MISSISSIPPI STATE UNIVERSITY

JUDY AND BOBBY SHACKOULS HONORS COLLEGE

SUMMER 2021 UNDERGRADUATE RESEARCH SYMPOSIUM

AUGUST 4, 2021

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

MISSISSIPPI STATE UNIVERSITY™
JUDY AND BOBBY SHACKOULS
HONORS COLLEGE

Welcome to the Spring 2021 Mississippi State University Undergraduate Research Symposium.

WELCOME MESSAGE

The Shackouls Honors College is pleased to sponsor this event twice annually. This symposium is a great way for students to showcase their interest and dedication to research activities and for the MSU family to celebrate their engagement, curiosity, and hard work. Thank you for attending!

We view the encouragement and support of undergraduate research and creative endeavors for all students to be part of our core mission as an institution of higher learning. Participating in undergraduate research is an exciting way for students to complement their academic studies and preparation, paving the way for future intellectual work and exploration.

THANK YOU TO MENTORS, PARTNERS, AND SPONSORS

This event is not possible without the time, effort, and assistance of our dedicated faculty. The student work presented here represents many hours of mentoring students in their research, planning, and analysis. Many faculty have also volunteered their time and expertise to serve as judges, so thank you to all of them!

This event is an endeavor that relies on the support and sponsorship by other units, including the Office of Research and Economic Development, the Office of the Provost and Executive Vice President, and the College of Arts and Sciences.

AWARDS

Projects are categorized by 4 areas: Arts and Humanities, Biological Sciences and Engineering, Physical Sciences and Engineering, and Social Sciences. Students are being judged on the projects during the symposium and winners in each category will be announced through an email announcement, posted on the SHC website, and through a press release in the next few weeks. We are delighted that you have joined us today to peruse the accomplishments of our young researchers and hope you learn much from the diversity of fascinating research activities underway at MSU. Enjoy!

Sincerely,

Anastasia D. Elder, Ph.D.
Associate Dean for Undergraduate Research, Shackouls Honors College

Summer 2021 Undergraduate Research Symposium Schedule

MSU Foster Ballroom, Colvard Student Union

12:55 p.m.	Opening Statement from Dr. Anastasia Elder
1:00 p.m. - 3:30 p.m.	Poster Session 002 - 046: Biological Sciences and Engineering 047 - 098: Physical Sciences and Engineering 099 - 111: Social Sciences Judging will begin at 1:00 p.m. and conclude at 3:30 p.m.
3:45 p.m.	Closing Statement from Dr. Anastasia Elder

Room 330, Colvard Student Union

Arts and Humanities Oral Presentations/Performances are 15 minute talks followed by a short question and answer session.

1:30 p.m. - 1:45 p.m.	Arts and Humanities Oral Presentation/Performance 001 - Joseph Newell: Shakespeare's Expansion of Heteropatriarchy through Dreams: A Mockery of Women's Triumph in *A Midsummer Night's Dream*

Project Awards

Projects are categorized by four areas: Arts and Humanities, Biological Sciences and Engineering, Physical Sciences and Engineering, and Social Sciences. The number of places awarded in each category is determined by the number of projects in each category. Winners in each category will be announced through an email announcement, posted on the SHC website, and through a press release in the next few weeks.

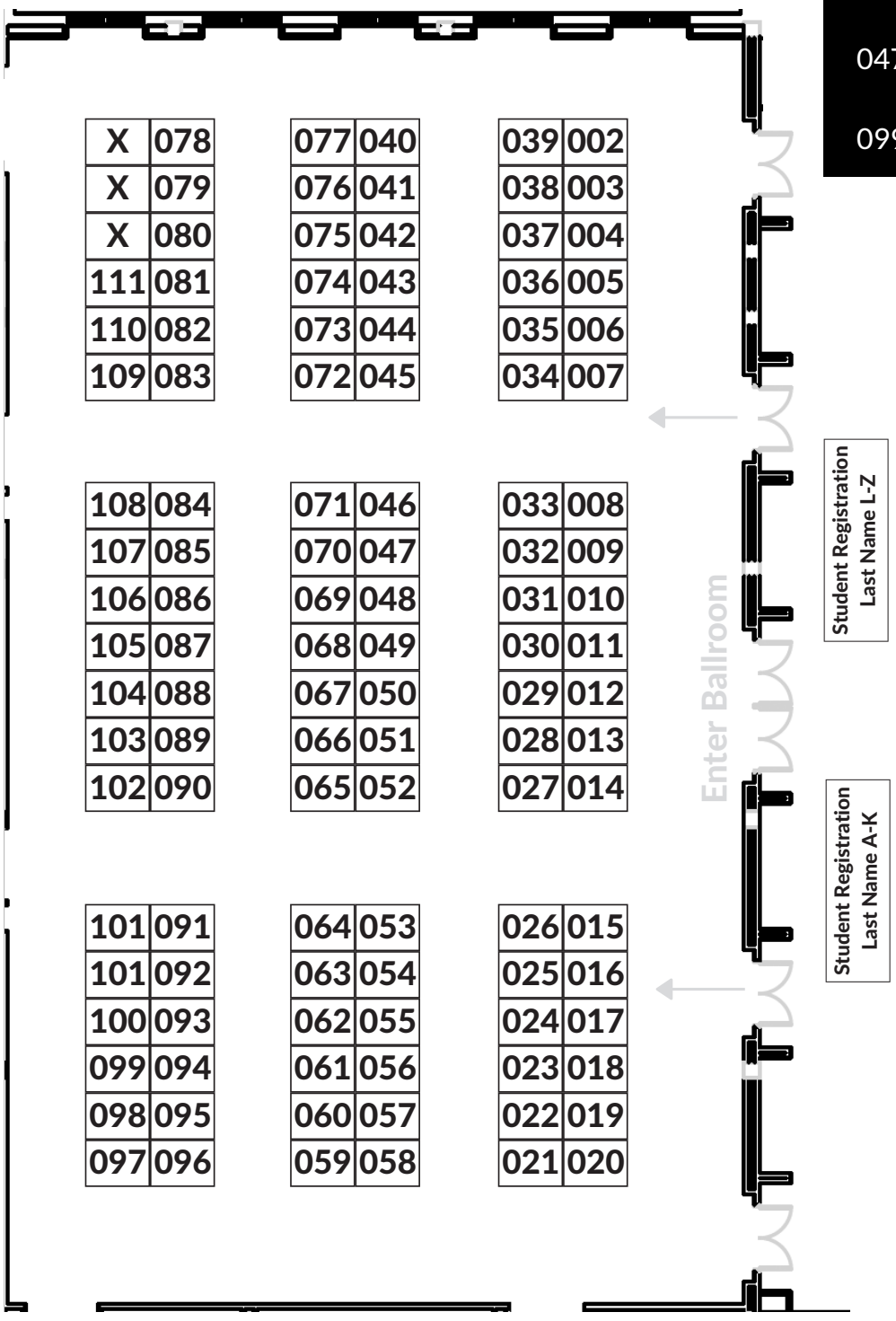
This symposium would not be possible without the hard work of the judges who work under time pressure to try to determine which excellent project is just a bit more excellent than the others. If you see a judge, thank him or her.

POSTER MAP
Colvard Student Union - Mississippi State University

MSU Foster Ballroom (2nd Floor)

Poster Category Key:

002 - 046	Biological Sciences & Engineering (BSE)
047 - 098	Physical Sciences & Engineering (PSE)
099- 111	Social Sciences (SS)



Student Presenters

Student Presenter	Project Category	Project #	Abstract Page #
Abbood, Ibraheem	Biological Sciences and Engineering	002	7
Adair, Rachel	Social Sciences	099	7
Adams, Lauren	Social Sciences	100	8
Allen, Lea	Physical Sciences and Engineering	047	8
Armand, Cody	Social Sciences	101	9
Ashbrook, Sophie	Biological Sciences and Engineering	003	9
Babaei Zadeh, Sina	Physical Sciences and Engineering	048	10
Baldwin, Quennetta	Physical Sciences and Engineering	049	10
Belles III, Dale	Physical Sciences and Engineering	050	11
Bowers, Caleigh	Physical Sciences and Engineering	051	11
Braman, Kevin	Biological Sciences and Engineering	004	12
Brock, Madeline	Social Sciences	102	12
Brown, Leah	Biological Sciences and Engineering	005	13
Bullard, Bailey	Physical Sciences and Engineering	052	13
Bunker, Ian	Physical Sciences and Engineering	053	14
Cassidy, Haley	Social Sciences	103	14
Chamberlain, Kari	Physical Sciences and Engineering	054	15
Clark, Benjamin	Physical Sciences and Engineering	055	15
Comer, James	Biological Sciences and Engineering	006	16
Conner, Reagan	Biological Sciences and Engineering	007	16
Cook, Ryan	Physical Sciences and Engineering	056	17
Cothron, Samuel	Biological Sciences and Engineering	008	17
Crawford, Katelyn	Physical Sciences and Engineering	057	18
Cutler, Riley	Biological Sciences and Engineering	009	18
Dahal, Sushil	Biological Sciences and Engineering	010	19
Dauber, Stephanie	Biological Sciences and Engineering	011	19
Davis, Seth	Biological Sciences and Engineering	012	20
Duckworth, Alison	Physical Sciences and Engineering	058	20
Dulaney, Sarah	Social Sciences	104	21
Easley, Hannah	Biological Sciences and Engineering	013	22
Ebbert, Noel	Biological Sciences and Engineering	014	22
Farmer, John	Biological Sciences and Engineering	015	23
Feduccia, James	Biological Sciences and Engineering	016	23
Fenderson, Erin	Biological Sciences and Engineering	017	24
Flynn, Darrock	Biological Sciences and Engineering	018	24
Foster, Micah	Biological Sciences and Engineering	019	25
Gaddy, Caitlyn	Social Sciences	105	25
Gill, Deven	Physical Sciences and Engineering	059	26
Green, Addison	Physical Sciences and Engineering	060	26
Griffiths, Rudane	Physical Sciences and Engineering	061	27
Hampton, Natalie	Physical Sciences and Engineering	062	27
Harjono, Jonathan	Social Sciences	106	28
Hauer, Alanna	Physical Sciences and Engineering	063	28
Heidelberg, Lauryn	Biological Sciences and Engineering	020	28

Student Presenter	Project Category	Project #	Abstract Page #
Hejny, Madison	Biological Sciences and Engineering	021	29
Henkel, Benjamin	Physical Sciences and Engineering	064	29
Heson, David	Physical Sciences and Engineering	065	30
Hooper, Mattea	Physical Sciences and Engineering	066	30
Huggins, Hannah	Physical Sciences and Engineering	067	31
Huggins, Morgan	Physical Sciences and Engineering	068	31
Huynh, Alexander	Physical Sciences and Engineering	069	32
Jennings, Madalyn	Biological Sciences and Engineering	022	32
Jessup, Ainsley	Biological Sciences and Engineering	023	33
Johnson, Ian	Physical Sciences and Engineering	070	33
Johnson, William	Physical Sciences and Engineering	071	34
Jordan, Brian	Physical Sciences and Engineering	072	34
Ladison, Abby	Biological Sciences and Engineering	024	35
Lee, Jacob	Biological Sciences and Engineering	025	35
Lee, Kyung Won	Physical Sciences and Engineering	073	36
Lewis, Timothy	Physical Sciences and Engineering	074	36
Liao, Kevin	Physical Sciences and Engineering	075	37
Lindsey, Shelby	Physical Sciences and Engineering	076	37
Loganathan, Arvind	Biological Sciences and Engineering	026	38
Lund, Timothy	Physical Sciences and Engineering	077	38
Lusby, Samuel	Physical Sciences and Engineering	078	39
Maldonado, Joshua	Physical Sciences and Engineering	079	39
Marion, Ka'Miyah	Physical Sciences and Engineering	080	40
Martin, Bryce	Physical Sciences and Engineering	081	40
Maynard, Meredith	Biological Sciences and Engineering	027	41
McCormick, Caitlin	Physical Sciences and Engineering	082	41
McDevitt, Reagan	Biological Sciences and Engineering	028	42
Mills, Kelly	Physical Sciences and Engineering	083	42
Moore, Corey	Biological Sciences and Engineering	029	43
Moore, Kirsten	Physical Sciences and Engineering	084	44
Morrow, Brendan	Biological Sciences and Engineering	030	44
Myers, Tanner	Physical Sciences and Engineering	085	45
Nanney, Andie	Physical Sciences and Engineering	086	45
Nettles, Camille	Biological Sciences and Engineering	031	46
Newell, Joseph	Arts and Humanities	001	46
Ningthou, Lyem	Biological Sciences and Engineering	032	47
O'Briant, Zy'Leecia	Biological Sciences and Engineering	033	47
Ousley, Jacob	Biological Sciences and Engineering	034	48
Peal, Celia	Biological Sciences and Engineering	035	48
Phillips, Maggie	Biological Sciences and Engineering	036	49
Quinn, Makela	Social Sciences	107	49
Reese, Robert	Biological Sciences and Engineering	037	50
Roberson, Graham	Biological Sciences and Engineering	038	50
Rogers, William	Physical Sciences and Engineering	087	51

Student Presenter	Project Category	Project #	Abstract Page #
Santos, Ariadna	Biological Sciences and Engineering	039	51
Schwirian, Elijah	Physical Sciences and Engineering	088	52
Scott, Ané	Biological Sciences and Engineering	040	52
Secrist, Carlee	Physical Sciences and Engineering	089	53
Shah, Ashutosh	Biological Sciences and Engineering	041	54
Sims, William	Social Sciences	108	54
Smith, Tarlys	Physical Sciences and Engineering	090	55
Smith, Tomyah	Biological Sciences and Engineering	042	56
Solis, Jacob	Physical Sciences and Engineering	091	56
Stamps, Ben	Social Sciences	109	56
Taylor, Cassie	Physical Sciences and Engineering	092	57
Taylor, Joshua	Biological Sciences and Engineering	043	58
Thompson, Beau	Physical Sciences and Engineering	093	58
Thorn, Dakota	Physical Sciences and Engineering	094	59
Todd, Alayna	Social Sciences	110	59
Tucker, Emily	Biological Sciences and Engineering	044	60
Wade, Emma	Biological Sciences and Engineering	045	60
Walters, Gabbi	Biological Sciences and Engineering	046	61
Welch, Jaycie	Social Sciences	111	61
Wells, Garrett	Physical Sciences and Engineering	095	62
Williams, Harrison	Physical Sciences and Engineering	096	62
Woodard, Katelyn	Physical Sciences and Engineering	097	63
York, Peyton	Physical Sciences and Engineering	098	63

Abstracts

002
Name: Abbood, Ibraheem
Major: Chemistry
Home Institution (Other than MSU): The University of Arkansas at Little Rock
Faculty Advisor Name, Affiliation: Nick Fitzkee, Chemistry
Project Category: Biological Sciences and Engineering
Co-Author(s): Rahul Yadav, Joanna X. Xu, Nicholas C. Fitzkee
REU/Research Program: REU

Using Mutagenesis to Understand How a Protein Binds to a Polystyrene Surface
Bacterial biofilms can form on many different types of surfaces and are a leading cause of hospital-related infection. The bacteria in biofilms typically resist antibiotic treatments and are therefore a serious global health concern. Bacterial biofilms are dependent on extracellular polymeric substances (EPS) surrounding and protecting the cells, and these substances interact with surfaces during the early stages of biofilm formation. R2ab is an example of one such EPS. R2ab is a domain of the autolysin protein from *Staphylococcus epidermidis*, and it has a high affinity to polystyrene surfaces. R2ab is implicated in biofilm formation, and removal of this domain significantly reduces biofilms in *S.epidermidis*. However, the molecular mechanism of how R2ab interacts with polystyrene is not well understood. Based on prior research on isolated amino acids, we hypothesize that aromatic residues in R2ab drive binding to polystyrene. In this study, we use site-directed mutagenesis to identify important amino acid residues in R2ab as it binds to polystyrene surfaces and polystyrene nanoparticles

We have designed mutagenesis primers and used the polymerase chain reaction (PCR) to generate two variants so far, Y722A and Y844A. Fluorescence-monitored protein denaturation experiments reveal a preliminary unfolding stability of $\Delta G = 3.5 \pm 0.3$ kcal mol^{-1} for Y722A. These variants were grown in ^{15}N media for characterization by NMR spectroscopy Based on two-dimensional HSQC spectra, both proteins are folded and appear to adopt similar structures to the wildtype (WT) R2ab domain. The Y722A and Y844A amino acid substitutions, therefore, do not appear to affect R2ab itself, making these variants suitable for surface binding studies. Work is ongoing to characterize polystyrene binding as well as to assess whether these variants are effective at interfering with *S. epidermidis* biofilm growth. Our long-term goal is to identify key surface binding residues as a means of developing new treatments for preventing biofilm growth.

099
Name: Adair, Rachel
Major: Marketing
Faculty Advisor Name, Affiliation: Holli Seitz, Communications
Project Category: Social Sciences

Relationship between linguistic characteristics of HappyHealthy Facebook posts and user engagement
Introduction: HappyHealthy is a healthy living social marketing campaign that uses Facebook to promote campaign content. Although user engagement with posts is important for campaign effectiveness, little is known about the relationship between post characteristics and user engagement.
Objective: To describe the correlation between characteristics of Facebook posts and user engagement.
Methods: Facebook shares, likes, and comments were captured for HappyHealthy Facebook posts from February 2018 through April 2021. Some posts (*n*=90) were created by an external marketing group and others (*n*=817) were created internally. Posts were analyzed separately based on their origin using Linguistic Inquiry and Word Count (LIWC2015). Spearman's correlation coefficient was calculated to examine the relationship between linguistic characteristics of posts and user engagement.

Results: Across both groups, shares (S), likes (L), and comments (C)* were positively and significantly correlated with each other. In posts created externally, clout (S,L), pronoun use (S,L), social words (L), tentativeness (C) and certainty (S) were positively and significantly correlated with user engagement, and words per sentence (S,L) and informal speech (L) were

negatively correlated with engagement. In posts created internally, the following characteristics were positively correlated with user engagement: word count (S,L,C), words per sentence (S,L), function words (L,C), pronouns (S,L,C), verbs (S,L,C), interrogatives (S,L,C), female references (L), cognitive processes (S,L,C), perceptual processes (C), ingestion (S,L), affiliation (S,L), time orientation (S,L,C), informal speech (S), and question marks (S,L,C). In the same group, the following characteristics were negatively correlated with user engagement: analytical thinking (S,L,C), longer words (C), family (C), hearing (L), health (L,S,C), achievement and power (C), work (C), leisure (C), and exclamation points (S).

Conclusion: The use of questions, pronouns, and cognitive process words was consistently related to higher user engagement. Findings have implications for health communicators designing posts to maximize engagement. *Abbreviations in parentheses represent type of user engagement.

100
Name: Adams, Lauren
Major: Chemistry
Faculty Advisor Name, Affiliation: Deb Mlsna, Chemistry
Project Category: Social Sciences
Co-Author(s): Lauren Adams, Lisa Smith, Deb Mlsna

Eye Tracking Studies on Organic Molecule Representational Competence
Chemical education plays an important role in the development of our STEM workforce in the United States. In this research study, a device called an Eye Tracker is being utilized to better understand misconceptions in chemistry by tracking participant's eye movements when interacting with organic chemistry problems. This data can be used to create heat maps to show what the participants are focusing on the most when they are solving the problem. The "think-aloud" process is also recorded to document how participants approach the solving process. By combining the eye movements, heat maps, and think-aloud processes, misconceptions can be analyzed to better understand the analytical process when answering a problem. Within this research study, organic chemistry professors and graduate students have participated as designated "experts" in organic chemistry, while undergraduate students participated as a "novice" group. Participants answered organic chemistry questions related to substitution and elimination reactions with an emphasis on both 2D and 3D representations of the molecules and differing prompts for reaction. Think-aloud transcripts have been analyzed to note the quantity and quality of responses. This research study will be used to better understand the approaches and thought processes utilized by expert and novice groups so that curriculum can be developed to support effective learning of the material.

047
Name: Allen, Lea
Major: Biological Sciences
Faculty Advisor Name, Affiliation: Benjamin Crider, Physical Sciences and Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Benjamin Crider, Ronald Unz, Caitlin McCormick, Benjamin Henkel, Sam Lusby

Characterization of the Effects of Soil Moisture on Gamma-ray Activity Measurements of Environmental Soil Samples using a Planar Germanium Detector
A long-term goal at the Institute for Clean Energy Technology (ICET) is utilization of a newly acquired planar germanium detector for laboratory-grade radioactivity measurements made in the field. Laboratory measurements can be extremely costly and require a long-time to produce, so capabilities of replacing these with in-field measurements are extremely attractive. When making measurements of environmental gamma-ray radiation, there are many variables that are controlled in a laboratory setting that are not directly controlled in the field. One such variable is soil moisture. The amount of water content in the soil has an effect on the activity measurements made by a Germanium Gamma Ray Imager, or for short GeGI. Because the water in the ground acts a shield for gamma rays, it differs from the readings if it was just the soil itself. The moisture content of soil will be tested within a controlled environment using a moisture detector. The results

on how the known moisture content can be measured in the field will be presented. Furthermore, the effects of the soil moisture will be systematically evaluated for its effects on gamma-ray activity as measured by the GeGI.

101
Name: Armand, Cody
Major: Computer Science
Faculty Advisor Name, Affiliation: Junfeng Ma, Industrial Systems and Engineering
Project Category: Social Sciences
Co-Author(s): Keith Wilcox

Environmental Outreach Through Virtual Reality
Man-Made waste, ranging from plastic microbeads to derelict fishing vessels, comprises the majority of the estimated 5.25 trillion pieces of marine debris that pollute oceans across the globe. This debris is responsible for major habitat damage, aiding the spread of invasive species, serious illness and death among marine animal populations, as well as economic loss and navigational hazards in coastal areas. To combat this ever-growing issue, organizations such as the EPA and NOAA frequently sponsor research and removal operations in affected areas, however, these are short-term reactionary responses that target the symptoms rather than the root cause. Thus, our current goal is to create an educational program to focus on that root cause by teaching future generations to reduce and eventually eliminate the spread of marine debris. In addition, we felt that developing the program to utilize the Oculus Quest and Quest 2 virtual reality headsets offered an unparalleled opportunity to immerse the users in the experience. By utilizing the Unity Engine's built-in VRTK framework and a variety of Tilia plugins, we were able to create an educational experience that not only shows the users the impact of marine debris but also allows them to actively participate in simulated encounters involving cleaning marine debris from both beaches and oceans. The program is expected to be finalized by August 2021, at which point we plan to run a short testing phase to gather user feedback before delivering the program to the EPA for full-scale utilization.

003
Name: Ashbrook, Sophie
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Dr. C. LaShan Simpson, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Ursla Offiah

Developing a Three-Dimensional Vascular Calcification Model
Vascular calcification is defined as the extracellular deposition of calcium in the arterial wall causing build-up. Vascular calcification was once considered to be a side effect of aging which was irreversible, until recently. It is now believed to be potentially preventable. Vascular calcification can be mainly found in patients with kidney disease, type 2 diabetes, and has a higher cardiovascular mortality rate. The purpose of this study is to create a 3D model of calcification using porcine pulmonary and renal arteries, making it the first model to date. The first step of creating this model would be to decellularize or discharging the native cells in the tissue or organ while minimizing the adverse effects to the biological activity, the composition, and the mechanical properties of the extracellular matrix (ECM). This will be done by lysing the cell membrane by using physical treatments, separating the cellular components from the ECM by using enzymatic treatments and detergents, and removing cell debris from the tissue. Once the process of decellularization is complete, we plan to recellularize the artery by seeding cells onto the decellularized scaffold. After recellularization is completed, the arteries will be calcified and the model of vascular calcification will be evaluated to improve calcification studies.

048
Name: Babaei Zadeh, Sina
Major: Physics
Home Institution (Other than MSU): The University of Toronto
Faculty Advisor Name, Affiliation: Ted Mackereth, Banting-Dunlap-CITA Fellow, University of Toronto
Project Category: Physical Sciences and Engineering
Co-Author(s): Josh Speagle, Lamiya Mowla
REU/Research Program: URSP

Building galaxies from the bottom up: how uniquely does galaxy assembly determine their present day properties?
An important question in astrophysics is how to predict the future state of galaxies, and determine if two evolving galaxies will share the same properties given their assembly history. In an attempt to answer this, we look at the EAGLE simulation (Evolution and Assembly of GaLaxies and their Environments) which contains data on about one million galaxies, and their defining properties. Our research utilizes the assembly history in order to answer this question. By analyzing and grouping similar assembly histories (e.g. linear or quadratic growth), we look to analyze the properties of the galaxies in a particular group to see if their likeness in assembly history can predict their likeness in other properties. Specifically, we focus on the main characteristic properties such as the star formation rate (SFR), Gas Mass, and Star Mass. Using this bottom-up approach, we hope to be able to predict the properties of galaxies like our own Milky Way in a few billion years in the future. This analysis complements the work done in the reverse direction, which attempts to predict the assembly history given the properties of a particular galaxy.

