychlordane, a major metabolite of the pesticide chlordane, has been linked to increased prevalence of obesity and type 2 diabetes. Given that type 2 diabetes is a disease which is characterized by low-grade systemic inflammation, the possibility arises that oxychlordane may promote obesity and type 2 diabetes via altering systemic inflammation via macrophage activation/polarization. M1 macrophages are associated with phagocytosis and proinflammatory responses, while M2 macrophages are an important part of wound repair and anti-inflammatory responses. This study was designed to determine the effects oxychlordane has on the regulation of macrophage activity and function. To perform this experiment, J774a.1 macrophages were incubated for two days, then treated with increasing concentrations of oxychlordane (0 to 20 uM) for 24 hours in serum free media (0.5% BSA) with exposure to

lipopolysaccharide (LPS) for the final 8 hours. Mitochondrial membrane potential, phagocytic function, reactive oxygen species (ROS) generation, and inflammatory cytokine expression were all used to assess macrophage function. Exposure to oxychlordane resulted in significant increases in phagocytic activity, ROS generation, and inflammatory cytokine expression at concentrations greater than 0.2 uM compared to vehicle while mitochondrial membrane potential was decreased at higher concentrations (20 uM). Thus, the present data indicate that exposure to oxychlordane may promote an inflammatory phenotype of macrophage which may exacerbate disease states which are characterized by low-grade systemic inflammation such as type 2 diabetes.

SS-06
Name: Feifei Zeng
Major: International Business
Project Category: Social Sciences
Faculty Advisor, Affiliation: Vasabjit Banerjee, Political Science and Public Administration

What does China's Belt and Road Initiative mean to the U.S.?

This thesis through a case study method examines U.S. involvement in China's Belt and Road Initiative (BRI), 一带一路, also known as One Belt, One Road, with an emphasis on analyzing the benefits and costs associated with U.S. involvement, lack of involvement, and maintenance of current status. As a rising power, China hopes to further expand its influence through BRI. Historically, whenever there is a rising power and an existing dominant power, there exists a potential risk of war. What does this mean for the U.S.? Should the U.S. oppose this initiative to lessen China's power? Or should the U.S. be involved in the infrastructure initiatives to help with the development of the countries involved in the BRI? Or should the U.S. continue to standby and observe where the BRI will lead? Two case studies are generated based on the following hypothetical scenarios: (a) the U.S. actively supports BRI, and (b) the U.S. actively opposes BRI.

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