049
Name: Baldwin, Quennetta
Major: Chemistry
Home Institution (Other than MSU): Tuskegee University
Faculty Advisor Name, Affiliation: Todd Mlsna, Department of Chemistry, Mississippi State University; Willard Collier, Department of Chemistry, Tuskegee University
Project Category: Physical Sciences and Engineering
Co-Author(s): Prashan Rodrigo, Hashani Abeysinghe
REU/Research Program: 2021 MSU Department of Chemistry Summer REU: Food, Energy, and Water Security

Sorption of Heavy Metals and Oxyanions using Fe2TiO5 modified Douglas Fir Biochar
Heavy metal and oxyanion water contamination from industrialization, urbanization, mining, agriculture and so much more, threaten aquatic life and human health. Improper disposal of heavy metals and oxyanions, even at low concentrations, can result in a toxic and carcinogenic environment upon chronic exposure to a living organism. Heavy metals and oxyanions are nonbiodegradable, leading to a buildup of metals such as Cu^{2+} and oxyanions including AsO_4^{3-}, PO_4^{3-}, UO_2^{2+}, that can be discharged in wastewater ultimately polluting the environment, unless removed before discharge. According to the World Health Organization (WHO) the maximum concentrations allowed for our focused heavy metals and oxyanions are as follows: arsenate 10 μgL^{-1}, copper 1 mgL^{-1}, uranium (VI) 50 mgL^{-1}, and undetermined for phosphate. In this experiment, Douglas fir biochar, a by-product of the pyrolysis of Douglas fir plant biomass was modified using iron titanium oxide (Fe_2TiO_5) and used for the removal of heavy metals from wastewater samples. Modifying the biochar using Fe_2TiO_5 allowed for the creation of a biochar with more functional groups, and thus more able the absorb the heavy metals and oxyanions. Optimum sorption conditions for PO_4^{3-}, AsO_4^{3-}, Cu^{2+}, and UO_2^{2+} from sample solutions were investigated using several studies including a pH study, adsorption kinetics, isotherm study, competitive ion study, and a column study. The biochar was then tested for regeneration and characterized using SEM, TEM, XPS, and XRD. The results from these studies will be used to optimize heavy metal and oxyanion absorption in wastewater for safer environments and cleaner water overall.
Keywords: Heavy metal, oxyanion, biochar, carcinogenic, nonbiodegradable, biomass.

050
Name: Belles III, Dale
Major: Chemistry
Home Institution (Other than MSU): Harrisburg University of Science and Technology
Faculty Advisor Name, Affiliation: Dr. Charles Webster, Chemistry
Project Category: Physical Sciences and Engineering
REU/Research Program: CCS REU

Photophysical Properties of Novel Polycyclic Aromatic Hydrocarbons and their Complexes
Pincer CCC-bis(NHC) transition-metal complexes show promising potential as engineering materials for the improvement of photovoltaic efficiency. The CCC-NHC platinum complexes are of particular interest as they emit blue light, a much needed color for organic light emitting diodes (OLEDs). Organic LEDs are composed of thin films of organic molecules which emit light upon the application of electricity. Organic LED screens boast brighter, crisper displays on electronic devices and additionally they consume less power than conventional light-emitting diodes (LEDs) and liquid crystal displays (LCDs). In this work we have computationally studied the absorption and emission properties of a series of CCC, CAAC, and CAArC complexes. Of the CCC complexes, twenty-one models were made by varying the backbones between imidazole (i), benzimidazole (bz), and 1,2,4-triazole (t) and varying the arms between methyl and phenyl. Of the twenty-one compounds, nine were found to emit blue light, with Ph-CbzCbzC-Ph-PtCl being the strongest emitter.

051
Name: Bowers, Caleigh
Major: Chemistry
Home Institution (Other than MSU): Catawba College
Faculty Advisor Name, Affiliation: Dr. Amanda L. Patrick, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Matthew J. Carlo
REU/Research Program: NSF REU- INFEWS

Analysis of Salbutamol by Mass Spectrometry: Towards Anti-Doping Initiatives
The World Anti-Doping Agency (WADA) maintains a list of prohibited substances for athletes, with therapeutic dose exceptions present for certain drugs. On the list of monitored substances are Beta-2agonists, a class of drugs that are used to treat respiratory diseases, such as asthma. Given their legitimate use and possible performance enhancement (when taken in supratherapeutic doses or via non-inhalation routes),some of these substances are allowed in-competition within a certain therapeutic dose threshold only. In the case of salbutamol (one of the drugs with a therapeutic exception), the drug is typically administered as a racemic mixture, but only the R isomer is therapeutically active. If an athlete were to take only the R isomer in pure form, but the test was to only quantify total salbutamol (with the expectation that ½ of that quantity was the inactive S isomer), a dose that is double the therapeutic limit of R isomer could theoretically be taken without surpassing the threshold. Thus, a method for differentiating racemic versus R salbutamol would be useful. Our research group is actively developing a collision-induced dissociation mass spectrometry-based (CID-MS) method toward such a differentiation. In this presentation, I will focus on the sample workup step of this method. Specifically, we used solid-phase extraction (SPE) to isolate salbutamol from spiked synthetic urine. I will present the SPE method and mass spectrometry data showing that the salbutamol was recovered and that the desired complex could still be formed via electrospray ionization with mass spectrometric detection.

004
Name: Braman, Kevin
Major: Animal & Dairy Sciences
Faculty Advisor Name, Affiliation: Amanda Stone, Animal and Dairy Sciences
Project Category: Biological Sciences and Engineering
REU/Research Program: Undergraduate Research Scholar Program

Assessing Dairy Cattle Preference for Shade or Sprinkler for Heat Stress Abatement in Pasture Housing
Mitigating the effects of heat stress in dairy cattle is of growing concern with rising global temperatures. The U.S. experiences an extended warm season in the southeast and is currently experiencing unusual heat waves in the Pacific northwest and northeast regions. The most common means of providing relief for heat stress in pasture dairy systems currently rely on shade. Shade trees and structures keep cows from getting direct sunlight whereas sprinklers are utilized for evaporative cooling. Sprinklers typically have been used for confinement dairy housing but by utilizing portable sprinkler systems, they can also be used in pastures. These abatement strategies have provided increased time feeding and decreased body temperature, respiration rate, and amount of water consumed. However, little research exists on the preference of dairy cows for shade or sprinklers when housed in a pasture system. The objective of this study was to assess the preference of pregnant and open lactating dairy cows for shade or sprinklers when heat stressed in pasture housing. This study was conducted from April 1 to 22 2021 at the Mississippi State University Bearden Dairy Research Center. Forty-eight HolsteinFriesian lactating dairy cows (38 pregnant, 10 open) were randomly divided into two groups (pregnant and open equally distributed among both groups). Each group was assigned shade or sprinkler in a three-acre paddock for seven days. Pens were then combined, and cows were allowed free access to both shade and sprinkler. The first 4 days of each pen would serve as an acclimation period followed by a three-day observation period. Uncharacteristically cold and rainy weather alongside water well issues forced the study to end prematurely. This study will be re-started in August 2021 and will rely on video surveillance and aerial video technologies to assess dairy cow behavior. It is expected that cows will prefer shade structures for rest but will utilize sprinklers while grazing.

102
Name: Brock, Madeline
Major: Criminology
Faculty Advisor Name, Affiliation: Margaret Ralston, Sociology
Project Category: Social Sciences

The Effects of Parental Incarceration on Depression in Midlife Adults
This research will investigate the effects of parental incarceration on depression rates in midlife adults. Previous research on the influence of parental incarceration has failed to address this question from the perspective of midlife adults. Numerous studies have explored the effects of parental incarceration on adolescents and concluded there is a connection between parental incarceration and childhood trauma. The link between parental incarceration and adolescent incarceration has also been made, resulting in findings that state that children are more likely to be incarcerated if one or both of their parents have been incarcerated. In 2019, 19.2% of adults received mental health treatment in the past 12 months. Personal incarceration has also been found to have effects on depression rates. Research shows that involvement in the criminal justice system is often linked to lower mental health in the incarcerated. The goal of this research is to gain a better understanding of the impact that parental incarceration has on midlife adults. There is an abundance of research on the effects parental incarceration has on adolescents, but we want to know how this affects adults later on in life. This project will analyze data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) Wave V study (N=12,300). The survey participants are between the ages of 32 and 42. We will look at survey participants who indicated that their parents had in fact been incarcerated, and then evaluate their survey data on questions concerning mental health. We have identified which survey questions align with the Center for Epidemiologic Studies Depression (CES-D) scale and will use those to determine levels of depression. We will also take into consideration the age of the participant at the time of parental incarceration.

005
Name: Brown, Leah
Major: Microbiology
Faculty Advisor Name, Affiliation: Dr. Shecoya White, Food Science, Nutrition, and Health Promotion
Project Category: Biological Sciences and Engineering
Co-Author(s): Katie Evans, Ainsley Jessup, Jacinda Leopard

Investigating the Influence of Essential Oil Carvacrol Infused Marinade on the Behavior of E.coli O157:H7 and Salmonella spp. on Lamb During Refrigerated Storage

The process of marination prior to cooking is known to enhance flavor, tenderness, and juiciness; however, it can also function as an antimicrobial preservative. Previous studies suggest that adding essential oils to marinade can magnify its antimicrobial properties. The objective of this study was to assess the impact of marination on the inhibition of growth and survival of *E. coli* O157:H7 and *Salmonella spp*. on marinated lamb meat. Lamb leg meat was acquired from a local meat processing plant. The lamb was cut into approximately 10 gram samples and divided into four groups: no marinade, unaltered marinade, marinade with .5% carvacrol, and marinade with 1% carvacrol. Commercial chipotle marinade mix was purchased at a locally and prepared according to package directions. The marinade was divided equally into three groups: unaltered marinade, 0.5% carvacrol, and 1% carvacrol. To both the 0.5% and 1% marinade mixtures, enough carvacrol was added to each group to create the corresponding carvacrol/marinade mixtures. Each sample was then submerged into its corresponding marinade for one hour. Samples were placed into sterile bags and inoculated with a 3-strain cocktail of *E. Coli* O157:H7 and 5-strain cocktail of *Salmonella spp*.. Samples were stored at 4˚C for 7 days with microbial, chemical, and physical testing on days 0, 3, 5, and 7. There was no growth for *E. Coli* or *Salmonella* in any of the samples; however, the microorganisms survived the duration of the 7 day study. Treated samples were not significantly different (P>0.05) compared to the control. All marinated treatments decreased in pH compared to the control. There was also no difference observed in cook loss. The results indicate that carvacrol did not contribute to growth or inhibit survival of *E. coli* O157:H7 or *Salmonella spp*. in this marinade formulation.

052
Name: Bullard, Bailey
Major: Chemistry
Home Institution (Other than MSU): University of North Georgia
Faculty Advisor Name, Affiliation: Dr. Todd Mlsna, Chemistry; Dr. Timothy Schauwecker, Landscape Architecture
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Chanaka Navarathna, Casey Johnson
REU/Research Program: NSF REU

Testing of Engineered Biochar for the Removal of Phosphorus in Stormwater Runoff

Eutrophication has become a considerable concern as dead zone sizes continue to increase globally. When excess plant nutrients from fertilization run into water systems via agricultural runoff, the abundance of nutrients can lead to exponential algae growth. Decomposition of algae can lead to hypoxic environments, and if left unchecked, this can create ecological dead zones where life cannot be supported. Many water treatment methods have been studied, but it is important to develop an effective yet low-cost way to purify water of these contaminants. Two materials, biochar and slag, have shown great promise in their ability to adsorb and retain organic and inorganic pollutants in water. Biochar is a carbon-rich co-product of the pyrolysis of biomass, and slag is a co-product of recycled steel. In a mesocosm study, both materials proved effective in removing phosphates from water. In this study, methods are being developed to treat a Douglas fir biochar to adsorb phosphates on a larger scale. A coprecipitation method using $FeCl_3$, $MgSO_4$, and NaOH is used to modify the biochar for phosphate adsorption. A sample of the modified biochar is tested for its phosphate adsorption capacity using an inductively coupled plasma mass spectrometer (ICP-MS) to ensure that the treatment methods were effective. Preliminary results show that 50 mg of treated biochar has an average capacity of about 44.44 mg/g from 25 ml of a 1000 ppm PO_4^{3-} solution. Once enough biochar is treated, a slag filled check dam with a biochar backfill will be placed in head-cutting gullies leading into Catalpa Creek (Starkville MS) with the goal of removing phosphates from runoff before the contaminated water can reach the creek. Dissolved phosphorus levels have been

monitored in Catalpa Creek, and once the bioreactors are placed, it is expected that phosphorous levels will decrease over the next couple of years.

053
Name: Bunker, Ian
Major: Chemistry
Faculty Advisor Name, Affiliation: Kun Wang, Physics and Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Rajesh Shrestha
REU/Research Program: Chemistry Summer Research Program

Computer aided data processing of single molecule break-junction experimental results
Growing demand for faster, smaller, and environmentally friendly optoelectronics drives researchers to interrogate the viability of using a single molecule, nature's smallest stable structure, as a functional electronic component. Understanding how charge transport properties fundamentally interact within a single-molecule junction, i.e., a structure in which a single molecule is electrically connected between two electrodes, is critical. Through the development of Scanning Tunneling Microscopy (STM) break-junction techniques, single molecules can now reliably be wired to two conductive electrodes and repeatedly studied. Unfortunately, important molecular structural information is often buried underneath instrumental noises or false signals inside a large experimental data set. Locating useful molecular signals from unprocessed raw data often becomes a laborious, time-consuming process, posing a significant challenge to understanding structure-property relationships of single-molecule devices.

In this work, we aim to develop an unsupervised automatic data processing program that rapidly converts experimental data, into informative two-dimensional (2D) conductance vs. displacement density graph data, addressing the above challenge. Employing MATLAB, we have developed the following functionalities: 1) *data feeding*: harvesting large amounts of machine-generated raw data; 2) *data aligning*: aligning all molecular conductance traces to a newly defined reference zero; 3) *data filtering*: removing conductance traces that contain strong noise signature and do not contain molecular features; 4) *data exporting*: reformatting 2D conductance vs. displacement (sec) density graph data, that now reveals single-molecule conductance *plateaus* for future use in Origin. This program and method have subsequently been tested and verified with Gold (Au) Atomic Junction Data. To improve accuracy and efficiency, we plan to optimize our approach using larger single-molecule junction data sets.

103
Name: Cassidy, Haley
Home Institution (Other than MSU): East Mississippi Community College
Faculty Advisor Name, Affiliation: Mary E. Dozier, Psychology
Project Category: Social Sciences
Co-Author(s): Ben Porter, Ph.D.
REU/Research Program: NIH R25 Bridges to Baccalaureate

Indicators of Probable Animal Hoarding in Mississippi
Hoarding disorder has only been its own diagnosis since 2013, and individuals experience symptoms of discomfort, distress, and difficulty in discarding personal belongings (American Psychiatric Association, 2013). Individuals with hoarding disorder often hoard inanimate objects; however, some individuals with hoarding disorder hoard animals (Ferreira et al., 2017). Animal hoarding is associated with failure to provide the animals with proper care (Ung et al., 2017). The purpose of this study is to explore the association between number of pets and animal welfare. We examined all electronic medical records from animal encounters at the MSU-CVM Community Veterinary Services clinic between 2009 and 2019. Dental care and annual visit were used as indicators of proper pet care and skin problems or dehydration were used as indicators of animal neglect. The average number of pets per owner seen in the clinic was 5.62 (*SD* = 17.62, range 1-170). The average number of additional pets per owner (i.e., reported but not seen in the clinic) was 1.56 (*SD* = 3.46, range 0 - 200). In addition to pets, many individuals also reported having livestock, most notably horses (*n* = 329). Number

of animals was associated with both indicators of neglect, increased skin issues (t (20959) = 4.31, p < .0001) and dehydration (t (20959) = 11.09, p < .0001). Number of animals was negatively associated with indicators of proper pet care, having an annual visit (t (20959) = -3.57, p = .0002) and dental care (t (20959) = -2.63, p - .0043. Thus, individuals who own more pets tend to take poorer care of their animals than individuals with fewer pets. Lack of insight may play a key role in the connection between animal hoarding and animal welfare. Future studies should examine how targeting animal owners' insight into animal welfare can reduce animal hoarding and neglect.

054
Name: Chamberlain, Kari
Major: Chemistry
Faculty Advisor Name, Affiliation: Dennis W. Smith, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Gustavo Muñoz, Charles U. Pittman Jr., Charles E. Webster

Synthesis of Semi-Fluorinated Polyaryl Ethers via Friedel-Crafts Polymerization of Aromatic Hexafluoropropanol Derivatives

Polyaryl ethers (PAEs) are thermoplastics with high thermal stability, chemical resistance, fire resistance, high mechanical strength, and good processability. Due to their leading performance (processability), these polymeric materials find applications in automobile, aerospace, electronics, and biomedical fields. This work focuses on the synthesis of semifluorinated PAEs enchained hexafluoroisopropylidene linkages. Polymers of this kind are typically synthesized from halogenated bis-aryl monomers via nucleophilic aromatic substitution with the corresponding bis-phenoxide. A less explored alternative is the electrophilic aromatic substitution (EAS) of aryl ethers. Herein, a practical synthesis of semifluorinated PAEs via Friedel-Crafts hydroxyalkylation is presented. Although prepared by indirect methods in 1966 (Stamatoff et al., US Patent 3,291,777) further pursuits and modern characterization, surprisingly, has not been reported. To produce the polymer mentioned above two synthetic strategies were evaluated: Route 1, the polymerization of 4-Phenoxy-α,α-bis(trifluoromethyl)benzenemethanol as type AB monomer; Route 2, the polymerization of 4,4'-bis(2-hydroxyhexafluoroisopropyl)diphenyl ether and diphenyl ether as monomers type AA and BB, respectively. The monomers AB and AA were prepared by the condensation of diphenyl ether with hexafluoroacetone trihydrate, catalyzed by triflic anhydride. The energetics of the reactions were investigated computationally using B3LYP/BS1 (where BS1 = H, C, O, F: 6-31G(d'); S: LANL2DZ(d,p)/ECP) and correlated with the experimental results. The polymeric materials were characterized by NMR, FTIR, GPC, TGA, and DSC. Results showed a successful linear polymerization with a low degree of branching, thermal stability until 500 ºC under nitrogen, and a glass transition (T_g) around 170 ºC. This work contains important information on the most simple semi-fluorinated PAEs that have been hidden and unexplored for years.

055
Name: Clark, Benjamin
Major: Physics
Faculty Advisor Name, Affiliation: Dr. Gautam Rupak, Astronomy and Physics
Project Category: Physical Sciences and Engineering

Solving The Ising Model Using Nested Sampling

Many problems in physics and engineering require evaluating high-dimensional integrals. Markov Chain Monte Carlo is a popular choice for such calculations although it is not the most efficient method. Parameter estimations and model comparisons in Bayesian analysis involve such calculation. Nested Sampling is an algorithm that is used to evaluate high-dimensional integral for evidence calculations for different models. The evidence calculation in Bayesian analysis can be interpreted as the partition function calculation that represents the thermodynamic potential of a system of particles. The partition function in quantum mechanics is a fundamental quantity that contains all the information about the system. In this project we calculate the thermodynamic potential of the Ising model on a 1, 2 and 3 dimensional spatial lattice. The Ising model is a classical system of spin that is used to represent ferromagnetism in statistical mechanics. The exact solution to the 1- and 2-dimensional Ising model is known. We study the applicability of Nested Sampling for calculations in the Ising model using several different implementations of Nested Sampling.

006
Name: Comer, James
Major: Wildlife & Fisheries Science/Pre-Veterinary
Faculty Advisor Name, Affiliation: Beatrice Arwenyo, Chemistry; Todd Mlsna, Chemistry; Jac J. Varco, Plant and Soil Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Andrew Dygert

Nutrient Utilization and Yield of Corn Crop Grown in Acidic Soil with Phosphorus Enriched Biochar/ Coal Lignite
Phosphorus (P) deficiency in most agricultural soil is the limiting factor for crop growth and development. Farmers have widely used soil additives including fertilizers, manures, and compost to enhance plant yield and utilization of plant P. However, the continued use of these conventional soil additives has proven costly and ecologically harmful. Phosphorus enriched Biochar/ Coal Lignite has been suggested to improve the bioavailability of P in the soil. This study evaluated the nutrient utilization and yield of corn crops grown in acidic soil amended with P enriched Douglas fir Biochar/ Coal Lignite. The study was conducted at a greenhouse located at Mississippi State University for 61 days using corn as the experimental crop. The experiment's design included 10 treatments, each replicated 4 times. All pots were treated at a rate of 60 Kg/P/ha^-1, except for the control group (soil with no amendments added). The pots were arranged in a completely randomized block to prevent bias and minimize variables. During the growing period, plant height and chlorophyl content were regularly measured. After 61 days, the plants were harvested and oven dried at 60 C. Aboveground dry weight was then determined. The dried plant material was processed and the elemental and available nutrient contents determined using an elemental analyzer and ICP-OES respectively. Plant heights and aboveground biomass in soil amended with P enriched Biochar/ Coal Lignite was much greater than other treatments. This suggests that the application of P enriched Biochar/ Coal Lignite in acidic soil can enhance nutrient utilization and plant growth.

007
Name: Conner, Reagan
Major: Biochemistry
Faculty Advisor Name, Affiliation: Dr. Ryan Folk, Biological Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Stephanie Dauber, Nicholas Engle-Wrye, Heather Jordan, Carolina Siniscalchi
REU/Research Program: Dr. Ryan Folk NSF Grant REU

Phylogentic and spatial determinants of leaf endophyte microbiomes in the flowering plant Heuchera
Endophytes are non-pathogenic microbes that are universally present in plants, existing in a symbiotic relationship to provide functions such as abiotic stress responses, growth promotion, and defense to the plant host. To determine the poorly understood role of environmental and host-related factors that are responsible for acquiring leaf endophyte communities, we use amplicon sequencing using broad geographic coverage of North America within the restricted phylogenetic scope of the genus, *Heuchera* (Saxifragaceae), a recent plant host radiation with well-understood habitat variation and phylogenetic relationships. We used strong host species and population sampling to examine microbial diversity at multiple host evolutionary levels, from phylogenetic to within-population diversity.

Bacterial and fungal communities were characterized with 16S and ITS amplicon sequencing, using QIIME2 to call OTUs (operational taxonomic units) and calculate standard diversity metrics (species richness, Shannon diversity, phylogenetic diversity). We assembled a series of environmental predictors for bacterial and fungal diversity at collection sites including latitude, elevation, temperature, precipitation, and soil parameters. To account for spatial autocorrelation, a geographic distance matrix among sites was also calculated.

Surprisingly, we find differing assembly patterns for bacterial and fungal endophytes. Using UniFrac distances to investigate community composition, we found that only host phylogeny is significantly associated with bacterial endophytes, while geography alone was the best predictor of fungal community composition. Species richness and phylogenetic diversity are very similar across sites and species, with only fungi showing a response to aridity for some metrics. In this system, microbes show no relationship with pH or other soil factors, unlike what has been observed with

rhizosphere and root endophyte communities. Our results indicate the importance of detailed clade-based investigation of microbiomes and the complexity of microbiome assembly within specific plant organs.

056
Name: Cook, Ryan
Major: Chemical Engineering
Home Institution (Other than MSU): The University of Louisiana at Lafayette
Faculty Advisor Name, Affiliation: Dr. Mahesh Gangishetty, Chemistry, Physics and Astronomy
Project Category: Physical Sciences and Engineering
REU/Research Program: REU-CEMOs: Optoelectronic Materials

Gold Nanotriangle Synthesis to Quantify the Role of Hot Carrier Electrons
Nanostructured gold is proven to be a useful material for light harvesting applications such as photovoltaics and photocatalysis. Our group is focusing on photocatalytic applications. When gold nanostructures interact with photons, the electrons in the conduction band oscillate at a certain frequency. If this frequency matches the incoming photon's frequency, then the electron cloud exhibits a unique optical phenomenon called surface plasmon resonance (SPR). As a result of SPR, the electron cloud of gold can store a tremendous amount of energy depending on the size and shape of the material. Some of these oscillating electrons can become a "hot (high energy) carrier" to release the energy generated by SPR. In addition, electrons can release heat and photons in the relaxation process. Among all these phenomena, the role of hot carriers in catalysis is currently an area of debate. In this work, we are looking to quantify the role of hot electron carriers in driving chemical reactions. To do this, we are developing gold nanotriangles in colloidal solutions and molding them on thin films via various techniques.

Briefly, for synthesizing colloidal solutions of nanotriangles, we use a seed-mediated growth method, and for thin films we use a technique called nanosphere lithography (NSL). NSL is a method where polystyrene nanospheres in solution are allowed to self-assemble in layer(s) on thin films by controlling the capillary forces of their solvent. The nanospheres we use are roughly ~500 nm in diameter and, to control them, we use multiple techniques including spin coating and solvent evaporation. The triangular gaps that develop between the self-assembled nanospheres are used as a mold for growing gold nanotriangles. We use a physical vapor deposition technique to deposit the gold on the nanosphere layer. Once we develop these nanostructures, we will use them to drive chemical reactions and characterize the role of hot electron carriers.

008
Name: Cothron, Samuel
Major: Agronomy
Faculty Advisor Name, Affiliation: Ling Li, Biological Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Lei Wang

Metabolites in Sucrose/starch synthesis pathway affect QQS transcript in Arabidopsis
Protein and starch content of plant tissues are critical qualities of domesticated crop plants, and the ability to modulate carbon and nitrogen allocation-- and thus the ratio of protein to starch-- in crop produce is of great economic importance. The *Arabidopsis* orphan gene qua-quine starch (*QQS*) regulates carbon and nitrogen partitioning when expressed in plant species. While its interaction with the conserved transcription factor family NF-YC is well studied, the regulation of *QQS* transcription at the molecular level is still unclear. Previous data from our lab showed that *QQS* transcript level is obviously increased in the *Arabidopsis thaliana* Starch Synthase III knock-out (*ss*3) mutant, which exhibits systemic changes in the concentration of multiple metabolites in the sucrose/starch synthesis pathway. To identify the role of sucrose/starch pathway metabolites in regulation of *QQS* transcription in *A. thaliana*, selected mutants with mutations involved in starch biosynthesis were grown, and the relative expression of several genes of interest was analyzed via RT-qPCR. To elucidate the factors involved in this modification of *QQS* transcription, we discovered the potential effect of phytochrome interacting factors (PIFs) through literature retrieval. Genetic analysis combined with transcription level analysis confirmed

that PIFA and PIFB are involved in sensing certain metabolite concentration changes and in the subsequent regulation of *QQS* transcript level. Taken together, our studies reveal a novel molecular mechanism of the regulation of *QQS* transcript level through metabolite concentration and signaling PIFs, which act to regulate resource partitioning and alter hypocotyl development *in vitro*. Our findings shed light on the interrelations of sucrose related metabolites, transcription factors and *QQS* transcript in *Arabidopsis*.

057
Name: Crawford, Katelyn
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Santanu Kundu, Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Madhu Lakdusinghe, Mohammed Almtiri, Hari Giri, Colleen N. Scott

Developing Hybrid Gel of Low Molecular Weight Gelator and Phenoxazine Containing Polyaniline Derivatives
With the usage of electronics growing and advances in biomedical technology, the study of conductive gels has become important to assist these developments. Interest in low molecular weight gels has continued due to their soft and wet character that gives them potential in soft electronics used in biomedical applications. The goal of this study is to obtain a conductive gel combining the low molecular weight gelator, Fmoc-Lys(Fmoc)-OH (di-Fmoc), the electrically conductive phenoxazine containing polyaniline derivatives, and the solvent, ethanol. The first step was to find an appropriate solvent for di-Fmoc and the polymers and then to determine the critical concentration needed to form gel. Heating and sonication are used to dissolve the gelator and sonication has been found to assist in gel formation. Once a method was determined to form gel, the gels' properties were analyzed. Ultraviolet-visible spectroscopy (Uv-vis) and Photoluminescence spectroscopy (PL) tests were performed to show how the polymer aggregates in the gel. Fouriertransform infrared spectroscopy (FTIR) shows interactions between the polymer and gelator. Conductivity was measured for the wet gel and for pristine polymer and compared to see how gel formation affected conductivity.

009
Name: Cutler, Riley
Major: Biological Sciences
Faculty Advisor Name, Affiliation: Dr. Amy Dapper, Biological Sciences
Project Category: Biological Sciences and Engineering
REU/Research Program: Honors Summer Research Fellowship

Biological Illustration of Caenorhabditis elegans
Bio-medical Illustration is the intersection of art and science: used to communicate complex scientific concepts via visual explanations in ways that photography cannot. Caenorhabditis elegans are currently being used to study the evolution of recombination rates via inserted fluorescent markers. These markers make it easy to scan offspring for recombination phenotypes underneath a fluorescent scope. However, the nematode themselves are small, around 1mm, and require the help of a microscope to be seen. They also move relatively quickly; which makes observation of the anatomy, sexual mechanisms, and the fluorescent patterns, mentioned above, difficult. During the course of the summer three scientific illustrations were created using Photoshop and a Wacom Tablet:

1) An illustration demonstrating the structural differences between male worms and hermaphrodites.

2) A more artistic and visually interesting interpretation of the worms.

3) A drawing that displays worms with the recombined fluorescent patterns used to identify recombination events the lab. Currently there are no public domain images that exhibit the correct fluorescent pattern for worms with the recombined markers.

These illustrations will be utilized as both instructional tools for incoming lab members and public outreach/education on the research done in the lab.

010
Name: Dahal, Sushil
Major: Biological Sciences
Faculty Advisor Name, Affiliation: Ryan A. Folk, Biological Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Carolina Siniscalchi, Nicholas Engle-Wrye
REU/Research Program: Dr. Ryan Folk NSF REU

Population genomics of Symphyotrichum subg. Virgulus and test of the putative hybrid origin of S. amethystinum
Symphyotrichum, comprising most species traditionally treated as asters in the New World, is one of the most diverse genera in the eastern US and well-known for its taxonomic difficulty, including putatively widespread hybridization and polyploidy. Its broad presence across major biomes also make it an excellent system for investigating phylogeographic breaks across eastern North America and biogeographic connections to the rest of the continent. As a preliminary investigation into the genus, here we investigate phylogenetic relationships and phylogeographic patterns in subgenus *Virgulus*.

We performed sequence capture on DNA libraries derived entirely from herbarium specimens using the Angio353 baitset, sampling broadly across the range of the subgenus (19/~25 species, with strong representation across the range of broadly distributed taxa) and finding broad success with herbarium specimens and numerous variable sites at subspecific levels. We applied standard phylogenetic methods (concatenation in RAxML-NG and coalescence in ASTRAL-III), and ordination methods to obtain a view on overall diversity. We then tested for the presence of hybridization in the group, using phylogenetic network methods in PhyloNet and coalescent simulations.

Our results suggest decisive support for the monophyly of subg. *Virgulus* and mostly corroborate monophyly of the existing subsectional taxonomy. We were able to recover strong phylogeographic structure within the widespread species *S. novae-angliae* and *S. patens*, which does not correspond with subspecific variation recognized in the past. Finally, we test the hybrid origin of the morphologically distinct hybrid species *S. amethystinum*.

011
Name: Dauber, Stephanie
Major: Biochemistry
Faculty Advisor Name, Affiliation: Dr. Richard E. Baird, Plant (Forest) Mycology, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Chathuri Gamlath-Mohottige

Morphological, Pathological, and Biochemical Differences in Macrophomina phaseolina Growth on Sweet Potatoes
Macrophomina phaseolina (MP) is a soil fungal pathogen that occurs worldwide and causes major yield losses to economically important crops like sweet potatoes, strawberries, and soybeans by causing storing rots that are difficult to detect before and after packaging.

The microbial volatile organic compounds (MVOCs) present in the MP variants can affect fungal characteristics like region range, pathogenicity, and morphology (flat or fluffy) and identification and early detection of these MVOCs can help prevent crop loss, in the field and after packaging. From previous research, MP MVOCs have been identified with headspace solvent microextraction (HSME) and gas chromatography-mass spectroscopy (GC-MS). Our study is investigating if there is any discernable link between the pathogenicity and morphology in variants collected from three regions of the United States: West, Midwest, and South using sweet potato storage roots to observe colony growth and pathogenicity.

Preliminary results comparing morphology and pathogenicity show that fluffy isolates have greater growth than flat isolates on average, but results vary drastically when they are compared between regions (W, MW, and S). Based on HSSPME and GC-MS data, using morphology, rather than geography, might be the best way to determine pathogenicity of an isolate.

012
Name: Davis, Seth
Major: Biochemistry
Faculty Advisor Name, Affiliation: Natraj Krishnan, Biochemistry, Molecular Biology, Entomology, and Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Chance J. H. Anderson, Caleb Snoddy

The Wobble Effect: Disruption of genes encoding tRNA-guanine transglycosylase and the Queuosine salvage protein has physiological consequences in Drosophila melanogaster
Queuosine is a hypermodified 7-deaza-guanosine that occurs at the wobble anticodon position 34 of four tRNA (Tyr, Asn, Asp, His) species for amino acids His, Asn, Tyr, and Asp with 5'GUN anticodons. Although the Q-modification occurs in most organisms, its precise role remains unclear in eukaryotes. The enzyme that substitutes Q for G34 in the Q-tRNAs is tRNA-guanine transglycosylase (TGTase), encoded by the *Tgt* gene. Eukaryotic TGTases consist of a catalytic subunit (QTRT1) and a homologous accessory subunit (QTRTD1), forming a functional complex. Unlike eubacteria, eukaryotes are unable to synthesize the Q-nucleoside or its precursors *de novo*. Animals must therefore salvage the nucleobase of queuosine, known as queuine, using salvage proteins such as DUF2419. *Drosophila melanogaster* has a single *Tgt* gene (CG4947) encoding the QTRT1 protein (NP_608585.1) and the accessory subunit gene (CG3434) encoding the protein QTRTD1 (NP_6483201.1) necessary for Q-tRNA formation. There is also a single gene (CG9752) encoding the potential Qsalvage protein family DUF2419 (NP_611573.1). It is hypothesized that lack of Q-tRNA modifications would impact an organism's physiology. To understand the physiological consequences of lack of such modification, disruption of the *Tgt* gene and its accessory subunit gene was achieved by ubiquitously driving the expression of an RNAi transgene targeting these genes using the powerful GAL4/UAS system. The lifespan, accumulation of protein carbonyls, dopamine levels and neuronal degeneration was documented in flies which lacked Q-tRNA compared to control flies. In parallel, gene-disrupted and control flies were subjected to stress by exposing them to hydrogen peroxide (21 mM) and oxidatively modified proteins documented using Western blotting. The obtained data lend strong support to the hypothesis that lack of Qincorporation affects tRNA species such as tRNA-Asn, tRNA-Tyr and tRNA-His, which ultimately leads to compromised stress response and neurodegenerative symptoms.

058
Name: Duckworth, Alison
Major: Chemistry
Faculty Advisor Name, Affiliation: Dennis Smith Jr., Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Ernesto I. Borrego, Saidulu Gorla, Sumudu Athukorale, William W. Johnson, Hossein Toghiani, Charles U. Pittman Jr.
REU/Research Program: Chemistry Summer Undergraduate Research Program

Optimization of Processing Window and Carbon Yield of Bis-ortho-diynylarenes for Applications in Carbon-Carbon Composites
Carbon-carbon composites have high thermal resistance (>2000 °C), high mechanical strength, low coefficient of thermal expansion, low density, high thermal and electrical conductivity and are of high interest for hypersonic vehicles (velocity >8 km/s) in aerospace applications. Bis-*ortho*-diynylarene (BODA) polymers are particularly attractive for this class of composites. BODA monomers form polynaphthalene networks via thermal-initiated Bergman cyclization and when pyrolyzed under non-oxidative conditions, produce glassy carbon with unprecedented yields (>80%). A high-carbon yield increases the density of the matrix. This increased density will increase the uniformity and improve the mechanical

properties of the composite. Out of existing BODA monomers, BODA-Biphenyl monomer has the highest carbon yield (83%), but also the highest melt temperature (T_m=173 °C). This gives the monomer a short processing window, from the T_m to the onset of the polymerization (210 °C), for carbon fiber impregnation. To expand this processing window, BODA-Biphenyl was copolymerized with BODA-Ether (T_m=105 °C, 75% carbon yield) in varying compositions. Isothermal differential scanning calorimetry (DSC) kinetic studies were utilized to optimize the cure schedule for later composite fabrication. Using thermogravimetric analysis (TGA), a negligible decrease in the carbon yield was observed in these copolymers of varying compositions. To improve the carbon yield of these monomers further, cross-linked BODA-Biphenyl homopolymers were post-cured in air for 0.5 to 2 hours at temperatures between 300 and 500 °C. These post-cured polymers exhibit higher carbon yields than the nitrogen-cured BODA-Biphenyl and are expected to improve the performance of the BODA-derived carbon-carbon composites by increasing the density of the matrix.

104
Name: Dulaney, Sarah
Major: Microbiology
Faculty Advisor Name, Affiliation: Dr. Holli Seitz, Communication
Project Category: Social Sciences
Co-Author(s): Hasna Handekar

Thematic Analysis of Vaccine Misinformation In Social Media

Introduction: Vaccine misinformation is prevalent on social media platforms. In order to tailor a response to combat misinformation, communicators should be aware of the themes present.

Objective: To identify the themes present in vaccine misinformation on social media.

Methods: Gnip was used to collect tweets that included search terms for the HPV and MMR vaccines (HPV = 16,5000 and MMR = 46,892). The YouTube search engine was used to search for “HPV vaccine” and “MMR vaccine.” Comments were recorded from the 25 most relevant videos for each search term (HPV = 10,715 and MMR = 12,068). A random sample of tweets (HPV = 1,800 and MMR = 2,349) and comments (HPV = 6,848 and MMR = 1,081) was manually coded for inclusion criteria and the presence of misinformation. Tweets and comments that included misinformation (HPV = 520 and MMR = 108; HPV = 475 and MMR = 206, respectively) were analyzed thematically using the Braun and Clarke (2006) methodology. This methodology included generating initial codes, searching for themes, defining and naming themes, and identifying illustrative quotes for each theme.

Results: One prominent theme was the fear of vaccine side effects, including autism and ADHD/ADD (more prevalent in MMR data), neurological disorders, and infertility (more prevalent in HPV data). Additional dominant themes included fear and distrust of powerful entities, such as the government and “Big Pharma,” and the presence of conspiracy theories (e.g., vaccines are being used for population control).

Conclusions: This thematic analysis provides insight into vaccine misinformation shared via social media. Although the themes varied between the HPV and MMR data, the major themes were the same: a fear of entities promoting or funding vaccinations. Health communicators should be cognizant of this fear when addressing vaccine misinformation online.

013
Name: Easley, Hannah
Major: Chemistry
Home Institution (Other than MSU): Oglethorpe University
Faculty Advisor Name, Affiliation: Richard Baird, Plant Pathology; Todd Mlsna, Chemistry
Project Category: Biological Sciences and Engineering
Co-Author(s): Chathuri Mohottige
REU/Research Program: REU-INFEWS

Developing Methodologies for Metabolomic Assessment of Arbuscular Mycorrhizal Fungi

Rhizophagus irregularis is an arbuscular mycorrhizal fungus and a member of the order Glomerales of which all species are biotrophic mutualists: they are reliant upon their host plant to survive. In exchange for carbon from the host plant, the fungi improve uptake of vital nutrients necessary for the plant's survival. As such, a comprehensive understanding of this species is of key interest for agricultural application. Metabolomics is an emergent discipline that assesses organisms holistically and seeks to elucidate their biomechanisms. Previous research into arbuscular mycorrhizal fungi has focused on the fungal-host interaction because assessing the fungal metabolisms independently is complicated by their obligate biotrophic nature.

This research provides a methodology for untargeted metabolite assessment of *Rhizophagus irregularis* which could be applied to other arbuscular mycorrhizal fungi. Purification of samples prior to metabolic analysis is critical; high molecular weight compounds such as proteins can obstruct analysis and impede accuracy. Protein precipitation is a necessary step in metabolomics sample preparation and is directly correlated with the efficiency of metabolite extraction and detection. Therefore, we are assessing the protein precipitation efficiency of various liquid extraction methods. We are using bicinchoninic acid (BCA) protein assay coupled with UV-VIS spectrophotometry for protein quantification. The metabolites will be assessed using LC-MS and GC-MS and the comparative analysis of the efficiency of the metabolite extraction methods will be presented with respect to the efficiency of the protein precipitation of the extraction method.

014
Name: Ebbert, Noel
Major: Horticulture
Faculty Advisor Name, Affiliation: Guihong Bi, Plant and Soil Sciences
Project Category: Biological Sciences and Engineering

Containerized Organic Production of Culinary Herbs and Spices

Demand for locally-grown culinary herbs and spices has been growing rapidly in recent years due to increasing awareness of health benefits. Additionally, consumer demand for organically grown produce continues to grow. This creates a niche market and opportunities for local growers. The objective of this study was to evaluate and identify suitable cultivars of selected herbs and spices for containerized organic production in Mississippi. Two herbs (basal, 11 cultivars; and parsley, 7 cultivars) and one spice (garlic, 13 cultivars) were evaluated in this study. Plants were grown in 3-gallon containers filled with Metro-Mix® 852 substrate and supplied with organic fertilizer Garden-tone 3-4-4. Results showed that basil and parsley performed well in containers, and different cultivars showed differences in growth habit, vigor, leaf color, size, and biomass. Among the eleven basil cultivars tested, 'Greek' produced the highest fresh weight and 'Italian Large Leaf' produced the highest dry biomass. Among the seven Parsley cultivars tested, 'Italian Flat Leaf' produced the highest fresh and dry biomass. Garlic planted in containers in late fall 2020 and early spring 2021 did not sprout well due to cold damage from low night temperatures, falling down to 7°F. Garlic planted in raised beds in both fall 2020 and spring 2021 performed well, and garlic planted in fall 2020 produced larger sized bulbs compared to the ones planted in Spring 2021. Among the thirteen tested garlic cultivars, 'Shilla' produced the largest bulb size and highest yield. Preliminary data from this study suggest basil and parsley can grow successfully in containers in Mississippi. There is risk of frost damage on garlic bulbs when grown in containers. However, garlic can grow successfully in raised beds in Mississippi, requiring limited frost protection.

015
Name: Farmer, John
Major: Biochemistry
Faculty Advisor Name, Affiliation: Xueyan Shan, Biochemistry
Project Category: Biological Sciences and Engineering
Co-Author(s): W. Paul Williams
REU/Research Program: CALS USRP

Extraction of Proteins from Corn (Zea mays. L) Kernels

Proteins are complex molecules that serve to carry out almost all functions in living organisms. In order to study proteins and their functions, they need to be isolated and purified from biological samples. Extraction of proteins is determined by several factors such as: size, shape, binding affinity, and solubility of proteins. Cells from different organisms and different parts of the same organism can contain wide ranging quantities of different proteins. The uniqueness of the sources of proteins requires the extraction methods to be specialized to suit the varying biological properties of cells. This research details a protocol for the extraction of proteins from corn kernels. Proteins are delicate macromolecules that degrade quickly under normal conditions; therefore, the extraction procedure must take into account factors to ensure a high quality of extraction. In order to effectively extract proteins from corn kernels and to minimize loss, different protein extraction protocols from literature search were examined and tested. The extracted proteins must then be checked for the quality and quantity of the yield. To test for the presence of proteins, sodium dodecyl sulfide polyacrylamide gel electrophoresis (SDS-PAGE) was used. Being able to confirm the existence of all the extracted proteins will allow further research into isolating functionally specific and gene specific proteins.

016
Name: Feduccia, James
Major: Biochemistry
Faculty Advisor Name, Affiliation: Xueyan Shan, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): James Feduccia, Madi Claire Windham, W. Paul Williams, Xueyan Shan

The search for genetic links to the corn resistant trait against Aspergillus flavus and aflatoxin

Aflatoxin producing *Aspergillus flavus* is a cause for the loss in the corn production due to the fact that most corn varieties are not resistant to this pathogenic fungus. The goal of this research was to find genetic links that can be used to study the metabolic processes behind *Aspergillus flavus* / aflatoxin resistance in corn. The genes tested in the study were selected using the MaizeGDB website (Maize Genetics and Genomics Database) to obtain appropriately sized and sequenced primers. To discover links between certain genes and aflatoxin resistance, PCR and gel electrophoresis analysis were used to identify polymorphisms between the same genes in a panel of corn near isogenic inbred lines that carry different levels of aflatoxin resistance. Different band patterns among the corn near isogenic inbred lines within the same genes were possible indications of aflatoxin resistance. One specific group of genes, antimicrobial peptide encoding genes, were also examined to test correlations with resistant and susceptible traits to find if certain variations of these genes may contribute to the resistance of *A. flavus*.

017
Name: Fenderson, Erin
Major: Mathematics
Faculty Advisor Name, Affiliation: Dr. Kimberly Woodruff, CVM Clinical Science Department
Project Category: Biological Sciences and Engineering
Co-Author(s): Dr. Hannah Urig, Dr. David Smith

Apparent and true prevalence of feline leukemia virus and feline immunodeficiency virus in northern Mississippi shelter cats

Feline Leukemia Virus (FeLV) and Feline Immunodeficiency Virus (FIV) are two important viruses of cats, and testing for these diseases is common in shelters. The Zoetis Witness FeLV-FIV Rapid ImmunoMigration test has reported sensitivity and specificity of 92.9% and 96.5% for FeLV antigens and 97.5% and 94.4% for FIV antibodies, respectively. Given the imperfections of the test and the estimated low prevalence of disease in shelter cats, it may not be appropriate to make life or death decisions based solely upon test results. The objective of the study was to determine the apparent prevalence and estimate the true prevalence of FeLV and FIV in apparently healthy shelter cats. Blood samples (n=150) were collected from apparently healthy cats > 6 months from 5 selected shelters across northern Mississippi. The blood samples were centrifuged to extract serum and tested using the Witness test. Based on test results, cats were categorized as either FeLV or FIV positive or negative. Of the 150 cats selected, 102 (68%) were female and 48 (32%) were male. Two male (4.2%) cats tested positive for FeLV. Three females (2.9%) and two males (4.2%) tested positive for FIV. No cats tested positive for both diseases concurrently. Based on reported test performance, true prevalence estimates for FeLV and FIV were -2.4% (95% CI -3.7%, 1.4%) and -2.5% (95% CI -4.7%, 1.9%), respectively. True prevalence is likely to be extremely low, and, therefore, it is appropriate to question the predictive value of a positive test result for these retroviruses.

018
Name: Flynn, Darrock
Major: Mechanical Engineering
Faculty Advisor Name, Affiliation: Dr. Matthew Priddy, Mechanical Engineering; Dr. Lauren Priddy, Biomechanical Engineering
Project Category: Biological Sciences and Engineering
REU/Research Program: Computational Mechanics and Materials Laboratory

Approach for applying mechanical stimulus in bone remodeling within a bioreactor.

Mechanical stimuli are applied to your bones every day such as lifting weights, running, or walking from your car to your house. These everyday activities promote bone growth and density to improve mechanical strength. In general, understanding the process of bone growth induced by mechanical stimuli can benefit orthopedic medicine with potential treatments for osteoporosis, broken bone repair, physical therapy, and implant design. However, *in vivo* experiments are extremely limiting because of the cost and labor associated with them. Alternatively, bioreactors are well established at studying mineral density, porosity within bone samples, and bone remodeling as well as experimenting for a fraction of the cost as industrial or commercialized mechanical bioreactors that can apply tension, compression, shear, or a combination of the three loading types. Most bioreactors do not use multiple chambers and can be quite expensive.

The purpose of this work is to develop a low-cost mechanical bioreactor that can be placed within a benchtop incubator. A prototype has been designed using a linear actuator, load cell, stepper motor, peristaltic pump, and an Arduino microcontroller. The device will allow testing of static and cyclic compression loads at various strain rates. The mechanical bioreactor is expected to run autonomously using a microcontroller for extended periods of time. The bioreactor will be mounted and placed within an incubator with temperature and atmospheric control, which will also prohibit contaminants from interfering. The goal of these experiments is to confirm a prototype design that will be used in future experiments with bone specimens. It is expected to see bone growth formation directly correlated to the application of mechanical stimuli.

019
Name: Foster, Micah
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Lauren B. Priddy, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Caitlin Luke, Cody Gressett, Jaden Bennett, Zach Hooper, Matthew W. Priddy

Benchtop device for simulating spinal implant impact scenarios

Disc pathologies resulting from congenital deformities, trauma, or infection and can lead to spine weakness, nerve pinching, and spinal instability. The most common procedure to treat disc pathologies is Lumbar Interbody Fusion (LIF), where an intervertebral disc is removed and replaced by an interbody fusion device (implant). Currently, there is scarce data on loading conditions during the insertion process, and implants are tested using cadavers. The limitations of cadavers include time consuming preparation, biohazardous tissue, and storage requirements. Our objective was to design a benchtop device to measure the impact force on the insertion tool in a readily available and repeatable manner. The hypothesis was the benchtop device would provide a similar peak force to that from cadaver testing during the insertion of the interbody fusion device. A benchtop setup was created to measure the impact force and duration from a cylindrical drop-weight onto an insertion tool used to insert the implant into a simulated spinal disc space. The following impact scenarios were tested: drop-heights 20, 40, 60 cm; and weights 0.5, 0.75, 1 lb. Cadaver testing of a single impact scenario was also conducted. An increase in height and weight increased both peak force and area under the force-time curve. The peak force and initial slope matched those from cadaver testing, whereas duration and area under the force-time curve did not coincide with cadaver data. The significance of this project is the design of a benchtop impact testing setup that will collect repeatable data from implant insertion, to improve the design of implants and develop a better way to test implants.

105
Name: Gaddy, Caitlyn
Major: Social Work
Faculty Advisor Name, Affiliation: Margaret Ralston, Sociology
Project Category: Social Sciences

Depression and Social Support in Older Adults through a Gendered Perspective

This research will explore differences in depression among older adults with different levels of social support. Social support is the assistance individuals give and/or receive with daily tasks or with distinct events. This study will be looking at the financial and physical form of social support which can come from anyone within a person's social network, such as family, friends, and community members. In the United States the population of older adults is increasing, leading to a need for research involving the wellbeing of them in society. Previous research has shown a positive relationship in social support and quality of life among older adults in other countries (Unsar, Erol, & Sut, 2016). This study will investigate if males and females have differences when it comes to social support and depression. The goal of this research is to further understand the impact of intergenerational support on depression of older adults. We investigate the exchange of financial and physical social support to and from older person's adult children and the influence on the older parents' feelings of depression. We will analyze new data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) Parent Study. The Add Health is a longitudinal survey with a nationally representative sample of adults and their parents aged 50 to 80 (N=2,244). Studies of social strain and loneliness in older adult's lives has shown that children are the most important sources of support in later life (Chen & Feeley, 2014). Enhanced support and diminished strain directly and indirectly relate to improved well-being (Chen & Feeley, 2014). We expect that higher rates of physical support may increase depression among older adults while higher rates of financial help may decrease depression. This analysis will provide new information regarding later life depression and the well-being of older adults.

059
Name: Gill, Deven
Major: Mathematics
Faculty Advisor Name, Affiliation: Vaidyanathan Sivaraman, Mathematics and Statistics
Project Category: Physical Sciences and Engineering

Double-Threshold Graphs
Double-threshold graphs are graphs with special structure motivated from uniform sampling in phylogenetic trees in bioinformatics. These graphs are defined by the property that two vertices in the graph are adjacent if and only if the sum of the weights assigned to these vertices is no less than a fixed lower bound and no greater than a fixed upper bound: all graphs within this class are those for which there exists some distribution of weights satisfying this property. Recently Kobayashi, Okamoto, Otachi, and Uno posed the problem of structural characterization of graphs in this class. We have made major progress in presenting such a characterization. In particular we have found an infinite family of graphs and sixteen other graphs which are obstructions to being double-threshold: obstructions are defined as graphs which are minimally outside of a specific class meaning that if any single vertex is deleted from the graph the graph immediately falls into the class. We have designed new rules about the distribution of weights which dictate how these graphs are constructed; these rules are also used to facilitate the identification of specific graphs as obstructions and the construction of graphs that are candidates for obstructions. In addition, we have found specific conditions for which we know that the number of obstructions is finite. The proof under these conditions serves to give a means to construct such graphs which are not obstructions. Our conjecture is that we now have the complete list of all obstructions. Proving such a conjecture would completely settle the problem posed by the aforementioned researchers. Our current research focuses on proving this conjecture.

060
Name: Green, Addison
Major: Computer Science
Faculty Advisor Name, Affiliation: Matthew Priddy, Mechanical Engineering
Project Category: Physical Sciences and Engineering

Prediction of Plasticity Models using Neural Networks
Plasticity models have proved useful in investigating the properties of materials and their responses to varying applied forces. Finite element analysis (FEA) can be used to create computational simulations of these models, leveraging ever-increasing computing power to provide practical and efficient implementations of theoretical models. Depending on the size and complexity of a given simulation, the time and computational resources to run these simulations can still be undesirable – or even prohibitive. In response to this issue, our work aims to investigate the plausibility of using neural networks as a prediction method to augment existing plasticity simulations. Artificial neural networks (ANNs) are a subclass of artificial intelligence that use layers of nodes and weights to mimic the functionality of neurons in the human brain and make predictions about complex problems based on input data. For our work, training data is generated by existing computational simulations of a Johnson-Cook plasticity model. This model is run through Abaqus/Standard and python wrappers to apply loads in both a single direction and an arbitrary number of directions simultaneously. The data will be used to train a system of ANNs to make predictions about the output strain tensor based on factors such as temperature, strain rate, and the displacement tensor. This work also aims to investigate the use of these neural network models in conjunction with numerical methods, such as proper orthogonal decomposition, to reduce the complexity of the input data and – as a result – the neural network models. The accuracy and efficiency of this method will be evaluated in comparison to the traditional computational techniques to measure the benefits of neural networks to this application, with the ultimate goal of developing alternative methods for implementing simulations of plasticity models.

061
Name: Griffiths, Rudane
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Dr. Yizhi Xiang, Chemical Engineering
Project Category: Physical Sciences and Engineering

Efficient propane dehydroaromatization over ultralow loading Pt/HZSM-5 promoted with Cu

The increased production of shale gas significantly affected the landscape of the chemical industry. While the cost of ethylene has dropped, the prices of higher aromatics, such as benzene, toluene, and xylene (BTX) – all byproducts of naphtha/oil cracking – have increased as supplies have become constrained with the shift from naphtha to natural gas feedstocks. Consequently, there is an urgent need to develop an "on-purpose" technique to produce BTX from the cheap and abundant light alkanes to re-balance the market. BTX can be produced from propane through dehydroaromatization (DHA). The metal modified HZSM-5 bi-functional catalyst, such as Ga/HZSM-5, has been successfully employed in the Cyclar^{TM} process (UOP/BP) for BTX production from propane and butane. Besides the Ga/HZSM-5, the Pt/HZSM-5 catalyst also has a high potential for industrial application. However, the high cost and scarcity of Pt strongly restricted the application of Pt/HZSM-5 catalyst for light alkane DHA. Minimizing the Pt loading without sacrificing catalytic performance is particularly critical for designing cost-efficient hydrocarbon transformation catalysts. Unfortunately, most of the recent works use up to 0.1-1 wt% of Pt in their DHA catalyst. The Pt loading as low as 0.04 wt% was only reported in previous patents by Shell for ethane DHA. However, the cost of 0.04 wt% Pt catalyst is still about 4 times of that 1 wt% Ga. The activity of 0.01 wt% Pt/HZSM-5 catalyst in propane DHA can be significantly increased through alloying Pt with Cu nanocluster inside the micropore of HZSM-5. The specific activity of total BTX over the 0.01 wt% Pt/Cu_{SAAs}@HZSM-5 is ~4 times of the 0.01 wt% Pt/HZSM-5, ~3 times of the 2 wt% Ga/HZSM-5, and quite like the 0.05 wt% Pt/HZSM-5. The formation of Pt/Cu SAAs also increased the stability and total BTX selectivity.

062
Name: Hampton, Natalie
Major: Biological Sciences/Biological Sciences
Home Institution (Other than MSU): Tougaloo University
Faculty Advisor Name, Affiliation: Dr. Todd Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Chanaka Navarathna, Hannah Pray, Todd Mlsna
REU/Research Program: MSU REU-INFEWS Associated Summer Research Program 2021

Analysis of Microplastics (MPs) and Perfluoroalkyl substances (PFAS) in marine animal tissues

Plastics, including water bottles, eating utensils, and packaging containers, can adversely affect marine animal life. Improper disposal of these materials can pollute oceans worldwide leading to aquatic animal ingestion of macro and microplastics. Microplastics (MPs) are considered to be non-biodegradable debris that are less than 5 mm. MPs can serve as a vector to transport man-made surfactants [perfluoroalkyl substances (PFAS)]. PFAS can impact marine animals and can be very toxic to human health. These risks can include increased cholesterol levels and testicular cancer. In this work, MPs and PFAS from dolphin stomach contents were extracted using a pre-optimized KOH/methanol digestion and filtration via 9.8 µm filter paper. MPs were visually identified using a benchtop microscope (aided by Nile-red fluorescence staining). Fourier transformed infrared (FT-IR) spectroscopy, Raman spectroscopy, and pyrolysis gas chromatography (Pyro-GC) were used to confirm the identity of MPs. PFAS were pre-concentrated using solid-phase extraction (SPE) and analyzed by liquid chromatography quadrupole time of flight mass spectrometry (LC-Q-Tof-MS) using optimized EPA 537.1 method. PFAS extraction and analysis were validated using pike perch (IRMM-427) certified reference material. The overarching goal for this work is to establish a clear understanding of the distribution of MPs and PFAS contents in the tissues of various parts of the animal and to further optimize PFAS extraction and identification.

106
Name: Harjono, Jonathan
Major: Computer Science
Faculty Advisor Name, Affiliation: Junfeng Ma, Industrial and Systems Engineering
Project Category: Social Sciences

Virtual Reality to Enhance Nurse Training
During a time of the pandemic, healthcare workers such as nurses are indispensable. To ensure nurses can perform their tasks well, they need proper training. With the advancement in virtual reality technology, training modules can be made more efficient. For this project, we will be using the Unity Virtual Reality engine and the assets from the Unity asset store to create the training modules and simulate various activities that nurses will experience during training. To achieve this, the nurses will learn about required protection equipment, patient prioritizing, and interpersonal communication with the patients. Through virtual reality, training expenses and time can be reduced significantly and provide quick, quality training to more places. Quality training for nurses is a paramount aspect of healthcare.

063
Name: Hauer, Alanna
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Sean Stokes, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Joseph Emerson

Imine-Based Sulfonamide Inhibitors for AdcR
Sulfonamides are a class of compounds that have a wide degree of bioactivity. They possess the ability to act as inhibitors for proteins such as carbonic anhydrase and many others. The focus of this study is to synthesize some imine-containing sulfonamides through the reaction between sulfanilamide and a variety of different aldehydes. These compounds undergo a dehydration reaction to produce highly conjugated imines. Many of these products form crystalline solids that can be purified by recrystallization in the proper solvent. Once a multitude of imine-containing sulfonamides are created, these compounds will be tested for the inhibition of a transcription protein *AdcR* which is found in the virulent bacterium *Streptococcus pneumoniae*.

020
Name: Heidelberg, Lauryn
Major: Microbiology
Faculty Advisor Name, Affiliation: Dr. Shecoya White, Food Science, Nutrition, and Health Promotion
Project Category: Biological Sciences and Engineering
Co-Author(s): Maria Hildago, Dr. Juan Silva, Meredith Maynard

The Efficacy of Aqueous Chlorine Dioxide Application on Postharvest Blueberries
Blueberries are highly perishable and have a very short shelf life. This is a significant problem when storing and transporting blueberries long distances. Normally, blueberries are dried and placed in containers for shipping without any applied chemical preservatives. Chlorine dioxide (ClO_2) has been found to possess 2.5x the oxidizing capability of Chlorine, also requiring lower concentrations to achieve the same efficacy. It is widely used for decontamination on fresh horticultural produce and is safely consumed in small amounts. It is a disinfectant that effectively kills microorganisms such as fungi, bacteria, and viruses. This study was conducted to evaluate the effectiveness of various concentrations of a ClO_2 wash to extend the shelf life and quality of postharvest blueberries. Blueberries from three different farms were placed on metal racks and sprayed with aqueous chlorine dioxide solutions (0, 2, 3, 6, and 10 ppm) and dried for 40 minutes at 20°C in a biosafety cabinet. The treated blueberries were then placed on Potato Dextrose Agar (PDA), to cultivate natural yeast and mold, and stored at 20°C for 6 days. Visual inspection of blueberries, percentage of yeast and mold on plates, and pH was recorded every two days throughout the study. Sensory was also conducted to determine any adverse taste associated with the application of ClO_2. There was no significant difference in pH among treatments. Compared to the

control and other treated samples, 10ppm of ClO_2 caused the most reductions in populations of yeast and molds on blueberries ($P<0.05$). None of the ClO_2 treatments markedly affected the sensory quality of blueberries for long term usage. Based on this study, no significant differences were found between different farms or concentrations. ClO_2 washing with these concentrations is not an effective way of decreasing the yeast and mold growth, alternative applications need to be explored.

021
Name: Hejny, Madison
Major: Biochemistry
Faculty Advisor Name, Affiliation: Nicholas Fitzkee, Chemistry
Project Category: Biological Sciences and Engineering
Co-Author(s): Dhanush L. Amarasekara

Engineering a fusion protein on photothermally enhanced gold nanoparticles for bacterial targeting.
Biofilms are multicellular structures that can form an elastic matrix and thrive on a variety of surfaces. Many forms of bacteria will colonize their hosts to form these biofilms, and biofilms can prolong or facilitate the survival of bacteria in diverse environments. *Staphylococcus epidermidis* is a biofilm-forming bacteria found in hospital environments and is the root of many hospital-acquired infections. Once this bacterium forms a biofilm, it is resistant to multiple antibiotics and therefore can be extremely difficult to kill. Gold nanoparticles (AuNPs) produce a photothermal effect when exposed to high temperatures and can potentially be useful as a photothermal therapy for biofilms. Previous work in our lab has provided a way to enhance this photothermal effect at lower AuNP concentrations by using elastin-like polypeptides (ELP) to functionalize the nanoparticles (AuNP@ELP). In this project, we seek to develop an anti-biofilm photothermal therapy using this novel functionalized AuNP. Here, we additionally functionalize AuNPs with the R2ab protein. R2ab is an autolysin protein domain that binds to the cell walls of *S. epidermidis*, and we hypothesize that, when attached to AuNPs along with ELP, the R2ab domain will specifically target AuNP@ELP to *S. epidermidis* biofilms. In order to test this hypothesis, we have begun to generate a fusion protein of R2ab and GB3 using molecular cloning. In this construct, GB3 will stably attach the R2ab domain to the AuNP surface, allowing R2ab to retain its function and structure. We have purified plasmids of R2ab- and GB3-encoding DNA, and we are currently working to ligate these segments into a usable expression plasmid. If successful, this approach could have the potential to treat *S. epidermidis* biofilms when traditional antibiotics are ineffective.

064
Name: Henkel, Benjamin
Major: Physics
Faculty Advisor Name, Affiliation: Dr. B. P. Crider, Physics
Project Category: Physical Sciences and Engineering
Co-Author(s): R. J. Unz, C. McCormick, S. D. Lusby, L. T. Allen

Continued Development of Software for GeGI Data Analysis
Depleted uranium (DU) that is used in military munitions and left over from other processes pollutes the soils and environments of many different locations. Since the most common isotopes of uranium, uranium-235 and uranium-238, can undergo radioactive decay to produce a chain of emitted radiation such as alpha particles and gamma-rays, these leftover chunks of dangerous material can be detected using gamma-ray detectors and then removed using appropriate extraction tools. A Germanium Gamma-ray Imager (GeGI) Detector is used in conjunction with autonomous robotic platforms to detect the location and intensity of gamma-ray sources in such an environment. Data taken during this detection process must be interpreted, filtered, and analyzed before it is useful to scientists. To simulate and understand the field characteristics of the GeGI, the detector is being used on an automated gantry system in a lab-controlled environment to collect useful data and has a built-in tablet with software that analyses and converts to a useful form the data that is collected. Currently, the GeGI is only capable of being used as a standalone radiation detection system. In order to enable integration of this detector within a larger detection/sensor package, new software is being written to convert raw data to a more universally usable format. Comparisons are being made between the GeGI software and ours

in order to determine necessary changes to ensure accurate analysis can be performed. This will allow us to perform efficient and customizable analysis of multiple data sets from multiple detectors. Progress on the development of this software as well as comparison strategies/metrics between the software types will be presented.

065
Name: Heson, David
Major: Physics
Faculty Advisor Name, Affiliation: Gombojav Ariunbold, Physics and Astronomy
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Haifeng Wang (MSU Industrial Engineering)

Microplastic Image Enhancement Using U-Net Based Deep Learning Algorithm
Image enhancement is an emerging application area of using deep learning algorithms, as it provides the possibility of enhanced edge and fewer or none artifacts remaining from traditional issues such as parallax error. The purpose of this project is to create high resolution well-detailed images out of a series of overlapping microplastic optical scan patches. A modified U-Net model is proposed to remove concatenation lines and smooth the minor shape and lighting differences which appear from simply combining the image patches together. The current result is an image with remaining concatenation marks, and loss of edge sharpness in the microplastics. By proposing a new image enhancement process for our problem, we finally greatly improve the quality of the original image and obtain a cohesive image with no major lighting differences between areas and maintain the overall integrity and positioning of the microplastic cells. We expect to expend this research to biomedical field for tissue scanning and analysis.

066
Name: Hooper, Mattea
Major: Chemistry
Home Institution (Other than MSU): Tennessee Wesleyan University
Faculty Advisor Name, Affiliation: Dr. Steven Gwaltney, Chemistry
Project Category: Physical Sciences and Engineering
REU/Research Program: HPCC REU- Computational Methods with Applications in Materials Science

Near Infrared Emission and Absorption of Xanthene Derivatives for Advancement in Bioimaging
Molecules with near infrared emissive and absorptive properties are important for bioimaging because they offer low background autofluorescence, large penetration depth, and long excitation wavelengths that are less harmful to cells than ultraviolet light. The fluorescent properties of xanthene derivatives make them useful as biological dyes. The purpose of this project is to determine how modifying pH-dependent xanthene derivatives affects the wavelength at which they emit in order to develop near infrared emissive xanthene derivatives. This is done by expanding the π-conjugation length of the molecule or by modifying the conjugated system with electron donors and acceptors. A set of conformers for each molecule of interest is generated with molecular mechanics. The sets of conformers are put through a series of calculations that allow for higher energy conformers to be removed leaving only the lowest energy conformers. Ground-state equilibrium geometry calculations with the semiempirical PM6 method, as well as density functional theory calculations with the ωB97X-D functional and the def2-SV(P) and def2-SVPD basis sets were performed. Once the sets of conformers are reduced to only the lowest energy conformers, their excited state energies, intensities, and geometries are calculated. These results are then compared in order to identify how modifying the xanthene derivatives affects their fluorescence and absorption. The observation of trends can suggest new possibilities for near infrared emissive and absorptive xanthene derivatives in bioimaging.

067
Name: Huggins, Hannah
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Miguel Muñoz, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Mariana L. Díaz-Ramírez
REU/Research Program: Chemistry Undergraduate Summer Research Program

Seeking Large Group 13 Metallacalixarenes Derived from Benzimidazole Ligands and AlMe3 and GaMe3

Calixarenes are cyclic oligomers assembled through the condensation reaction between alkylphenols and formaldehyde, forming ring sizes of n = 4 through n = 20. These structures encompass an electron-rich cavity induced by hydrophilic and hydrophobic aromatic rims and hydroxide interactions. This cavity gives way to accommodation of host molecules through cation-π, H-bonding, π- π stacking, anion- π, and Van der Waal noncovalent interactions. Calixarenes have applications in biosensing, bioimaging, drug therapy, phase-transfer agents, and supramolecular chemistry due to their multiple binding sites and ability to self-assemble. Modification of calixarenes include functionalization of rims and methylene bridge replacement to induce electronic properties and solubilities. Substitution of methylene bridges with a metal center of square planar or tetrahedral geometry generate capable hosts for electron-deficient cavities, sought after for their catalytic capabilities. These metallacalix[n]arenes have been previously reported with Cu(II) or Pt(II) centers with imidazole and benzimidazole-based ligands. Group 13 centers, however, have not been extensively researched. From our previous reports, reactions between benzimidazole or 2-methylbenzimidazole with $AlMe_3$ or $GaMe_3$ yields metallacalix[4]arenes, with short metal center substituents showing increased host abilities due to larger cavities. From this, aluminum and gallium metallacalixarenes with larger than n = 4 substituents are derived through the elimination reactions of $AlMe_3$ or $GaMe_3$ with benzimidazole ligands with bromide or ethyl groups at the 2-position. Tetrameric species arose from 2-bromo1H-benzimidazole derivatives while hexameric and pentameric species arose from 2-ethyl-1H-benzimidazole derivatives for aluminum and gallium, respectively. These species were characterized by spectroscopic methods and SCXRD.

068
Name: Huggins, Morgan
Major: Chemical Engineering
Home Institution (Other than MSU): The University of Alabama
Faculty Advisor Name, Affiliation: Dr. Collen Scott, Department of Chemistry
Project Category: Physical Sciences and Engineering

Phenothiazine and carbazole-containing polymers as polyaniline-derivatives

Polyaniline (PANI) is a conducting polymer that is mostly studied for its electrical, redox, and mechanical properties. However, PANI is not soluble or redox stable; thus, we have prepared PANI-derivatives based on the phenothiazine and carbazole cores to investigate their redox stability and solubility. These polymers can be utilized for their electrochemical stability as biosensors, batteries, and supercapacitors. For example, our polymers can be used as sensing agents that can selectively detect hydrogen peroxide (H_2O_2) in a biosensor application. The starting materials for the PANI-derivatives (phenothiazine, and carbazole) are based on conjugated, polyaromatic, heterocyclic compounds found in dyes, reoccurring antibiotics, and anti-cancer agents. These PANI-derivatives are prepared by polymerization of phenothiazine, and carbazole with 2,5 dimethyl-*p*-phenylenediamine and *p*-phenylenediamine as the other monomer using the Buchwald-Hartwig Cross-coupling reactions. Here we performed a detailed comparative study of the effect of dopant concentration and dopant types on PANI-derivatives, using ultraviolet/Visible spectroscopy (UV/vis) to evaluate the change in the polymer as it goes from an emeraldine base to an emeraldine salt. The different dopants used for doping the PANI are polystyrene sulfonic acid (PSS), trifluoroacetic acid (TFA), camphor sulfonic acid (CSA), hydrochloric acid (HCl), and dodecylbenzene sulfonic acid (DBS). Future study will investigate how the different dopants affect the crystallinity of PANI-derivatives by pXRD. We will present our data as a poster presentation.

069
Name: Huynh, Alexander
Major: Physics
Faculty Advisor Name, Affiliation: Tung-Lung Wu, Statistics; Asanka Duwanke, Statistics
Project Category: Physical Sciences and Engineering
REU/Research Program: REU CCS

Irregular Shaped Cluster/Anomaly Detection in Images of Nanofibrous Materials
Anomaly detection has yet to be fully developed for a general usage case. Though anomalies appear in everyday phenomena, there exists no universal method to detect such occurrences. There are only methods that work better than others. Applications of anomaly detection include better prospective/retrospective analysis in manufacturing, retail, security defense, etc. For example, with reference to the Covid-19 pandemic, anomaly detection can fine-tune dynamically changing parameters in the SIR(Susceptible, Infected and Recovered) for more accurate outcome projections. The aim of this paper was to employ scan statistics as a method of anomaly detection, as opposed to a Machine Learning algorithm, due to its embedded statistical hypothesis testing. Generally, Machine Learning techniques lack mathematical rigor, i.e. hypothesis testing, which provide consistent interpretability of the dataset. For the purposes of anomaly detection in nano-materials, the performance of scan statistics will be explored in hopes to show increased performance due to its statistical approach.

022
Name: Jennings, Madalyn
Major: Poultry Science
Faculty Advisor Name, Affiliation: Reshma Ramachandran, Poultry Science
Project Category: Biological Sciences and Engineering
Co-Author(s): Li Zhang, Pratima Adhikari

Evaluation of antibiotic resistance pattern of Avian Pathogenic Escherichia coli isolated from broiler breeders with colibacillosis from Mississippi
Avian Pathogenic *Escherichia coli* (APEC) is a pathogen that causes colibacillosis in poultry. Colibacillosis is a localized or systemic infection manifested as septicemia, omphalitis, airsacculitis, salpingitis, and peritonitis. Traditionally, the subtherapeutic use of antibiotics as growth promoters was successful in controlling APEC infections in poultry; however, the withdrawal of growth promoter antibiotics due to the emergence of multidrug resistant bacteria has increased the morbidity and mortality rates due to APEC infections causing huge financial losses to the poultry industry. Therefore, to develop alternative intervention strategies to control APEC there is a need to characterize the APEC strains. Thus, the objective of this study was to evaluate the antibiotic resistance pattern of APEC strains isolated from broiler breeders with symptoms of colibacillosis presented at the Poultry Research and Diagnostic Laboratory, MSU. A total of twenty-eight APEC isolates recovered in MacConkey agar and further confirmed by real-time PCR for *ybbw* gene were used. The antibiotic resistance pattern of these isolates were evaluated against ten extensively used antibiotics in poultry. These isolates were screened for antibiotic resistance genes using PCR, and sixteen isolates were tested for antibiotic susceptibility using the Kirby-Bauer disk diffusion method. The tetracycline gene *tetA* (68%); the aminoglycoside genes *aph(3')-Ia* (50%) and *aadA* (25%); the β-lactamases-encoding genes *blaTEM* (18%) and *blaCTX-M* (14.3%); and the sulfonamide gene (14.3%) were identified in these APEC isolates. Furthermore, 19% of the isolates showed multi-drug resistance with maximum resistance towards tetracycline (31.3%), followed by Kanamycin (19%), and Streptomycin (6.3%). In conclusion, this study exhibits high prevalence of antibiotic resistance genes and multi-drug resistance among APEC strains isolated from diseased broiler breeders in Mississippi. Further studies on the virulence characteristics and transmission of these antibiotic resistance genes are required to develop intervention strategies to control APEC.

023
Name: Jessup, Ainsley
Major: Food Science & Technology
Faculty Advisor Name, Affiliation: Dr. Shecoya White, Food Science, Nutrition and Health Promotion; Dr. Richard Baird, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Leah Brown, Felix Atsar, Katie Evans, Jacinda Leopard, Jailyn Smith

Influence of Rhizopus stolonifer on Post-harvest Quality of Sweet Potatoes and Serrano Peppers Held in Differing Storage Climates

Rhizopus stolonifer is a fungus in the Zygomycota phylum. This bread mold is a prevalent problem in the food industry impacting various food products, such as produce. In the United States, 40% of all food produced is wasted (Rogers, 2013). Produce is one of the most common foods wasted due to spoilage related fungal infection. The objective of the study was to determine the effect of *R. stolonifer* on the weight change and texture of sweet potatoes and serrano peppers held at various temperatures. In this study, sweet potatoes and serrano peppers were bought from a local grocery store. All produce was sanitized using a series of cleanings. A designated portion of the sanitized sweet potatoes were then cut into 1 inch thick slices. After sanitization, half of all produce samples were inoculated with *R. stolonifer* pure culture; the other half were used as negative controls. Each produce type was further divided into three temperature groups: 18℃, 24℃, and 37 ℃. They were stored in their respective temperatures for 8 days, and their weights were recorded on days 0, 3, 6, and 8. The results showed that as time progressed, all control whole and sliced sweet potatoes weights increased regardless of temperature, except the sliced sweet potatoes stored at 37 ℃. All weights for the inoculated sweet potatoes decreased regardless of temperature. The most noticeable weight change for all the sweet potatoes occurred at 37℃. Meanwhile, the weights of both the control and inoculated peppers decreased regardless of temperature. The most significant weight changes in all pepper samples occurred at 37℃. As the rate of decay increased, firmness decreased for all samples. This study shows that *R. stolonifer* infection can cause decrease in weights of both sweet potatoes and serrano peppers.

070
Name: Johnson, Ian
Home Institution (Other than MSU): University of Southern Mississippi
Faculty Advisor Name, Affiliation: Santanu Kundu, Chemical Engineering, Mississippi State University
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Mahesh Gangishetty
REU/Research Program: REU-Optoelectronics

Electrospinning Optically Active Polymer Fibers Containing Perovskite for use in Fibrous LED Devices

Optoelectronic devices are classified as devices that detect and control light. Recent studies have shown that perovskite materials form the most promising next-generation solar cells and LEDs. Perovskites are materials whose structure is similar to that of mineral calcium titanium oxide. Here, we investigate the possibility of adding optically active perovskite into a polymer fiber via electrospinning. Electrospinning is a well-studied process used to create polymer fibers on the micro and nano scale. This is achieved by using a constant voltage flow to force a polymer solution to be ejected from a needle as a fine fiber. A viscous polymethyl methacrylate solution was combined with a solution containing $CsPbBr_3$ particles and electrospun into fibers in the range of 2 to 5 micrometers in diameter. The fibers were optically active upon exposure to ultraviolet radiation, fluorescing in a green color. The same process was then used to spin a core-sheath fiber using a coaxial needle with differing colors in each layer for use in LED devices.

071
Name: Johnson, William
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Dennis Smith Jr., Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Ernesto I. Borrego, Saidulu Gorla, Sumudu Athukorale, Alison K. Duckworth, Santanu Kundu, Hossein Toghiani, Charles U. Pittman Jr.
REU/Research Program: Chemistry Summer Undergraduate Research Program

Carbon-Carbon Composites from Ortho-diynylarene Resins

Carbon-Carbon (C/C) Composites are valuable aerospace materials that are currently being sought for hypersonic vehicles. They are high strength, low density materials that have low coefficients of thermal expansion and can survive extreme, high temperature conditions (>2000°C) while maintaining their physical and mechanical integrity. Monoand bis-*ortho*-diynylarene (ODA) monomers have been shown to undergo a heat-propagated Bergman cyclopolymerization to create polynaphthalene networks, which produce glassy carbon in high yields (>80%) after a nonoxidative pyrolysis. These superior carbon yields are expected to impart improved composite mechanical properties with lower processing times than the current industrial standard (i.e. phenolic-derived C/Cs). Thus, a kilogram scale synthesis of three ODA monomers was carried out herein and their homo- and respective co-monomer mixtures were used as matrix precursors for fabricating C/C composites. For each ODA homo- and co-monomer mixture, dynamic mechanical analysis (DMA) was used to determine an optimal processing temperature and viscosity profile suitable for carbon fiber impregnation. With the processing conditions dialed in, a series of ODA-derived C/C composite panels were fabricated via vacuum-assisted resin transfer molding (VARTM) and hot mechanical pressing. Mechanical tests of these ODA-derived panels were done and the results were compared against phenolic-derived C/C panels. The fractured composites were analyzed by scanning electron microscope (SEM) to study the different types of failure mechanisms occurring and subsequently examined by Raman, XRD, density measurements, and computed tomography (CT) scanning.

072
Name: Jordan, Brian
Major: Biological Sciences
Home Institution (Other than MSU): Tougaloo College
Faculty Advisor Name, Affiliation: Sid Creutz, Chemistry Department
Project Category: Physical Sciences and Engineering
REU/Research Program: REU-INFEWS

Synthesis of Chalcogenide Perovskites from Single Source Dithiocarbamate Precursors

Perovskites are materials that have a crystal structure similar to the original perovskite mineral, $CaTiO_3$. Lead halide perovskites ($CsPbX_3$, X= I, Cl, or Br) have been used in the development of solar photovoltaic cells for a short time, but they have shown potential to be highly effective. Chalcogenide perovskites such as $BaTiS_3$ and $BaZrS_3$ are semiconductor materials that can be just as effective as lead halide perovskites but may be more stable and less toxic. The goal of this project is to optimize and study making $BaTiS_3$ nanocrystals from single source precursors and to extend the development to $BaZrS_3$, $SrTiS_3$, $CaTiS_3$, and $SrZrS_3$. This project uses a Ba^{2+} and Ti^{4+} dithiocarbamate ($-S_2CNR_2$) precursor that will react to form $BaTiS_3$. The Ti^{4+} dithiocarbamate precursor has a diisopropyl substituent $Ti(S2CNiPr2)_4$ while there are four different Ba^{2+} dithiocarbamate precursor substituents $Ba(S_2CNR_2)_2$ which are diisopropyl (R=iPr), diisobutyl (R=iBu), dicyclohexyl (R=Cy), and dibenzyl (R=Bn). Nanocrystals are synthesized using a heat-up method with temperatures around 360 ˚C. Once the products are made, they are put through powder x-ray diffraction analysis to determine their crystal structure compared to a reference pattern of $BaTiS_3$. Through experimentation, it has been found that the ideal stoichiometry is a 2 to 1 ratio of Ba^{2+} to Ti^{4+} in making $BaTiS_3$. Also, the diisobutyl (R=iBu) Ba^{2+} precursor has been shown to produce the optimal results through x-ray diffraction. The results have shown that $BaTiS_3$ nanocrystals can be synthesized using single source dithiocarbamate precursors.

024
Name: Ladison, Abby
Major: Animal & Dairy Sciences
Faculty Advisor Name, Affiliation: Dr. Derris Burnett, Animal and Dairy Science
Project Category: Biological Sciences and Engineering
Co-Author(s): Amberly A. Dennis, Thomas W. Dobbins, Julia Tate, Caleb O. Lemley

The Effect of Maternal Melatonin Supplementation During Gestation on Fetal Body Weight and Morphometric Measurements in Developing Porcine Offspring

In litter bearing species such as the pig, increasing the number of fetuses often results in greater incidences of intrauterine growth restriction (IUGR) which negatively impacts postnatal growth potential and lifetime production efficiency. Melatonin is an endogenous hormone, however, providing it exogenously has been proven in bovine and ovine models to rescue compromised pregnancies by increasing uteroplacental blood flow and nutrient delivery to the developing fetus. The purpose of this study was to determine the impact of maternal melatonin supplementation on fetal bodyweight and potentially reduce the incidence of IUGR offspring. A total of 24 gestating sows across 2 replicates were supplemented with (MEL; n=11) or without (CON; n =13) 20mg/sow/day of melatonin. Treatment was provided by top-dressing 2mL of 10 mg/mL melatonin dissolved in ethanol over the daily ration. Daily feeding occurred at 08:00 for each replicate. The sows underwent terminal hysterectomy at day 98-100 of gestation for the first replicate and day 106-107 for the second replicate, taking place at 05:00 and 17:00. All fetuses from each litter were counted and subjected to morphometric measurements to determine body weight, curved crown rump length (CCR), abdominal girth, and head width. The major finding was that fetuses from melatonin treated sows had increased birth weights across both replicates ($P \leq 0.023$; Fall MEL=895.49 vs. CON=842.51 grams; Spring MEL=1227.27 vs. CON=1153.45 grams). In addition, these offspring had greater CCR (Spring replicate; $P = 0.0014$) , abdominal girth (Spring replicate; $P = 0.0197$), and head width (Fall replicate; $P = 0.0260$) compared to offspring from CON sows. As the modern pig industry continues to select for increased litter size in sows, there will be a critical need to mitigate the negative impacts particularly in IUGR offspring. These data indicate that melatonin supplementation during gestation has the potential to rescue IUGR fetuses.

025
Name: Lee, Jacob
Major: Computer Science
Faculty Advisor Name, Affiliation: Dr. Sathish Samiappan, Geosystems Research Institute
Project Category: Biological Sciences and Engineering

Soil organic carbon estimation in croplands using hyperspectral remote sensing and deep learning neural networks

Determination of soil organic carbon (SOC) involves invasive and tedious lab analysis that can be expensive and time consuming. This research aims to develop a noninvasive, efficient method to determine SOC using hyperspectral data and deep learning neural networks (DLNN). Over 150 soil samples were collected from croplands across Mississippi, and 1500 spectral signatures were collected using a handheld spectroradiometer in the range of 350 – 2500 nm using a soil probe, and the SOC values were determined using the combustion method and a CNS analyzer. Traditional approaches such as multilinear regression, and support vector regression were studied in comparison with state of the art DLNNs. Particularly, the efficacy of multilinear regression, ridge regression, lasso regression, elastic-net regression, support vector regression (SVR), and DLNNs were studied to establish a correlation between the spectral data and SOC. This study focuses on agricultural soils with SOC between 0.0 and 4.0, though the research will widen its scope following the completion of this study. Pilot experiments show that correlation between hyperspectral signature and SOC values are strong enough to estimate organic carbon levels accurately, the multilinear models yielding R^2 ranging from .618 to .899, and SVR's R^2 values ranging from .63 to .86 and awaiting results from DLNNs. Initial experiments show that noninvasive, easy, and cost-saving method for estimating hotspots of SOC storage in agricultural systems can be achieved to predict and understand the effects of agricultural practices on SOC changes by monitoring and mapping the spatial variability of soil organic carbon. These findings could have multiple implications in the agricultural field, namely the ability to gather accurate information regarding the SOC that is both in-situ and computationally efficient.

073
Name: Lee, Kyung Won
Major: Mechanical Engineering
Faculty Advisor Name, Affiliation: Joonsik Hwang, Mechanical Engineering
Project Category: Physical Sciences and Engineering

The Safety System with IOT
Innovations may only be deemed a contribution to human development when it is without hazard. Irrespective to location, prioritizing safety first is proper when conducting research. When the objective of research promotes invention, an improper sacrifice of safety makes advancement inadequate and cannot be seen as the right direction for mankind to move forward. By eliminating safety risk factors, every single researcher and worker can perform their best. For this reason, designing a safety system is necessary for laboratories and research facilities.

I propose an environmentally integrative solution. Single board computing connects experimentation with sensors to collect data information about light intensity, amount of carbon dioxide, amount of TVOC (Total volatile Organic Compound), temperature, humidity, and pressure.

Furthermore, the information is accessible with ease to its permitted persons under Wi-Fi connection. Display on the sensor mount surface allow the visualization of the status in the lab. In addition, an alerting speaker is installed for preventative measure and emergency purposes. This installment is a safety feature that blares a sound to minimize casualties. In the event of danger and subsequent alarming, the system will self-prompt to send an email to its permitted persons notating with graphic figures detailing the imminent nature of danger. In addition to the mounted sensor, is a thermal camera and a vibration sensor that visualizes and quantifies safety when the experiment is running.

074
Name: Lewis, Timothy
Major: Chemistry
Home Institution (Other than MSU): University of Mississippi
Faculty Advisor Name, Affiliation: Santanu Kundu, Chemical Engineering, Mississippi State University
Project Category: Physical Sciences and Engineering
Co-Author(s): Humayun Ahmad
REU/Research Program: REU Program in Optoelectronic Materials

Electrospinning of Poly(3-hexlthiophene) with Insulating Polymer Matrices for Use in Optoelectronic Applications
The field of optoelectronics is a rapidly growing area of scientific inquiry, covering a wide class of materials that are capable of transforming electrical input into optical output, or vice-versa. Many different materials can serve as these important energy transducers, and one of the most versatile of these is micro/nanoscopic fibers. Microfibers can be either naturally occurring or synthetically manufactured, but in either case can, depending on their composite substance, function as an electrically conductive material. Of particular interest are organic polymer-based fibers: organic polymers are not only easily accessible and generally inexpensive but are also highly customizable to fit the needs of both the fiber-spinning method desired as well as the properties of the fiber itself. For example, poly(3-hexlthiophene), or P3HT, is a commonly used and well-studied polymer that exhibits electrical properties owing to its conjugated structure. Fiber spinning of P3HT has been attempted numerous times in previous experiments, yet great difficulty was encountered in obtaining fibers with uniform diameter and electrical properties. Recent attempts in literature, however, suggest that this problem can potentially be alleviated by spinning the conductive polymer in conjunction with an additional insulating polymer. Insulating polymers, such as polystyrene (PS), polyethylene oxide (PEO), and poly(methyl methacrylate) (PMMA), are widely available and facile to work with, owing to their low toxicity and high solubility in most organic solvents. To investigate the feasibility and results of blending P3HT with an insulating polymer, solutions of varying concentrations and secondary polymer identities were spun using the electrospinning method. The resultant fibers were characterized using both optical and scanning electron microscopes as well as differential scanning calorimetry. After determining the solution composition required to produce uniform fibers, we plan to examine the morphological properties of each fiber as well as the electrical properties using the single-fiber conductivity method.

075
Name: Liao, Kevin
Major: Electrical Engineering
Faculty Advisor Name, Affiliation: Yu Luo, Electrical and Computer Engineering
Faculty Advisor Affiliation: ECE
Project Category: Physical Sciences and Engineering

Semi-Passive Wake-Up Radio Based Time Synchronization for Ultra-Low-Power Wireless Devices
The applications of precision agriculture and environment monitoring require the participation of a large number of sensors. Consider a scenario where sensing nodes are deployed in the field, sensing and monitoring the environment (e.g., soil moisture, temperature, etc.). We use a drone to a data mule that will collect data from sensing nodes through wireless communications.

To preserve energy, the sensors will stay in sleep mode most of time and wake up when sensing or communication is needed. Communicating with sleeping devices will require activation and time synchronization. In the conventional synchronization schemes, communication entities synchronize with each other by exchanging timestamp messages, which is too energy hungry and unsuitable for ultra-low-power devices.

In our previous work, we developed a fully passive wake-up radio (WUR) based time synchronization that achieves comparable synchronization accuracy with much less energy cost than existing solutions. The drone will act as a central node that broadcasts WUR signals to synchronize nearby nodes. However, the fully passive WUR-based method has low sensitivity. The drone (i.e., WUR signal transmitter) needs to be very close to sleeping nodes so that the output voltage of WUR circuit will be strong enough to generate an interrupt to wake-up the devices.

To address the low sensitivity issue, we propose a semi-passive WUR-based time synchronization method that connects a low-offset comparator to the WUR circuit. When the output voltage of WUR circuit is higher than the reference voltage of the comparator, a high voltage will be generated to activate the sleeping nodes. Since the reference voltage of the comparator is very small, an input WUR signal as low as -45 dBm is strong enough to activate and synchronize the nodes, which significantly improves the working range of the drone.

076
Name: Lindsey, Shelby
Major: Chemistry
Faculty Advisor Name, Affiliation: Sid Creutz, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Ryan Gaynor, Ge Mu
REU/Research Program: Chemistry Department Summer Research Program

Manganese Polyimidazole Chelates
The protein calprotectin plays an import role in the human immune system as the only known manganese sequestering biomolecule. For calprotectin, a hexahistidine binding site sequesters manganese from pathogens or bacteria, prohibiting proliferation. Inspired by calprotectin, this work focuses on manganese chelation using polyimidazole type ligands. 1,4,7- triazocyclononane was used in the synthesis of the chelator. The imidazoles were attached to the 2o amines of 1,4,7- triazocyclononane forming 3o amines. The nitrogens of 1,4,7-triazocyclononane and the imidazoles are electron donating, making the coordination site more susceptible to metal binding. The effectiveness of ligand binding to manganese and other metals was studied. Imidazoles containing a variety of steric groups, as well as electron-donating and electron withdrawing groups were synthesized. The effect of these groups on manganese affinity was investigated. The computational, spectroscopic, and structural properties of the complexes were studied, providing insight on the unusual manganese sequestering binding site of calprotectin.

026
Name: Loganathan, Arvind
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Matthew Priddy, Mechanical Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Logan Betts

Modeling Crestal Bone Loss Around Dental Implants Using Finite Element Analysis
Bone remodeling is a complex, mechanobiological phenomenon. Physiological regulators such as parathyroid hormone and calcitriol facilitate bone resorption and growth in response to external mechanical stimuli. Osteoclasts break down the mineralized tissue, and osteoblasts subsequently reform and reorient the bone matrix in a manner most favorable to the mechanical stimulus place upon it. In dental applications, bone remodeling is especially important to study whenever monitoring dental implant behavior in a patient. Crestal bone loss is a product of bone resorption around the abutment, which is where the implant meets the prosthesis. This condition occurs within a year of loading the implant and can lead to multiple issues including implant fracturing and loosening. The result of this bone loss can be attributed to occlusal overload, which means that the chewing force or occlusal force is greater than the implant can withstand. Studying crestal bone loss in an experimental setting is useful for obtaining data such as bone density change over time; however, the process is time-and resource-intensive. This phenomenon transpires over the course of a year and requires careful monitoring of a large group of patients to obtain useful data. Instead, Finite element analysis (FEA) can serve as a practical alternative and supplement for studying crestal bone loss. In this project, we used Abaqus/Standard to model crestal bone loss around pure titanium grade IV dental implants. A Fortran user-subroutine (UMAT) was developed to simulate bone remodeling as a function of mechanical stimulus. This remodeling rule is based around the Isotropic Stanford Model and includes a damage evolution criterion to model bone loss due to occlusal overload. By validating the results of our model with experimental data, our simulation has the potential to predict crestal bone loss even before surgically inserting the implant into a patient.

077
Name: Lund, Timothy
Major: Mathematics
Home Institution (Other than MSU): Houghton College
Faculty Advisor Name, Affiliation: Gautam Rupak, Physics
Project Category: Physical Sciences and Engineering
REU/Research Program: Computational Methods with Applications in Materials Science

Bayesian parameter estimation and model comparison
Radiative neutron capture on carbon-14 is important in astrophysics due to its role in the neutron-induced carbon-nitrogen-oxygen cycle in the helium-burning regions of stars. The reaction cross section can be calculated in terms of a few unknown parameters, and a systematic expansion for the leading and next-to-leading order expressions for the cross section is obtained. This allows for uncertainty quantification of the theoretical calculations from the expansion. However, there is ambiguity regarding the sizes of the cross section parameters, affecting how the perturbative expansion is organized and leading to different theoretical expressions. Bayesian analysis is applied to determine the unknown parameters as well as to compare the evidence from the data in favor of each theoretical expression. This framework for comparing different theory expressions is useful in nuclear physics, as the construction of a microscopic theory of protons-neutrons often depends on assumptions about the sizes of unknown parameters. We use Nested sampling for the analysis, which relies on Markov Chain Monte Carlo simulation.

078
Name: Lusby, Samuel
Major: Physics
Faculty Advisor Name, Affiliation: Ben Crider, Physics and Astronomy
Project Category: Physical Sciences and Engineering
Co-Author(s): Ben Henkel, Caitlin McCormick, Lea Allen

Development of Automated Mechanisms for the Gantry Test Bed
Depleted uranium (DU) and its decay products, which emit gamma radiation, are environmentally damaging and can pose a public health hazard. Areas with large quantities of radiated material specifically depleted are normally found below the surface. It is crucial to identify and clean these areas. However, the process of both locating and removing the radioactive material are extensively time consuming and resource intensive. A new, automated system for the location of DU is being designed and implementation efforts will be developed, tested, and characterized through the utilization of a sandbox test bed gantry system with a movable mounted Germanium Gamma-ray Imaging detector (GeGI). Control of the detector's position has been performed using the LabVIEW systems engineering software. Now, steps have been taken to fully automate all aspects of gantry motion and data collection. This test bed gantry system, which acts as a simulated observational environment, will enable the development of automated processes that can be utilized for the search and identification of radioactive material by autonomous robotic platforms. Thus far, fully automated data collection using a minimal set of user-input parameters has been implemented. This includes using a logic pulse generation technique to control the GeGI's external data acquisition system all through the LabVIEW interface, enabling the user to fully determine where and for how long the GeGI will acquire data in the lab-controlled environment. Development of the gantry system's graphical user interface (GUI) has been furthered to streamline the usage of the newly implemented automated features of the system. The progress on the automation of the test bed system will be presented.

079
Name: Maldonado, Joshua
Major: Physics
Home Institution (Other than MSU): Humboldt State University
Faculty Advisor Name, Affiliation: Amanda Diegel, Mathematics, Mississippi State University
Project Category: Physical Sciences and Engineering
REU/Research Program: REU Computational Methods with Applications in Materials Science

Numerical Verification and Simulation of a Two-Phase Fluid Flow Process
In this project, we look at a numerical method that models a two-phase fluid flow process, specifically we consider a second order in time, mixed finite element method (FEM) for the Cahn-Hilliard-Navier-Stokes (CHNS) system of equations. The CHNS system we consider simulates a two-phase fluid flow process in which it is assumed that the two different fluids have similar densities. The analysis of the FEM has been completed and it has been proven that the method is unconditionally energy stable, uniquely solvable, and unconditionally convergent. This project is focused on verifying and supporting the conclusions of that analysis by tracking the numerical energy and computing convergence rates.

We will also be considering different boundary and initial conditions in order to simulate real-world processes. We will be building code using python and a software package utilizing some well-established FEM programming libraries. Our priority is to verify the conclusions of the paper, however a secondary goal is to use the high performance computing resources at the High Performance Computing Collaboratory at Mississippi State University in order to build more efficient code and take advantage of the parallel computing resources.

080
Name: Marion, Ka'Miyah
Major: Biomedical Engineering
Faculty Advisor Name, Affiliation: Dr. Colleen N. Scott, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Daijun Feng
REU/Research Program: CSURP (Dr. Scott)

C-H Functionalization of Polyphenyl Ether(PPE) toward Solubilizing PPE-based Arenes
Polyphenyl ether (PPE), which is soluble in common solvents and possesses excellent thermal stability, can be used to develop new materials through functional group transformation while sparing the characteristics of the native polymer. Ir-catalyzed C-H borylation has been a successful method of functionalizing PPE. Following the C-H borylation of PPE, a series of Suzuki reactions with different aryl bromide were conducted and the corresponding arene products bearing the PPE chain were isolated in good yields. In this study, we will investigate (I) the effect of PPE on the solubility as well as (II) on the stacking of the pyrene's molecules. For example, pyrene is a pi-conjugated scaffold that is extensively used in organic devices, but it is extremely difficult to solubilize when embedded into a polymer. Aside from pyrene, we will also seek to solubilize polythiophene by making a PPE-polythiophene composite. Should this project result in a successful outcome, this approach will be an efficacious method to solubilize aromatic units that are processed trickily due to their insolubility from aggregation. We will report our findings with a poster presentation.

081
Name: Martin, Bryce
Major: Chemistry
Faculty Advisor Name, Affiliation: Dr. David Wipf, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Hellen Stephanie
REU/Research Program: REU-INFEWS

Electrochemical Impedance Spectroscopy Study of Functionalized Biochar Electrodes
In our previous study, modified biochar electrodes were fabricated for capacitive deionization (CDI) by grafting amine and sulfonate groups or adding titania to a biochar surface. The functionalization of biochar electrodes aimed to increase the specific capacitance and salt removal capacity. Satisfactory performance was obtained with salt adsorption capacity of 9.25 mg/g using an amine biochar anode and a Nafion cathode in asymmetric CDI. A capacity of 8.19 mg/g using titania modified biochar in symmetric CDI. Electrochemical impedance spectroscopy (EIS) was used to characterize the charge transfer resistance and ion transport of the biochar electrodes and showed unexpected negative capacitance loops at low frequencies. Experimental parameters were varied to investigate this intriguing behavior. Impedance analysis is a challenging task. This is especially true when unusual shapes appear in the impedance Nyquist plot, and there is no commonly accepted explanation for a CDI device that includes an apparent negative capacitance (or inductive) loop in the Nyquist plot. The resistances of the biochar electrodes were analyzed using non-linear regression to electrically equivalent circuits and Orazem measurement model for error analysis. We found that low frequency data had larger confidence intervals and residual errors. In addition, Faradaic reactions on the biochar surface were observed in cyclic voltammetry (CV) data, which lowers the efficiency of the CDI electrodes and may be the cause of the EIS behavior. FTIR characterization are used to investigate functional group changes before and after impedance measurement. Results of the investigation of the EIS data will be presented as well as the proposed literature explanations for tis negative capacitance loop.

027
Name: Maynard, Meredith
Major: Culinology
Faculty Advisor Name, Affiliation: Dr. Shecoya White, Food Science, Nutrition and Health Promotion; Dr. Juan Silva, Food Science, Nutrition and Health Promotion
Project Category: Biological Sciences and Engineering
Co-Author(s): Lauryn Heidelberg, M. Gabriela Hidalgo-Sindoni

The Efficacy of Sodium Hypochlorite Solutions on the Deterrence of Yeast and Mold on Blueberries
Blueberries, Vaccinium section Cyanococcus, have limited shelf-life once harvested. They are not typically treated with any preservative solution or disinfectant before consumer consumption. Sodium hypochlorite is a disinfectant that is used to prevent bacterial and mold growth and can be safely consumed in small quantities. In this study different concentrations of sodium hypochlorite solutions were applied to blueberries to determine potential shelf-life extension. Blueberries from 3 different farms were subjected to the following sodium hypochlorite solutions: 0, 5, 10, 25, 50, 100, and 150 ppm. The solutions, along with distilled water, were sprayed onto the surface of the blueberries, then allowed to dry under the biosafety cabinet for 40 minutes at 20ºC. After drying, the blueberries were placed onto Potato Dextrose Agar plates and incubated at 20ºC for 7 days. The experiment was replicated, with periodic visual examination of the blueberries throughout the duration of the study. On days 2-5, less mold growth was exhibited on the blueberries treated with a 25 ppm solution. However, on days 6-7, there was no considerable difference between the treatments. A dose dependent reduction in yeast and mold growth was not observed. This data shows that in the short term, a 25 ppm solution was effective at preventing yeast and mold growth on the blueberries. However, in the long term, none of the solutions proved to be effective. When comparing the mold growth on the blueberries between farms, a difference was determined between the industrial and non-industrial farms. The industrial farms typically had a slower rate of mold growth than those from smaller, non-industrial farms. This shows that the treatment of blueberries from industrial farms and non-industrial farms is different, possibly contributing to shelf-life length.

082
Name: McCormick, Caitlin
Home Institution (Other than MSU): Mississippi College
Faculty Advisor Name, Affiliation: Dr. Benjamin Crider, Physics and Astronomy, Mississippi State University
Project Category: Physical Sciences and Engineering
Co-Author(s): R.J. Unz, L. Allen, B. Henkel, S.D. Lusby
REU/Research Program: Chemistry REU: Food, Energy, and Water Security

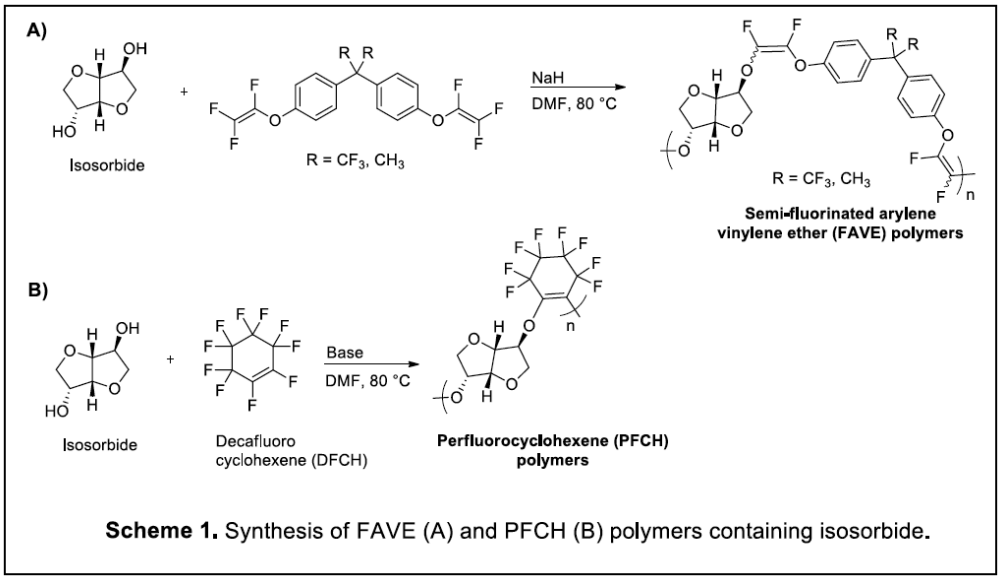
Characterization of Gamma-Ray Imaging System for use in Depleted Uranium Remediation Efforts
The United States Army tests munitions made from depleted uranium (DU) at Yuma Proving Grounds in Yuma, AZ. Continued testing of these DU munitions has led to a build-up of DU, causing concern for the surrounding environment and creating health risks. The DU emits gamma radiation, and it may corrode and migrate in the arid desert environment. Identifying and locating DU in the environment is crucial in the effort to remove it and allows implementation of a targeted removal strategy. The Germanium Gamma-Ray Imager (GeGI) is being prepared for deployment on autonomous robotic platforms to find and image sources of Depleted Uranium. Because of the high background radiation in such an environment, it is necessary to shield the GeGI so that it can detect the desired source without interference from background radiation caused by the natural decay of elements in the soil. Lead, a metal with a high atomic number, is very dense, making it one of the best materials to absorb gamma radiation, particularly at low energies. The main considerations for the design of the shield are its effectiveness and its weight, which must be as light as possible to allow for use on the self-contained, autonomous robotic platforms. The development of the lead shield will be presented, as well as details of the considerations for the design and data-based validation of its functionality.

028
Name: McDevitt, Reagan
Major: Biochemistry
Faculty Advisor Name, Affiliation: George E. Howell III, Department of Comparative Biomedical Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Carly Grabner

Pressure-Induced Wound Formation and Staphylococcus aureus Effects on Wound Healing in Diabetic Mouse Models
Of type 2 diabetics, 25% develop diabetic foot ulceration (DFU) in their lifetime, with approximately 15-20% of these cases resulting in limb amputation due to incomplete healing. This study was designed to compare the wound healing kinetics of a polygenic model of type 2 diabetes, the TALLYHO mouse, and a lean control, the SWR/J mouse, by determining pressure wound size during formation and after inoculation as well as view the effects of methicillin resistant *Staphylococcus aureus* locally on the wounds. Both mouse models were acclimated and put through a wounding procedure using magnets that consisted of three twelve-hour on, twelve-hour off cycles which led to the formation of pressure ulcers. After the cycles, the wounds were then inoculated with the USA300 strain of *S. aureus* and wounds were measured for ten days post-inoculation. Bacterial counts from the wounding area were also determined for each mouse following sacrifice. A significant difference was seen in the post-inoculation day wound size in the TALLYHO mice at days 7 and 10 compared to day 3, however, only a significant difference was seen from day 10 compared to day 3 in the SWR/J mice. Comparing the mice directly, on days 3 and 7 post-inoculation the TALLYHO mice had significantly larger wounds compared to the SWR/J mice. TALLYHO mice also had a significantly higher bacterial count than the SWR/J mice. These data indicate that the type 2 diabetic mouse model developed more significant wounds compared to the normal mouse model as well as a diminished healing response due to the bacterial infection. In the future, we will continue to look at the wound healing kinetics by observing the diabetic and normal mouse inflammatory response to pressure wounds.

083
Name: Mills, Kelly
Major: Chemical Engineering
Home Institution (Other than MSU): West Virginia University Institute of Technology
Faculty Advisor Name, Affiliation: Dennis W. Smith, Jr., Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Ketki E. Shelar, Karl M. Mukeba, Dennis W. Smith, Jr.
REU/Research Program: Department of Chemistry REU

Semifluorinated Polymers Containing Isosorbide
As waste generated from plastics is becoming an ever-growing issue, finding “greener” ways to produce them has become a global imperative. Isosorbide is a renewable diol derived from glucose and arguably more sustainable, less toxic, easily degradable, and potentially cheaper than other nonrenewable options. Polymers containing fluorine are desired as high performance materials for extreme environments (or mean) due to their high thermal stability, low dielectric constant, good chemical resistance, and low surface energy. Historically, our group has focused on semi-fluorinated aryl ether polymers via step-growth polymerization techniques to obtain well-established: perfluorocyclobutyl (PFCB), semifluorinated arylene vinylene (FAVE), and perfluorocyclohexenyl (PFCH) aromatic ether polymers. PFCB polymers are obtained from [2+2] radical-mediated thermal cyclopolymerization of monomers containing trifluorovinyl ether (TFVE) moieties as end groups; while FAVE and PFCH are synthesized via base-mediated nucleophilic addition/elimination of commercially available diols (e.g., bisphenols) with bis-TFVE monomers and decafluorocyclohexene (DFCH), respectively. Owing to the rigid stereochemistry and synthetic versatility of isosorbide, our lab has recently began the study of semifluorinated aryl ether polymers containing renewable isosorbide for potential optical and gas-separation applications. Where “green meets mean”, we have found that isosorbide polymerizes readily with fluoroalkenes in TFVE and DFCH monomers under basic conditions to afford high molecular weight (M_n = 30-50k) typically amorphous polymers that form tough transparent films from solution. These new isosorbide fluoropolymers exhibit variable glass transitions (T_g = 150-230° C) and good thermal stability (T_d at 5% loss ~ 375-425 °C in N_2). Here we present the first synthesis and characterization of isosorbide derived semi-fluorinated aryl ether polymers containing PFCB, PFCH, and FAVE functionality.



Scheme 1. Synthesis of FAVE (A) and PFCH (B) polymers containing isosorbide.

029
Name: Moore, Corey
Major: Geosciences/Geography
Faculty Advisor Name, Affiliation: David Lang, Plant and Soil Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Dr. John Read ARS-USDA

Utilization of Digital Imagery to Identify Complex Mixtures of Clovers

Digital images, both perspective and NADIR, were taken with a hand-held camera from a height of approximately 1.7 meters above forage plots containing various clovers (*Trifolium repens* and *T. nigrescens*) in mixture with several forage grasses (*Schedonorus arundinaceus, Cynodon dactylon*, etc.) and various broadleaf plants. The perspective photos were taken in the north, east, and west directions at the start of the plots and approximately every 10 meters, and north, east, west, and south at the end of the plots. The perspective photos were important for determining the location where each set of NADIR images were taken within plots. After harvesting a 1-m swath in the plot (each a 2 m x 11 m area), a set of NADIR images was taken at 1-m intervals across the length of each plot, starting from the west and ending in the east, giving 10 images per plot. Each NADIR image was uploaded into a PowerPoint and a grid overlay with 96 small squares was used to determine the percentage occurrence of clover leaf/flower. The grid overlay was created using an 8 x 12 matrix, and then the number of squares with clover in them was divided by 96 to create the percentages. These percentages of clover within grass mixtures constitute the contribution of a legume which acquire nitrogen from the atmosphere. Grasses must acquire nitrogen from nitrogen as nitrate or ammonium that can be released as legumes die and decay. Legumes increase protein in the clover grass mixture important to grazing livestock. Digital imagery provides a nondestructive less labor intensive measure of the clover portion compared with physically separating the clover/grass mixture. This tedious task can be utilized to generate relationships between empirical determinations and visual estimations. Digital imagery can be utilized to train detection of grasses, clovers and other broadleaf plants.

084
Name: Moore, Kirsten
Major: Biological Sciences
Home Institution (Other than MSU): Tougaloo University
Faculty Advisor Name, Affiliation: Dr. Xin Cui, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Hetti Handi Chaminda Lakmal
REU/Research Program: REU (Chemistry)

Synthesis of Tripyridyl Ligand for Iron(II)-Catalyzed Meta C-H Activation

A ligand is typically an organic molecule that binds to the central metal atom of a coordination compound to form a complex. A catalyst is a substance that accelerates a chemical process without being affected by chemical change itself. This research creates a tripyridylmethane-based tri-dentate ligand along with its Fe(II) complexes that will catalyze SP^2 C–H bond activation reactions. The ligand is playing a crucial role in the transition metal complexes, which are used as pre-catalysts. In this study, we are attempting to synthesize a nitrogen-based tridentate ligand and form a transition metal complex as a pre-catalyst. 2,2',2"-(methoxymethanetriyl)tripyridine was synthesized as a tridentate nitrogen based ligand and formed the Fe(II) containing transition metal complexes. Ligand synthesis consists of two steps: nucleophilic addition of 2-bromopyridine to di(pyridine-2-yl)methanone to form the tri(pyridine-2-yl)methanol and methylation of the tri(pyridine-2-yl)methanol to form final ligand 2, 2',2"-(methoxymethanetriyl)tripyridine. The ligand was stirred with Fe(II) salt to make the transition metal complex which is used as a pre-catalyst to perform the C–H activation. TLC, column chromatographic isolation, solvent extraction separation, NMR structure elucidation were done throughout the ligand synthesis and Fe(II) metal complex was characterized using high-resolution mass spectroscopy

030
Name: Morrow, Brendan
Major: Biochemistry
Faculty Advisor Name, Affiliation: Dr. Florencia Meyer, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering

Inhibiting the Growth of Mannheimia haemolytica with Metal Salts

Mannheimia haemolytica is an opportunistic bacterial pathogen that contributes to the nasal flora of cattle. When cattle are under stress, most notably during shipping or when infected with a virus, the immune system can become compromised and lead to bacteria invading the lower respiratory tract causing Bovine Respiratory Disease (BRD). Different metals such as cobalt, copper, and zinc have shown the ability to inhibit bacterial growth. This study aims to find the lowest concentrations of cobalt, copper, or zinc salts that inhibit the growth of *M. haemolytica*. Bacteria were grown in the presence of a different concentration of metal salts and at different cell densities. To quantify bacterial replication, a spectrophotometer was used to measure the optical density of the media at 600nm at hourly time intervals throughout 24 hours. We were able to show that the growth of *Mannheimia haemolytica* was inhibited by zinc concentrations as low as 1mM, while cobalt required a concentration of 5mM to inhibit growth to a similar level. A greater inhibitory effect was seen with lower cell densities. The results provide the starting point to carry out toxicity assays on bovine cells, with the ultimate goal of determining which metal concentrations are most effective at inhibiting bacterial growth while not harming the bovine cells. Further research will focus on testing other metal formulations on *M. haemolytica* and other bacterial contributors to BRD, such as *Pasteurella multocida*.

085
Name: Myers, Tanner
Major: Mechanical Engineering
Home Institution (Other than MSU): West Virginia University Institute of Technology
Faculty Advisor Name, Affiliation: Todd Mlsna, Chemistry, Mississippi State University
Project Category: Physical Sciences and Engineering
Co-Author(s): Beatrice Arwenyo, Chanaka Navarathna, Richard Millar, Sita Warren
REU/Research Program: NSF REU- INFEWS

Preparation and characterization of Nutrient enriched biochar/coal for soil amendments.

Commercial fertilizers and manures are known for aiding plant growth and development, but their continued usage has been linked to environmental and economic challenges because of the leaching of harmful chemicals into water bodies and the frequent need for reapplication. Both biochar and coal lignite products have shown promising results as alternative cost-effective and ecologically friendly materials for improving soil fertility and plant growth. However, limited research has been done to evaluate their use as a soil additive on a large-scale basis. This study aimed to prepare and characterize nutrient enriched biochar/coal lignite and examine their potential for large scale production. The nutrient enriched biochar and coal lignite were produced by treating successively Douglas fir biochar/coal lignite with aqueous solutions of magnesium sulfate, potassium hydroxide, and diammonium phosphate. The total mineral contents, pH, electrical conductivity, and elemental contents of nutrient enriched biochar and coal were then examined to evaluate their suitability as soil additive. Results indicated that the pH, the electrical conductivity, and the ash contents of both Douglas fir biochar and coal lignite significantly improved following treatment with magnesium sulfate and potassium hydroxide. However, there were slight drops in pH values after treating the modified biochar/coal lignite with diammonium phosphate solution. The increased ash contents associated with the P enriched biochar may suggest its ability to release essential plant nutrients in soil and hence its suitability for use as an alternative low cost and ecofriendly soil additive. Additionally, a pilot plant to produce biochar/coal lignite products at large scale is being designed, demonstrating product flow and equipment needs. The plant design shows the potential profitability and relatively simple product flow processes involved in the production of biochar/coal lignite products and that large scale production can be feasible and sustainable.

086
Name: Nanney, Andie
Major: Chemistry
Faculty Advisor Name, Affiliation: Todd Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Felix Atsar

Optimization of Douglas Fir Biochar for Hydrocarbon Bioremediation in Soil

Petroleum hydrocarbon contamination is a global environmental challenge due to its adverse effects on human health and ecosystems. These contaminants get into the human system via ingestion, physical contact, inhalation and food chain contamination, causing acute and chronic conditions like cancer. The soil fertility, microbial activity, soil porosity and bulk density are among several other properties of soil that are affected by hydrocarbon contamination, thereby reducing soil value and crop yield. Several methods of hydrocarbon remediation have been used in attempts to decontaminate hydrocarbon-polluted soil. These methods include thermal desorption, incineration, encapsulation, immobilization, soil washing, air stripping, chemical oxidation-reduction, phytoremediation, landfarming, biopiling, bioventing, and bioattenuation. However, these methods are considered either expensive or not environmentally sustainable, making bioremediation a more sustainable and promising method for hydrocarbon cleanup in soil. Previous literature has suggested that biochar, a cheap by-product in syn-gas production, has the ability to remediate hydrocarbon contaminants in soil due to its high porosity, large surface area, pore size, stability, water retention capacity, charged surfaces and functional groups, and the ability to provide nutrients and a habitat for petroleum-degrading microbes. In this research, the properties of douglas fir biochar were enhanced for optimal bioremediation potential by chemical modification using MgSO4, NH3PO4, and KOH. The modified biochar was characterized and the extent of modification was evaluated by

analyzing the pH, bulk density, moisture content, elemental composition, functional groups, and surface morphology, with the aim of assessing hydrocarbon bioremediation potentials of the modified biochar.

031
Name: Nettles, Camille
Major: Biochemistry (Pre-Vet)
Faculty Advisor Name, Affiliation: Dr. Florencia Meyer, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Victoria Jefferson
REU/Research Program: RS5 Bridges to Baccalaureate

Developing a quantitative polymerase chain reaction (qPCR) for the detection of Bovine Herpesvirus type 1 infection
Bovine Herpesvirus type 1 (BoHV-1) is a pathogen that primarily infects beef and dairy cattle. The acute infection causes immune suppression, which can lead to bacterial overgrowth in the respiratory tract. Overgrowth can cause Bovine Respiratory Disease (BRD), a major cause of morbidity and mortality. Current Polymerase Chain Reaction (PCR) tests are not accurate indicators of the onset of BRD, which leads to the over-use of antibiotics. Quantifying viral load through quantitative PCR (qPCR) has proven to be a more accurate predictor of BRD. In this project, we have fine-tuned a qPCR protocol for BoHV-1 that accurately quantifies the amount of virus in an unknown sample. We achieved this by finding the primers for BoHV-1 genes that amplify specifically. We used these primers to build a standard curve by serially diluting known quantities of the DNA. Cellular primers of *housekeeping* genes were used as internal controls of DNA extraction to standardize the qPCR assay. We were able to detect viral DNA in 10-fold decreasing amounts, up to 1ng/uL. Because non-specific binding can cause fluorescence in the late cycles of a qPCR reaction, we can confidently confirm a positive sample if it is detected within 29 cycles. Moving forward, the established protocol will allow us to quantify levels of BoHV-1 infection in laboratory (*in vitro*) or in clinical samples.

001
Name: Newell, Joseph
Major: English
Faculty Advisor Name, Affiliation: Dr. Dhanashree Thorat, English
Project Category: Arts and Humanities

Shakespeare's Expansion of Heteropatriarchy through Dreams: A Mockery of Women's Triumph in *A Midsummer Night's Dream*
William Shakespeare, a famous English playwright and poet often discuss the realms of heteropatriarchal societies in his work. Shakespeare offers works that showcase women's triumph over heteronormativity through their desire to gain freedom from heteropatriarchal structures. Scholars Garber, Gohlke, Mann, and Harris suggest that Shakespeare uses dreams to produce metaphorical plots to mirror the imaginative evolution of women. While previous scholarship discusses Shakespeare's treatment of women and his use of dreams as a metaphor, my research shows that a conjunction of the two ideas is a necessity to understand the conclusion of their cooperation in informing Shakespeare's work. Shakespeare suggests, in *A Midsummer Night's Dream,* that women's desires are only plausible through dreams. Shakespeare offers this metaphor to show the irrationality of women's desires and their ideal society while being subject to the realms of patriarchy. My research argues that Shakespeare advances the structure of hetero-patriarchy in *A Midsummer Night's Dream* by relying on the illogicality of dreamwork to insinuate that women's rationality and triumph over patriarchal realms possess that same irrationality. On this basis, my research not only showcases how Shakespeare advances patriarchy but also how he uses the desires of women to demean their thoughts rather than advocate for change. My research highlights how assessing figurative language and hidden metaphors helps readers understand the theatrics and puns found in accredited literary works which can be used to better teach and understand the history and intent behind the authors.

032
Name: Ningthou, Lyem
Home Institution (Other than MSU): Mississippi School for Mathematics and Science
Faculty Advisor Name, Affiliation: Mahalingam Ramkumar, Computer Science & Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Moses Ayoola, Michael J. Rothrock Jr.

Predictive Modeling to Study the Effect of Poultry Farm Practices on Foodborne Pathogens
Salmonella bacterium is a leading cause of foodborne illness within the United States and is responsible for 1.35 million infections and 26,500 hospitalizations per year. *Salmonella*, along with other deadly pathogens like *Campylobacter, Listeria*, and *E. coli*, is most commonly spread through contaminated poultry products in the food industry. On pastured poultry farms, where poultry is raised on an open pasture and exposed to outside factors, farm management practices can significantly affect the prevalence of pathogens in the final poultry product. For this reason, it is important to analyze and understand the relationship between different farm practices and the presence of various pathogens in poultry products. For our analysis, a dataset detailing the farming practices and pathogens in poultry samples for 11 pastured poultry farms over a span of four years was used. In addition, a dataset describing the microbiome makeup for each poultry sample was also integrated into the analysis. Collectively, these datasets were used to develop predictive machine learning models which produce results that can give actionable advice to pastured poultry farmers.

033
Name: O'Briant, Zy'Leecia
Major: Educational Psychology
Faculty Advisor Name, Affiliation: Heather Jordan, Department of Biological Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Magdalene Dogbe
REU/Research Program: Bridges to Baccalaureate

What is mycobacterium ulcerans?
Buruli ulcer is a necrotizing skin infection caused by *mycobacterium ulcerans* (*M. ulcerans*). This bacteria is closely related to *mycobacterium tuberculosis* and *mycobacterium leprae* which causes tuberculosis and leprosy respectively. *M. ulcerans* produces a toxin known as mycolactone. This toxin is an immunosuppressant and anti-inflammatory molecule. Although the bacteria causes so much necrosis, the absence of pain and fever often delays diagnosis and treatment. It is not considered fatal, but in areas where treatment is considered limited, morbidity is higher. Age and sex are not risk factors, however, women and children between 5- 15 are mostly affected but it can occur at any age. Lesions are usually observed on the upper and lower extremities but can occur anywhere with infections rarely reported for the scalp, palms, and soles of feet. Failure to receive early treatment could lead to bone deformity or even amputation. Mode of transmission still remains elusive, however, M. ulcerans DNA have been detected in and around aquatic habitats especially slow moving water bodies and aquatic insects such as Naucoridae and Belostomatidae.

034
Name: Ousley, Jacob
Major: Biochemistry
Faculty Advisor Name, Affiliation: Russel L. Carr, Center for Environmental Health Sciences, Department of Comparative Biomedical Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Jacob A. Ousley, Kylee J. Burroughs, Shirley X. Guo-Ross, Angela K. Ross, Katelyn N. Sette, Caera A. Taylor, Russel L. Carr
REU/Research Program: EMCC- MSU Bridges to Baccalaureate

Effect of Cannabidiol on the Immune Response in Juvenile Rats

According to anecdotal sources, CBD (cannabidiol) oil is thought to help with anxiety, ADHD and epilepsy. In fact, many parents are giving their children daily doses of CBD oil simply to treat hyperactivity and restlessness. However, CBD can affect immune function and it is unknown if giving CBD oil to kids will alter their immune response. In order to investigate this, juvenile rats were administered either corn oil, 20mg/kg CBD, and 60mg/kg CBD orally for 5 days beginning at age day 12 and continuing through day 16. Twenty-four hours after the last administration, the rats were intranasally administered the single-strand RNA viral mimic Resiquimod (R848) to challenge the rat's immune system. Six hours later, lung tissues were collected to determine the gene expression of the various cytokines. If there are any immunosuppressant effects from the oil, anti-inflammatory cytokine levels would increase. R848 induced changes in the immune response as expected. The CBD exposure altered that response with some cytokines. For the anti-inflammatory cytokines, CBD exposure altered the response to R848 by decreasing IL-13 and increasing IL-4 and IL-8 expression. For the proinflammatory cytokines, CBD exposure did not affect the response to R848 with respect to IL-6, MCP-1, TNFα but altered the response to R848 increasing IL-1β, IL-1α, Macrophage Inflammatory protein 2 (MIP-2). Our data suggests that pre-exposure to CBD enhances the immune response of juvenile animals to a viral challenge. If a similar situation exists in children, oral administration of CBD daily could have negative consequences on the child's health.

035
Name: Peal, Celia
Major: Food Science, Nutrition and Health Promotion (Pre-Health Professions)
Faculty Advisor Name, Affiliation: Steve Elder, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
REU/Research Program: R25 Bridges to Baccalaureate

Maintaining Steady Kartogenin Release in Fibrin Gels Used for Cartilage Repair

Cartilage does not independently heal itself due to its avascular composition. There are few known procedures to restore cartilage. Microfracturing, for example, is a procedure involving puncturing underlying bone to provide blood supply to injured cartilage. Unfortunately, microfracturing and other similar procedures produces fibrous cartilage, which resembles scar tissue. However, the introduction of kartogenin to injured cartilage has proven to restore hyaline cartilage by activating stem cell differentiation. The purpose of this study is to discover an effective way to introduce kartogenin into the injured area using fibrin gels. Additionally, the suspension of decellularized ECM in the fibrin gels is under investigation as a means to create a more natural microenvironment that promotes cell proliferation and differentiation.

036
Name: Phillips, Maggie
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Matthew Ross, Department of Comparative Biomedical Sciences, Center for Environmental Health Sciences, College of Veterinary Medicine
Project Category: Biological Sciences and Engineering
Co-Author(s): Abdolsamad Borazjani

Lipase Activity of Human Carboxylesterase 1 Toward Oxidized Diacylglycerols and Triacylglycerols

Carboxylesterases are members of the serine hydrolase superfamily and are defined by their ability to hydrolyze carboxyl ester bonds in xenobiotics and lipids. Previous work from this laboratory showed that carboxylesterase 1 (CES1) can hydrolyze lipids called prostaglandin glyceryl esters, which are cyclooxygenase-derived metabolites of 2-arachidonoylglycerol. To further explore the substrate specificity of CES1, this study examined whether oxidized lipid glyceryl esters (di- and tri-acylglycerols), which contain multiple oxylipins that control immune cell responses to lipid dysfunction and inflammation, can be metabolized by this enzyme. Oxylipin glyceryl esters are produced by either enzymatic or non-enzymatic oxidation of polyunsaturated fatty acids, such as arachidonic acid, linked to the glycerol backbone via an ester bond. These oxylipin derivatives include several hydroxyeicosatetraenoic acids (5-, 8-, 12-, and 15-HETEs), which exert anti- and pro-inflammatory effects. Partially oxidized 1-stearoyl-2-arachidonoyl glycerol (oxDAGs) and triarachidonoylglycerol (oxTAGs) were incubated with recombinant CES1 or a *Pseudomonas* lipase (a positive control) to assess the release of oxylipins (HETEs) and arachidonic acid (AA), which were detected by liquid chromatography-mass spectrometry. The cumulative amount of HETEs liberated from oxTAGs by CES1 was 35 pmol/30 min, whereas the amount of AA released was 2600 pmol/30 min. This data indicated that CES1 can effectively metabolize oxidized lipids to release oxylipins and AA. Furthermore, treatment of a human macrophage cell line (THP-1) with 15-HETE (0.3 μM) suggested that CES1 has an indirect role in the cellular disposition of this oxylipin, because a marked reduction was noted in the cell associated 15-HETE levels in CES1-expressing cells compared to those in CES1 depleted cells. This study further specifies the biochemical role of CES1 in the metabolism of bioactive lipid mediators that regulate the inflammatory activities of immune cells.

107
Name: Quinn, Makela
Major: Microbiology
Faculty Advisor Name, Affiliation: Terezie Tolar-Peterson, Food Science Nutrition and Health Promotion
Project Category: Social Sciences
Co-Author(s): Nicole Reeder

Bitter taste perception, gender, and alcohol use among college students at Mississippi State University

Young adults in the college age range tend to have one of the highest rates of participation in binge and heavy alcohol use. Individual differences in taste perception, such as whether a person is phenotypically a “taster” or “non-taster” of certain bitter compounds may be one factor to influence alcohol consumption. The purpose of this study was to assess whether disordered alcohol intake among college students was associated with the ability to taste the bitter compound 6-n-propylthiouracil. A total 248 students (n= 47 male, n=201 female) were administered the Alcohol Use Disorders Identification Test (AUDIT) survey and completed a bitter taste test by briefly placing a strip of filter paper saturated with PROP on their tongue. The PROP tasting assessment showed that 60.5% of students were classified as “tasters” and 39.5% of students were classified as “non-tasters.” Using the World Health Organization scoring criteria for the AUDIT survey, 16.9% of students were considered to have dangerous/hazardous drinking patterns, and of those students, 64.3% were non-tasters of the bitter compound PROP. The AUDIT scores of non-tasters were also significantly higher than for tasters (5.01 ± 4.49 vs. 3.67 ± 3.22, p= 0.12, t-test.) In terms of gender, male students had significantly higher AUDIT scores than female students ($p<0.001$, chi-square) as well as a higher non- PROP tasting percentage (57.45% and 35.32%). These results suggest that the inability to detect the bitter compound PROP may be associated with a greater risk of disordered alcohol intake, and there additionally may be an association between gender and AUDIT scores and PROP tasting ability. Binge drinking and heavy alcohol use are associated with many negative consequences, and thus, future research should continue to work to identify factors not just social, but also biological, that may place individuals at risk of alcohol abuse.

037
Name: Reese, Robert
Major: Forestry/Environmental Conservation
Faculty Advisor Name, Affiliation: Dr. Joshua Granger, Forestry; Dr. Sandra Correa, Forestry
Project Category: Biological Sciences and Engineering
Co-Author(s): Dr. Joshua Granger, Dr. Sandra Correa
REU/Research Program: URSP

Moss and Lichen Colonization of Floodplain Forests and their Impacts on Invertebrate Diversity

Floodplain forests provide a mosaic of periodically flooded habitats for fish. Mosses and lichens are known to colonize the stems of bottomland trees and may provide feeding grounds for fish during periods of inundation, but tree preferences and use by aquatic invertebrates are not well documented. Therefore, we aimed to determine how floodplain forests influence the colonization of lichens and mosses and how these species influence invertebrate diversity. To accomplish these goals, we: (1) quantified bottomland forest complexity and (2) assessed epiphyte composition and abundance. Overall, a total of 8-0.1ha plots were established in a bottomland forest at the Noxubee Wildlife Management Area in Winston, CO., MS. Tree species, diameter breast height (DBH), tree age, bark thickness, moss and lichen species, and moss and lichen percent coverage were recorded. A total of 29 species of trees were sampled across the stand. The two most abundant tree species recorded were sweetgum and musclewood. Sweetgum (*Liquidambar styraciflua*) averaged 45 trees per hectare, 2.45 m^2 per hectare for basal area, with an average age of 33 years, and a 15% average moss coverage. Muscelwood (*Carpinus caroliniana*) averaged 20 trees per hectare, 0.44 m^2 per hectare for basal area, with an average age of 28 years, and an average moss coverage of 29%. Preliminary observation of trees along the edge of the reservoir confirmed the presence of aquatic invertebrates among submerged epiphytes. Aquatic invertebrate diversity will be quantified winter of 2021 when refuge water levels are raised, and the assessed forests becomes flooded.

038
Name: Roberson, Graham
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Dr. Steve Elder, Biological Engineering
Project Category: Biological Sciences and Engineering

Electrospinning PLGA Scaffold Containing Kartogenin To Induce Hyaline Cartilage Cell Differentiation.

Small cartilage lesions can be healed using a procedure called microfracture surgery which forms fibrocartilage at the damaged articular cartilage site. However, fibrocartilage is a type of scar tissue and lacks the function and durability of the hyaline cartilage that was present before injury. Kartogenin, KGN, is a small-molecule compound that induces hyaline cartilage differentiation of stem cells. This study focuses on developing an alternative to microfracture surgery by incorporating KGN, without degradation, into an ultrafine scaffold via electrospinning. The scaffold serves as a cellular framework and as a mechanism for sustained drug delivery. The scaffold is to be placed at the site of the damaged cartilage, allowing hyaline cartilage to form. In this study, KGN was incorporated into a poly(lactic-co-glycolic acid), PLGA, solution and formed into a nano-fiber scaffold through electrospinning. The optical absorbance of the KGN was measured at 284nm before and after electrospinning, confirming minimal degradation of the KGN across the electrospinning process. Samples of the scaffold were placed in phosphate-buffered saline to record the release of KGN over time. Testing continues with the intent to confirm the consistent release of the Kartogenin. Further research will be conducted to replicate the KGN and PLGA nano-fiber scaffold in the form of nanoparticles using the electrospraying technique.

087
Name: Rogers, William
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Maryam Mirabolghasemi, Chemical Engineering
Project Category: Physical Sciences and Engineering

Measurement of the Rate of Capillary Rise in Tight Rocks Using Electrical Resistivity

Capillary force is a force that drives many natural and engineered processes such as water pull in plants and writing with pens. Capillary force results in capillary rise, which is a key phenomenon in oil recovery as well as civil engineering applications. Capillary rise is referred to the rise of a fluid inside a porous material or a capillary tube and is caused by the upward capillary force. The rate of capillary rise, which is the speed at which the fluid rises, has been the subject of several studies; however, little is known about the rate of capillary rise in tight sandstones and shales. The objective of this study is to develop a simple experimental method to measure the rate of capillary rise in various porous media such as sandstone and shale. We start by studying various methods that researchers have already developed for quantifying capillary rise in various media, such as soil, cement, and textile. Next, we devise a method to use electrical conductivity measurements to locate the rising waterfront in a column of the porous rock during capillary rise. This is achieved by taking resistance measurements at varying heights on a sandstone core using an Arduino and breadboard. Several tests have been performed to determine the appropriate method to record this information. These experiments have ranged in what liquid flows through the medium as well as what medium we use. Using these models, we should be able to discern the location of the waterfront at various times. This will allow us to be able to calculate the rate of capillary rise and compare it with the available theoretical models. The findings of this study will help to determine the interaction between crude oil or water and the reservoir rock they reside in. This improved understanding may result in the design of more efficient hydrocarbon recovery methods.

039
Name: Santos, Ariadna
Major: Biochemistry
Faculty Advisor Name, Affiliation: Seung-Joon Ahn, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
REU/Research Program: URSP

Development of genome editing toolkits in the cotton bollworm

CRISPR/Cas9 is a genome editing tool which have multiple ways of applications to edit, remove, or add sections of DNA sequence. In current research we will examine the feasibility of this technique to manipulate the cotton bollworm (*Helicoverpa zea*), a serious agricultural pest around the country, including Mississippi. The basic design of this study includes: (1) selection of the CRISPR/Cas9 target gene, (2) microinjection of insect eggs, and (3) genotyping of the edited individuals. Briefly, I have selected a gene encoding pheromone biosynthesis activating neuropeptide (PBAN), which plays a key role in finding mates in the moth. A single guide RNA (sgRNA) was designed to target an active motif of the PBAN gene. Then, I established the microinjection method with fresh eggs laid by the moth using NanoJector III. Finally, the genome-editing efficiency was measured by genotyping the survived adults using the gene cloning method. As a result, I have injected 670 eggs and screened 71 survived adults in total. The utilization of the microinjector was optimized to inject the tiny insect eggs, which are easily damaged, resulting in high mortality. I have performed five batches of injections in total and have been studying the adults to confirm any mutation of their DNA sequence. This research will pave a way to manipulate the genes of insect pests in favor of our purposes.

088
Name: Schwirian, Elijah
Major: Chemistry
Faculty Advisor Name, Affiliation: Dr. Xin Cui, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Nirosh Udayanga
REU/Research Program: MSU Chemistry Summer Research Program

Ru-Catalyzed Transient Directing Group Assisted Intramolecular C-H Activation of Indole
Transition metal catalyzed C–H activation and functionalization provides powerful synthetic tools for constructing complex structures from simple and available molecules. These synthetic processes are important for developing more advantageous and effective natural products and medicinal agents. Indole-based scaffolds are the basis of a large number of pharmaceutical molecules and natural compounds; however, development of more efficient pathways for synthesizing tricyclic indole scaffolds is both arduous and technically challenging. Therefore, efficient, and selective reactions that allow for the construction of fused cyclic systems are necessary for the development and production of future medicines. Herein we document, the intramolecular C–H activation of tricyclic indole derivatives using transient directing groups incorporating ruthenium as a catalyst. Currently, the pertinent reaction conditions have been optimized, and further explorations of the substrate scope are being developed within our laboratory.

040
Name: Scott, Ané
Home Institution (Other than MSU): Tougaloo College
Faculty Advisor Name, Affiliation: Dr. Ling Li, Biological Sciences, Mississippi State University
Project Category: Biological Sciences and Engineering
Co-Author(s): Lei Wang, Ling Li
REU/Research Program: REU-INFEWS Summer Program

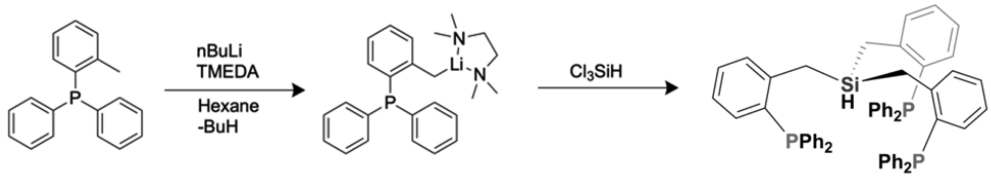
Arabidopsis orphan gene, metabolites and transcription regulation
Deficiency in dietary protein is globally one of the most severe health problems. The ability to optimize protein productivity of plant-based foods has far-ranging impact on both world health and sustainability. The *Arabidopsis thaliana* orphan gene Qua-Quine Starch (QQS) has been identified as a regulator of carbon and nitrogen partitioning when expressed in crop plant species. QQS transcript levels are altered in plants under stresses and in mutants with genetic mutations, indicating that QQS may integrate primary metabolism with environmental perturbations, thus adjusting the plant's adaption to abiotic and biotic stresses. However, how QQS transcript level is regulated still unknown. Previous research from our lab showed that QQS transcript level was obviously increased in the Arabidopsis Starch Synthase III (*ss3*) knockout mutant, together with the changed accumulation levels of metabolites in sucrose/starch synthesis pathway. My research goal was to identify the metabolites in sucrose/starch synthesis pathway that impact QQS transcript level. Using genetic approaches, our lab showed that QQS transcript level was reduced upon sucrose treatment and in a knockout mutant in trehalose metabolism connecting sucrose/starch synthesis pathway (unpublished data). The relationship between QQS transcript level and the content of metabolites, corresponding changes of protein and starch content in mutants involved in sucrose/starch synthesis, and which transcriptional factor is involved in sensing the level change of the metabolites and further regulates QQS transcript level are to be explored. Here we quantified the content of metabolites in several gene-knockout mutants related to sucrose pathway and QQS transcript level. Taken together, our study aims to reveal a novel molecular mechanism on regulation of QQS transcript level through metabolites and signal factors

089
Name: Secrist, Carlee
Major: Chemistry
Home Institution (Other than MSU): Capital University
Faculty Advisor Name, Affiliation: Dr. Virginia Montiel-Palma, Chemistry, Mississippi State University
Project Category: Physical Sciences and Engineering
Co-Author(s): Luz Jimena Barrios-Vargas
REU/Research Program: Chemistry REU-INFEWS

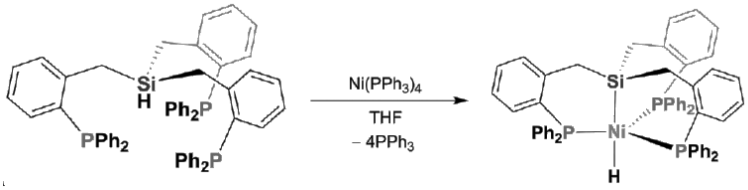
Probing the Catalytic Activity of a NU-1000 based Catalyst Grafted with a Ni Organometallic Complex

Dehydrogenative silylation is an important reaction to generate monomers for polymeric materials and pharmaceuticals. Benzylic borylation is also a reaction that serves to access important intermediates for the synthesis of carbon-carbon and carbon-heteroatom bonds. By using a metal-organic framework (MOF), and grafting on a NiP_3SiH organometallic complex, a heterogeneous catalyst for these reactions can be synthesized and its catalytic activity can be directly compared to its homogeneous counterpart. First, the P_3SiH ligand is synthesized, then a Ni phosphine complex is added to create the organometallic complex, to be grafted. The structures of the ligand and the organometallic precursor are confirmed with ^{1}H and $^{3}1P$ NMR. MOFs have a crystalline structure, low density, and thermal stability, allowing them to have extraordinary heterogeneous catalytic abilities. NU-1000, a zirconium-based MOF, is used. The synthesized catalyst, [Ni]@NU-1000, allows the dehydrogenative silylation reaction and the benzylic borylation reaction to take place in one step, and can be easily removed and reused after the reaction occurs. The reactions were monitored using GC/MS, to directly measure the selectivity of the reaction.

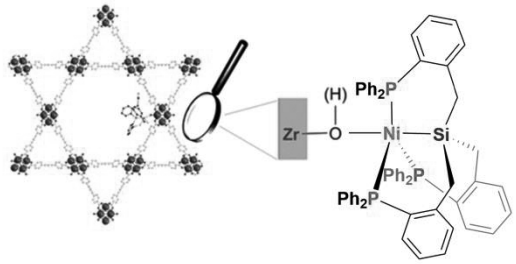
Synthesis of ligand "P_3SiH"



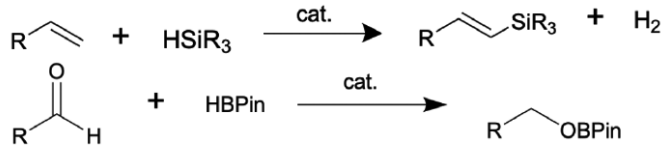
Synthesis of the Ni complex derived of "P_3SiH"



Grafting the NU-1000 MOF material with complex NiP_3SiH



Catalytic Reactions (cat. = Ni@NU-1000)



041
Name: Shah, Ashutosh
Major: Mechanical Engineering
Faculty Advisor Name, Affiliation: Dr. Sathish Samiappan, Geosystems Research Institute; Dr. Gray Turnage, Geosystems Research Institute
Project Category: Biological Sciences and Engineering

Automated Classification of Invasive Aquatic Plants Using Deep Learning Models and Visible Spectrum Imagery
Invasive aquatic plants are considered one of the greatest threats to indigenous aquatic plants in wetland ecosystems. These invasive species can displace native submersed plants and some floating invasive plants like Water Hyacinth or Giant Salvinia can cover the water surface entirely, blocking sunlight, hindering gaseous exchange between water and atmosphere, and affecting water chemistry in ways that negatively impact aquatic flora and fauna. Identifying and locating invasive aquatic plants is intensely challenging using traditional methodological approaches because some invasive plants have similar appearances to native species which can make mapping the distribution across a waterbody costly and time-consuming. One potential solution to this problem is utilizing Un-crewed Aerial Systems (UAS) to collect visible spectrum imagery across a landscape and running them through machine learning models for image classification. However, prior to UAS image collection, training images needs to be collected and used to validate the ability of this process at a small scale before implementation in a field setting. The aim of this project was to design and apply deep learning image classification models to identify 11 common invasive aquatic species found in Mississippi. Our key objectives were to: (1) design deep learning models to identify and classify target species among non-invasive species, (2) train the models using in-situ imagery of target invasive plants collected at ground level, and (3) test the accuracy of the models to identify and classify plants to be either invasive or native from images taken on site. Once validated in a field setting, these models can be used for image analysis of wetland areas affected by the spread of invasive species to support resource management activities for such species.

108
Name: Sims, William
Major: Agribusiness
Faculty Advisor Name, Affiliation: Kalyn T. Coatney, Agricultural Economics; Alan Barefield, Agricultural Economics
Project Category: Social Sciences
REU/Research Program: Extension Apprentice Program

Estimating the Regional Economic Impacts of Increasing Mississippi Bred Heifer Quality
Mississippi cattle producers strive to produce the highest-quality cattle possible. Producers face many challenges when trying to raise cattle in Mississippi, such as climate and genetic issues. Agriculture is a major driver in the state's economy and improving the genetic quality of a herd can result in higher sale prices, benefiting the economy of the state by providing more revenue for producers as well as economic spillover effects that benefit the entire state.

Proprietary data from a special bred heifer sale is used to estimate the premium producers can receive by marketing improved animals and the additional economic spillover effects to the economy through business-to-business transactions and employee spending using input-output analysis. This analysis estimates the total direct, indirect, and induced economic effects caused by increased sale prices. These effects are felt at various levels, from individual households to industries across the state.

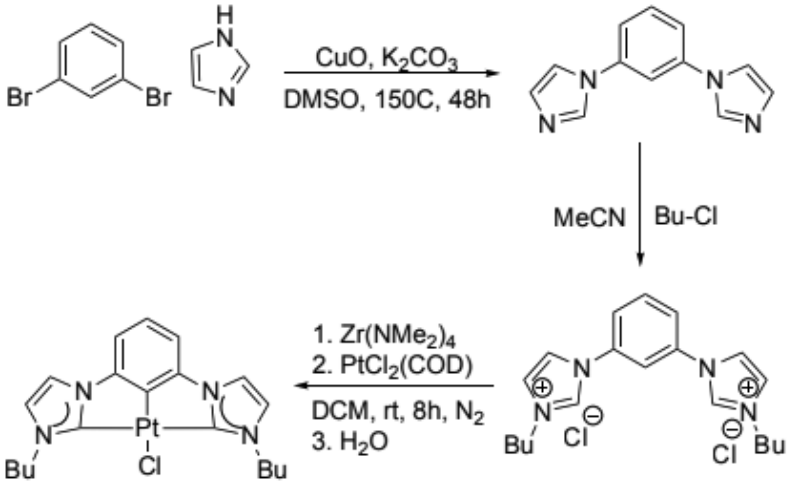
This study estimates the total economic effects on individuals, businesses, and various levels of government of increasing the herd quality of bred heifers in Mississippi. This research tests the current economic impact of a selection of commercial sales as compared to sales from the Southern Producers' Regional Heifer Sale, a sale featuring only top-quality bred heifers. This sale is used as a benchmark for the price of higher quality bred heifers. Second, the research tests a ten percent shift in the total number of bred heifers sold as replacements from "commercial-grade" to "high-grade" (582 head). Note that the total number of replacement heifers does not change, only the proportion of commercial vs. high quality heifers. These before and after numbers are then used to find a per-head premium that higher-quality heifers draw

over their commercial counterparts and the estimated total effect, including government fiscal effects, that this premium has on Mississippi's economy.

090
Name: Smith, Tarlys
Major: Biological Engineering
Faculty Advisor Name, Affiliation: Dr. Keith Hollis, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Evans Fosu
REU/Research Program: Summer Undergraduate Research

Light Copper Coupling Catalyst with CCC- N- Heterocyclic Carbene Pincer Complex

Organic light emitting diodes (OLEDs) are high demanded materials that emit blue and white light for cell phones, light celling, and tv screens in excess. In this study presented, a ligand-based Pt-Complex offers a cheap and effective way of allowing OLEDS to work for a more durable time. A well-establish method to create princer complex is using the formation of two N-heterocyclics carbenes. N-heterocyclic carbenes (NHC) are commonly known as transition metals ligands that catalyze many reactions such as ring-opening metathesis polymerization (ROMP), ring-closing metathesis (RCM), and the most abundant Pd-cross coupling. To prepare stable organic metallic compounds, 1,3-dibromo benzene is allowed to react with imidazole using CuO as catalyst, and K_2CO_3 as a base at 150°C in DMSO, gives 1,3 bis-imidazole benzenes as product. The product is allowed to react with alkyl halide through a process known as alkylation by the addition of alkyl groups by carbocation, free radical, or carbenes the predominate method. 1-chlorobutane alkylates the 1,3 imidazole-benzene to form imidazolium salts. These are then metalated with Zr $(NMe_2)_4$ and trans-metalated with Pt(II) sources that was added to the in situ prepared Zr reagent complexes. The metalation and trans-metalation processes are used to synthesis of the many complexes. The latest attempts of preparing new complexes will be reported.



042
Name: Smith, Tomyah
Major: Biochemistry
Faculty Advisor Name, Affiliation: LaShan Simpson, Biomedical Engineering
Project Category: Biological Sciences and Engineering
REU/Research Program: Bridges Program

Confirmation of Wnt Signaling in Vascular Calcification
Cardiovascular diseases are known for causing many deaths worldwide and being the deadliest disease in the United States. One of the causes of cardiovascular diseases is vascular calcification. Vascular calcification is the build-up of plaque that hardens healthy arteries. Wnt signaling pathway is a possible cause of vascular calcification. It is hypothesized that the Wnt signaling pathway changes vascular smooth muscles cells into osteoblast-like cells. Our research group has developed an in vitro cell culture model to induce vascular calcification in human vascular smooth muscle cells and we have shown this happens in a manner similar to bone mineralization. We induced vascular calcification by adding 3-mmol inorganic phosphate to normal cell growth media. We discovered the effects of Wnt signaling in cells and different kinds of Wnt signaling expressions. The objective of this study is to confirm Wnt signaling in our vascular smooth muscle cell calcification in vitro model.

091
Name: Solis, Jacob
Major: Biochemistry
Home Institution (Other than MSU): University Wisconsin-Stevens Point
Faculty Advisor Name, Affiliation: Dr. Joseph P. Emerson, Chemistry, Mississippi State University
Faculty Advisor Affiliation: Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Prakash Khanal, Alexander J. Cutright, Dr. Joseph P. Emerson
REU/Research Program: MSU REU-INFEWS

Isolation and Characterization of CopR a Copper(II)-Dependent Transcription Factor from Streptococcus pneumoniae.
Copper is a vital nutrient found within organisms; this oxidative metal is responsible for many reactions dependent on electron transfer. Although a necessary component of the cell, copper in high concentrations is incredibly toxic and deadly. Thus, copper homeostasis is tightly regulated in all living systems. CopR is the copper(II)-dependent transcription factor thought to be linked to modulating internal copper(II) concentration in *S. pneumoniae*. The biophysics of copper(II) binding to CopR and CuCopR binding to its DNA binding domain are explored here using calorimetry and spectroscopic techniques. These key thermodynamically controlled interactions are then probed with small molecule inhibitor complexes that show promise against similar zinc(II) transcription factors.

109
Name: Stamps, Ben
Major: Agribusiness
Faculty Advisor Name, Affiliation: Dr. Carley Morrison, Agricultural Education, Leadership and Communications, School of Human Sciences
Project Category: Social Sciences
REU/Research Program: USRP (AELC)

Public or Private: Students' perceptions of writing skills compared to their secondary educational experience
Language Arts and Writing is a core subject that every student is required to take each year in order to graduate from high school. However, in post-secondary education, writing courses often cause frustration for students. The purpose of this study was to describe the perceived writing skill-level of students in the College of Agriculture and Life Sciences who are enrolled in AELC 3203 – Professional Writing in Agricultural and Life Sciences during the 2020-2021 school year. We also compared their perceived writing skill with their high school learning environment. Students enrolled in all sections of

AELC 3203 were asked to complete an anonymous questionnaire (N = 250). The instrument included questions pertaining to students' writing ability, resources provided to assist with writing as a high school student and a college student, and demographic questions. One hundred and forty-one (n = 141) students responded to the survey. The majority of students attended public school (n = 104), 34 attended private school (n = 34), and three were homeschooled (n = 3). Students (n = 141) indicated they had a moderate writing skill level (M = 3.36, SD = 0.71). When comparing the three school environments there was no statistically significant difference (p = 0.84). However, writing longer papers and having teachers who were available to answer questions and stressed the importance of grammar, spelling and punctuation did significantly influence students perceived writing skill level ($p < .05$). Students who did not have similar experiences in high school may perceive their skill level to be lower once they arrive at college. It is recommended that university writing instructors continue to provide assignment that allow students to practice while stressing the importance of correct grammar, spelling, and punctuation. Additionally, instructors should be available and supportive to students in an effort to build their writing confidence.

092
Name: Taylor, Cassie
Major: Chemistry
Home Institution (Other than MSU): Bridgewater College
Faculty Advisor Name, Affiliation: Dongmao Zhang, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Max Wamsley, Weiyu Peng
REU/Research Program: MSU Summer 2021 Chemistry REU

Solvent Effects on Kinetic Quantification of Lipid Peroxidation in Practical Samples

Malondialdehyde (MDA) is a biomarker of oxidative stress, which is why it is commonly used in food and medical testing. However, MDA is a relatively small molecule that is difficult to detect. This issue can be resolved by reacting MDA with 2-thiobarbituric acid (TBA), which forms a TBA-MDA adduct. This adduct can fluoresce under light excitation, which makes it much easier to detect. Our research group has recently developed a kinetic quantification method, rather than the typical equilibrium quantification approach, to determine the concentration of MDA in practical samples. While each method has possible disadvantages, kinetic quantification is more efficient as it can be done during the reaction, unlike equilibrium quantification which can only be done after the reaction is completed. My work is to further improve the kinetic fluorescence method by focusing on which solvents give the best fluorescence sensitivity, assay efficiency, and robustness against matrix interference in practical biological samples.

Based on the data collected, it will be determined which solvent offers the highest TBA-MDA fluorescence activity, the one for the fastest TBA/MDA reaction rate in the organic solvent/water mixture, and the one enabling efficient MDA extraction from biological samples with minimum protein and DNA interferences. This information will be utilized for selecting the most effective reaction solution to ensure the fluorogenic assay sensitivity and efficiency, and the extraction solvent for assay robustness. Example applications of the optimized method will be demonstrated for the quantification of MDA in ground beef. Based on these results, the best solvent will be tested kinetically and then compared to an equilibrium quantification method. Thus far it seems as if DMSO has the best fluorescence sensitivity and assay efficiency of the solvents tested.

043
Name: Taylor, Joshua
Major: Biochemistry
Home Institution (Other than MSU): East Mississippi Community College
Faculty Advisor Name, Affiliation: Xueyan Shan, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Joshua Hartley
REU/Research Program: NIH

To Identify the Allelic polymorphisms of Aspergillus Flavus Resistant Genes in Corn (Zea mays. L)
The Fungus *Aspergillus Flavus* causes an accumulation of aflatoxin within corn plants (Z*ea mays. L*); that lead to both chronic and acute hepatocellular carcinoma cellular injury and immunosuppression. This has led to strict laws in which aflatoxin is regulated in food for human consumption as well as animal feed. Along with strict regulation on the food industry of The United States of America, this has a major economic impact on the U.S. since it is a major producer and exporter of corn. Within the genetic makeup of the corn, scientists can take two parental gene lines, Mp313E and Va35, test the samples through PCR identify the sequences that can be used to locate insertion and deletion points in nearisogenic lines (NIL); so, the researchers can see which genes will be expressed and continued through the offspring. Through Research scientist have identified a quantitative trait loci (QTLs) associated to the reduction of aflatoxin in Mp313E meaning that it is resistant to the fungus; unlike Va35 which is susceptible to the infection but is more efficient than Mp313E for uses such as mass agricultural production. This research is attempting to identify Allelic polymorphisms of *Aspergillus flavus* resistant genes found within QTL #1 (chromosome 2 bin 5). Finally, the reason behind this research is to create a corn species that has sufficient Farming / agricultural capabilities along with being resistant to *Aspergillus flavus* and aflatoxin collection.

093
Name: Thompson, Beau
Major: Physics
Home Institution (Other than MSU): Vasser College
Faculty Advisor Name, Affiliation: Dr. R. Torsten Clay, Physics and Astronomy
Project Category: Physical Sciences and Engineering
REU/Research Program: REU: Computational Methods in Materials Science

Modeling Long-Range Electron Interactions in Superconductors
The mechanism for superconductivity in conventional superconductors is well explained by the Bardeen-CooperSchrieffer model. However, the mechanism for unconventional superconductors, which have much higher critical temperatures (T_c's), is still not understood. They have many applications, as their higher T_c's allow them to be superconductors without the use of coolants such as liquid helium. One model that is used to study how electrons behave in these materials is the Hubbard model, which accounts for the electrons moving between sites, and includes an energy cost for spin up and spin down electrons occupying the same orbital. This model fails to explain unconventional superconductivity. It has been proposed that extending this model to include repulsive interactions between nearest neighbor electrons is enough to cause superconductivity. Here we examine and numerically solve an extended Hubbard model which includes interactions between nearest neighbors. Preliminary results on smaller systems suggest that electron-electron interactions are not enough to explain superconductivity, although we have yet to solve the model for larger systems, which will be more reliable as it reduces the influence of the finite-size effect. We employ the Density Matrix Renormalization Group method to solve these systems, utilizing the computing power at the Mississippi State University High Performance Computing Collaboratory. This research was supported by the National Science Foundation grant NSF-DMR-1950208.

094
Name: Thorn, Dakota
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Mohammad Heshmati, Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Ndeye Fatou Diop, Taylor Blake Shelton, Maryam Mirabolghassemi

Converting Oil and Gas wells of Mississippi into Enhanced Geothermal Resources
Enhanced geothermal energy is obtained from depths of earth by injecting water into deep wells to be heated by underground rocks. Deep wells are time-consuming and expensive to drill; therefore, changing the functionality of already-drilled wells would be a smart investment. There are many producing hydrocarbon wells in Mississippi that will eventually be abandoned. This research examines the feasibility of conversion of these wells into geothermal wells. This is primarily determined by examining well log data to find formation temperatures. Logging operations are typically performed immediately after drilling is concluded. This is when a lower temperature mud is circulated inside the well to remove drill cuttings and prepare the well for logging operation; therefore, log-measured bottom hole temperatures need to be corrected to find an estimate of reservoir temperature. The calculated reservoir temperatures can then be used to locate areas in Mississippi with relatively high geothermal gradient and depth, which are conducive of productive enhanced geothermal well locations. The enhanced geothermal method discussed in this research utilizes a single well for both, injection of cold water, and production of hot water. Cold water is heated as it flows down the annulus and the hot water is then produced through the insulated tubing of the same well, which is finally used to generate power at the surface. The formation temperature and other data such as tubing type, size, and price, and tubing insulation type and cost are then utilized for economic evaluation. Our results show that geothermal energy production is viable in certain areas of Mississippi. Converting existing oil and gas wells into enhanced geothermal wells reduces the cost of operations, potentially making it comparable to the costs of solar power generation. This conversion can also have a relatively small environmental impact when compared to renewable resources such as solar energy.

110
Name: Todd, Alayna
Major: Human Sciences/Apparel Textiles & Merchandising
Faculty Advisor Name, Affiliation: Charles Freeman, Fashion Design and Merchandising
Project Category: Social Sciences
Co-Author(s): Santanu Kundu, Bill Elmore, Rangana Wijayapala

Development of a Compost-Ready PPE for Use in Poultry Production
The poultry industry consistently utilizes compost bins for sustainable waste disposal. Every individual that enters a poultry farm must wear a PPE suit to prevent the spread of diseases to and from the poultry. Once the individual exits the farm, the PPE suit is disposed of in the waste bin. As regulations tighten, poultry farm inspections increase, thus, increasing the amount of PPE waste sent to landfills. To minimize waste and energy consumption, a compostable PPE suit with minimal permeability is to be created. The material's base placard is to be composed of 50% hemp hurd and 50% PLA (polylactic acid) from a Twin-screw extrusion process. Following placard production, the material undergoes a melt-blow process to yield a nonwoven fabric. Preliminary findings indicate that the 50/50 Hemp/PLA material will complete the composting process in 3 to 7 months under standard compost bin conditions of 40-60% humidity and 130- 160 °F. Testing of compostability percentages and optimal placard composition are underway.

044
Name: Tucker, Emily
Major: Biochemistry
Faculty Advisor Name, Affiliation: Dr. Anuraj Theradiyil Sukumaran, Poultry Science
Project Category: Biological Sciences and Engineering
Co-Author(s): Hudson Thames, Li Zhang, Aaron Kiess, Thu T. N. Dinh, Anuraj T. Sukumaran
REU/Research Program: CALS URSP

Efficacy of Peracetic Acid and Cetylpyridinium Chloride against Salmonella Reading in vitro and on Turkey Carcasses
In the last 3 years, *Salmonella* Reading has evolved as a potential food safety challenge to the turkey industry. Since 2017, *Salmonella* Reading on turkey meat has resulted in 358 cases of foodborne illnesses, 133 hospitalizations, and one death. The objective of this study was to determine the minimum inhibitory concentration (MIC) of peracetic acid (PAA) and cetylpyridinium chloride (CPC) at 2 different temperatures and exposure times, on *Salmonella* Reading outbreak and non-outbreak strains and the efficacy of these antimicrobials on *S*. Reading inoculated on turkey carcasses in a simulated finishing chiller. The MIC was determined by a broth dilution assay in tryptic soy broth using 96-well plates and direct plating onto tryptic soy agar. Further, turkey carcasses were inoculated with 1 mL of 8 log CFU/mL *Salmonella* strains individually and immersed in 200 ppm PAA or CPC for 15 s. Carcasses were rinsed with 400 mL BPW for 1 minute and the rinsate was serially diluted and plated on XLT4 agar plates. Presumptive *Salmonella* colonies were enumerated and expressed as log CFU/carcass. Data were analyzed by the GLIMMIX procedure of SAS 9.4 at a significance level of 0.05. The MIC of PAA was 140 ppm, much greater than that of CPC (25 ppm; $P < 0.001$). Temperature, exposure time, and strain had no effect on MIC. On turkey carcasses, PAA and CPC at 200 ppm reduced both strains of *Salmonella* to nondetectable levels. Salmonella was only recovered from positive controls at an average of 6.2 log CFU/carcass for both *Salmonella* strains. These results suggest that 200 ppm of PAA or CPC in chilling tanks is sufficient to reduce the novel *S.* Reading outbreak strain on turkey carcasses.

045
Name: Wade, Emma
Major: Computer Science
Faculty Advisor Name, Affiliation: Jean-Francois Gout, Biological Sciences
Project Category: Biological Sciences and Engineering

Contrasting Transcription Fidelity in Long Noncoding RNA and Protein-Coding Genes
The genome is diverse - some regions encode proteins, others play roles as regulators, promoters, etc., and many may not serve a function at all. Typically, genes are classified into two categories: coding (i.e. codes for a protein) and non-coding (e.g. transfer RNA, ribosomal RNA, small interfering RNAs, …). Long non-coding RNAs (lncRNAs, a catch-all category for untranslated transcripts 200+ nucleotides long) are one of many types of non-coding genes and arguably the most mysterious. Although these transcripts are spliced, polyadenylated, and transcribed by the same RNA polymerase in charge of protein-coding genes (RNAPII), very little is known about their function. Here, we investigate the fidelity of transcription of lncRNAs in humans, defined as the rate at which the RNA Polymerase incorporates a wrong nucleotide. Using data generated with rolling-circle sequencing (a method allowing for ultra-accurate sequencing of RNA molecules) and a collection of lncRNA annotation databases, we discovered that transcription of lncRNAs is far more error-prone than that of protein-coding genes. We then investigated features that could be responsible for their elevated error-rate. We find that lncRNAs overlapping protein-coding genes are especially prone to inaccurate transcription. These results suggest that many lncRNAs are simply the non-functional products of noisy transcription by inaccurate RNA polymerases.

046
Name: Walters, Gabbi
Major: Animal and Dairy Sciences (Pre-Vet)
Faculty Advisor Name, Affiliation: Jamie Larson, Animal and Dairy Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Tate Johnson
REU/Research Program: CALS URSP

Comparison of Blood Perfusion within Ovarian Tissue in Pregnant and Non Pregnant Beef Cows

Our objective was to compare the blood perfusion within ovaries during the first 21 days of pregnancy in pregnant and non-pregnant cows. We hypothesized that pregnant cows would have increased blood perfusion compared to non-pregnant cows. For this project, 23 cows divided into two groups had their estrous cycles synchronized (an injection of gonadotropin releasing hormone with a controlled internal drug release (CIDR) device containing progesterone, followed in seven days with removal of the CIDR and an injection of prostaglandin F2α). Cows were randomly assigned to either receive artificial insemination (n = 17) or not (n = 6). For the next 21 days, an ultrasound exam was performed, via rectum, on each cow every other day and images showing blood perfusion to each ovary were collected and saved. Values for both percent area of blood perfusion and integrated density (the number of pixels counted indicating blood perfusion; indicating intensity) were calculated using ImageJ. After pregnancy status was determined at 30 days, non-pregnant cows in the pregnant group were removed. Data was then analyzed using the GLIMMIX procedure of SAS. LSMeans and standard errors are presented; significance was declared when P≤0.05. The percent area of perfusion was greater (P=0.024) in non-pregnant cows (5.44 ± 0.36%) than pregnant cows (4.33 ± 0.34%). Integrated density was greater (P=0.018) in non-pregnant cows (236.34 ± 17.70) than pregnant cows (179.17 ± 16.46). When comparing across days of the study, there were significant differences in percent area of blood perfusion (P=0.057) and integrated density (P=0.007). These results indicate that our hypothesis was not supported and that non-pregnant cows had increased blood perfusion in their ovaries compared to pregnant cows. This may be a result of continued and increased follicular dynamics in non-pregnant cows compared to a sustained luteal phase in pregnant females.

111
Name: Welch, Jaycie
Home Institution (Other than MSU): East Mississippi Community College
Faculty Advisor Name, Affiliation: Michael Nadorff, Psychology, Mississippi State University
Project Category: Social Sciences
REU/Research Program: Psychology

Gatekeeper Training: The Alliance Project

Suicide is a leading cause of death nationally and globally. The feeling of burdensomeness and lack of belongingness are the two main factors to make up the desire for suicidal behavior. Specifically, at Mississippi State University, symptoms of suicide have been predominantly seen among veterans, veterinary students, LGBTQ students, and students in recovery from substance use disorders. Five MSU students fatally attempted suicide in the last five years with one additional individual, who had withdrawn from school before the death, included. Gatekeeper training is an educational program for suicide prevention. At Mississippi State University, the training is known as The Alliance Project. The Alliance Project offers suicide prevention trainings, postvention trainings, and response services. Services are available to anyone wanting to become more comfortable helping individuals in distress within the state of Mississippi. This training will train at least 1,000 students, faculty, and staff. People who participate in The Alliance Project gatekeeper training come out of it with more knowledge and understanding of what individuals with mental health concerns experience. It also leaves participants with resources for the person to refer to that can help. The fear of initial contact and the lack of trust in oneself can cause them to be resistant to use the skills they were taught in this training. Getting past these restraints, The Alliance Project gatekeeper training is an effective training to help reduce the risk of suicide with the help of the participants.

095
Name: Wells, Garrett
Major: Chemistry
Faculty Advisor Name, Affiliation: Charles E. Webster, Chemistry; Mahesh K. Gangishetty, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Dale Belles III
REU/Research Program: Chemistry Summer Research

Analysis of Emission and Absorbance Spectra for CCC-NHC-Pt and CCC-NHC-Pd Complexes
Pincer CCC-bis(NHC) transition-metal complexes show promising potential as engineering materials for the improvement of photovoltaic efficiency. The CCC-NHC platinum and palladium are of particular interest as they emit blue light, a much needed color for organic light emitting diodes (OLEDs). Organic LEDs are composed of thin films of organic molecules which emit light upon the application of electricity. Organic LED screens boast brighter, crisper displays on electronic devices and additionally they consume less power than conventional light-emitting diodes (LEDs) and liquid crystal displays (LCDs). In this work we have computationally studied the absorption and emission properties of a series of the palladium and platinum complexes.

096
Name: Williams, Harrison
Major: Mechanical Engineering
Faculty Advisor Name, Affiliation: Matthew W. Priddy, Mechanical Engineering
Project Category: Physical Sciences and Engineering
REU/Research Program: Computational Mechanics and Materials Laboratory

Comparison of cellular automaton and phase-field models to simulate microstructure evolution during dynamic recrystallization of additively manufactured austenitic stainless steels
Dynamic recrystallization (DRX) is a metallurgical thermodynamic process that occurs during hot deformation in materials with low-to-medium fault stacking energy, such as 316L SS. Mechanical properties of 316L SS are largely affected by the nucleation and growth of DRX grains. Thus, the wide range of SS applications in the marine, biomedical, and aerospace industries makes it necessary to understand microstructure development during DRX at the mesoscale level. In this study, the cellular automata method (CA) and phase-eld model (PF) were developed and compared to simulate microstructure evolution during DRX of 316L SS. CA inherently describes grain size/shape and phase volume fraction while intrinsically scaling up to exascale multi-scale simulations. However, PF results tend to have superiority over those achieved by CA due to limitations of describing curvature-driven interface migration. While PF better describes interface geometry, grain mobility/orientation, and morphological change, the main advantage is the model's ability to simulate the morphological change in computational microstructure evolution based on total free energy of the material. However, computational runtime and complexity limit PF in scalable applications. The two methods have been compared in simulating dendritic solidification, but there is a lack of available literature in modeling DRX. Therefore, it is essential to investigate the capabilities of the two models and compare them with experimental results obtained during hot deformation of additively manufactured 316L SS from the aforementioned literature. Future work consists of constructing new experiments for comparison and coupling CA and PF methods to generate a more detailed and accurate microstructure estimation.

097
Name: Woodard, Katelyn
Major: Chemical Engineering
Faculty Advisor Name, Affiliation: Dr. Julie Jessop, Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Sage Schissel

A Radical Library: Cataloging Radiation Yield of Acrylates Undergoing Electron-beam Polymerization
Electron-beam (EB) polymerization provides a fast, environmentally friendly method to create thin films and coatings for commercial applications. Expanding EB technology to new applications requires a better understanding of how starting materials (i.e., monomers) form free radicals under the EB. Free radical formation dictates the ability for the monomer to polymerize and the properties that final polymer exhibits. One measure of this attribute is the primary radical chemical radiation yield, $G(R^{\bullet})$, defined as the number of primary radicals formed per 100 electron volts (eV) delivered. The monomers chosen in this study belong to the acrylate family, as this family is industrially prevalent and also exhibits a range of properties, such as number and type of labile bonds, that can be used to understand the influence of these properties on free-radical formation. The concentration of primary radicals was determined based on the absorbance of DPPH, a free-radical inhibitor, at 520 nm after EB irradiation of an acrylate monomer at a given dose (eV) and line speed (ft/s). By plotting changes in DPPH concentration over different EB exposure times through UV-Vis spectroscopic analysis, the rate of primary radical formation was calculated and used to estimate the $G(R^{\bullet})$ for each monomer in the study. By developing this monomer library, we can relate $G(R^{\bullet})$ to chemical structure and ultimately polymer properties, providing guiding principles for materials synthesis, selection, and processing, rather than trial and error, as is the current industrial practice. This monomer library can be reliably expanded using the methods developed in this study to further the potential uses for EB polymerization in the industrial field and academia.

098
Name: York, Peyton
Major: Biochemistry
Faculty Advisor Name, Affiliation: Dr. Mahesh Gangishetty, Chemistry
Project Category: Physical Sciences and Engineering
REU/Research Program: Mississippi State Shackouls Honors Research Fellowship

2-D Halide Perovskites
Recently, 2D Lead halide perovskites have been showing great promises as emissive layers in light-emitting diodes (LEDs). They have tunable optical properties with an ability of producing high color purity, and high photoluminescence quantum yields. The molecular composition for 2D-metal halide perovskites is $L_2[ABX_3](n\text{-}1)BX_4$, and L, A and X play crucial role in color tunability. The A is a small cation, which in our experiment is Cesium-bromide/iodide, and the B is a divalent Pb^{2+} ion and X is a halide ion. Doping at B-site can produce highly efficient and dual emissive perovskites that are suitable for LED applications. Specific to our research, we use Mn^{2+}, and Nd^{3+} as the dopant ions, and the equation for perovskites is $[CsX]_2Pb_yNd/Mn_{(1-y)}X_4$. My long-term project is to optimize the composition, particularly the dopant concentration in 2D-halide perovskites, to create environmentally stable, blue light-emitting diodes for their potential application into cellular and electronic devices. Using additional B-site dopants, like Manganese and Neodymium ions, we are attempting to tune the wavelength of emission towards 470nm and optimize emission intensity of the perovskites. Additionally, I am currently working on a optimizing the composition primarily by varying concentrations of bromine and iodine and developing methods to produce single crystals of lead halide perovskites. In this project, we are using P-XRD/single crystal XRD to observe the crystal structure, and UV spectroscopy to observe the emission of each perovskite composition.

Summer 2021 Undergraduate Research Symposium Addendum

112
Name: Stewart, Cara
Major: Wildlife, Fisheries, and Aquaculture
Faculty Advisor Name, Affiliation: Dr. Kristine Evans, Wildlife, Fisheries, and Aquaculture
Project Category: Biological Sciences and Engineering
Research Program: ORED URSP

Assessing Climatic Extremes to Priority Bird Species in the Southeastern Coastal Plain
This research project aims to study Northern bobwhite (*Colinus virginianus*) and Louisiana waterthrush (*Parkesia motacilla*) responses to droughts and rising temperatures in the Southeastern Coastal Plain. Although there is extensive work on this topic in the central and western states, there is virtually no work assessing regional climatic extremes on avian communities in the Southeast. The main goal is to view how the Northern bobwhite and Louisiana waterthrush abundance and species richness are related to climatic extremes.

This study uses publicly available North American Breeding Bird Survey data, which has been collecting data across thousands of randomly distributed survey routes in the U.S. and Canada. Precipitation and maximum temperature data were pulled from PRISM Climate Group from 1997 - 2020 for the months of May and June. A generalized linear mixed effects modeling structure was used, with count data of the priority bird species as the response variable and drought index measures as fixed effects.

113
Name: Singh, Puneet
Home Institution (Other than MSU): Goose Creek Memorial High School
Faculty Advisor Name, Affiliation: Neeraj Rai, Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Chandra S. Sarap, Neeraj Rai

Topological Tailoring of Linear Polycyclic Diradical Hydrocarbons
The rational design with tailoring the conjugated hydrocarbons results in possibility of introducing controlled spin states for potential application in organic ferromagnetic materials and spintronics. Herein, we explore the diradical character in linear polycyclic hydrocarbons based on five-membered and six-membered rings. Using density functional theory and combinatorial selection of fused rings, we study the structural and electronic properties leading to low/high spin states. The diradical index (y_0) is one of the key parameters to quantify the open/closed-shell nature in organic molecules ranging from 0 (closed-shell) to 1 (pure open-shell). Our computations reveal that hydrocarbons with quinoidal nature have open-shell character with localized electrons. We predict the diradical character increases with the number of fused rings with low electronic and singlet-triplet gap. Our studies are motivated to understand the structure-property relationship with topological tailoring of simple organic hydrocarbons that can open the window to design novel electronic devices.

Thank you to the judges for their help with the Summer 2021 Undergraduate Research Symposium.

Dr. Ty Abernathy	Social Science Research Center
Dr. Seung-Joon Ahn	Biochemistry & Molecular Biology, Entomology, & Plant Pathology
Dr. Navatha Alugubelly	Veterinary Medicine
Ridwan Ayinla	Chemistry
Elizabeth Baach	Forestry
Tom Brooks	Raspet Flight Research Laboratory
Matthew Carlo	Chemistry
Dr. Zully Contreras-Correa	Animal & Dairy Sciences
Dr. Kelsey Crane	Geosciences
Dr. Sid Creutz	Chemistry
Dr. Joby Czarnecki	Geosystems Research Institute
Dr. Mary Dozier	Psychology
Dr. Steve Elder	Agricultural & Biological Engineering
Dr. Daijun Feng	Chemistry
Chathuri Gamlath Mohottige	Chemistry
Dr. Jean-Francois Gout	Biological Science
Dr. Joshua Granger	Forestry
Casey Iwamoto	Forestry
Dr. Julie Jessop	Chemical Engineering
Dr. Ling Li	Biological Science
Sapan Luitel	Physics & Astronomy
Dr. Kelly Marsh	English
Dr. Florencia Meyer	Biochemistry & Molecular Biology, Entomology, & Plant Pathology
Dr. Maryam Mirabolghasemi	Chemical Engineering
Dr. Maryam Mohammadi Aragh	Agricultural & Biological Engineering
Pathirage Perara	Physics
Dr. Sabin Poudel	Poultry Science
Sujan Poudyal	Electrical & Computer Engineering
Binod Regmi	Physics & Astronomy
Teri Robinson	Libraries
Dr. Chandra Sarap	Chemical Engineering
Chiranjibi Shah	Electrical & Computer Engineering
Ketki Shelar	Chemistry
Dr. Chris Snyder	Shackouls Honors College
Dr. Sean Stokes	Chemistry
Rezwan Tanvir	Biochemistry & Molecular Biology, Entomology, & Plant Pathology
Bradly Thornton	Wildlife, Fisheries, and Aquaculture
Dr. George Trawick	Computer Science & Engineering
Dr. Lei Wang	Biological Science
Dr. Shane Warren	National Strategic Planning & Analysis Research Center
Dr. Shecoya White	Food Science, Nutrition, & Health Promotion
Woody Wilson	Chemical Engineering
Dr. Jianling Xie	Educational Psychology

congratulations

MISSISSIPPI STATE UNIVERSITY™

TO OUR SUMMER 2021 UNDERGRADUATE RESEARCH SYMPOSIUM WINNERS!

Arts and Humanities

Joseph Newell: Shakespeare's Expansion of Heteropatriarchy through Dreams: A Mockery of Women's Triumph in *A Midsummer Night's Dream* (Mentor: Dr. Dhanashree Thorat, English)

Biological Sciences and Engineering

1st Place - Cara Stewart: Assessing Climatic Extremes to Priority Bird Species in the Southeastern Coastal Plain (Mentor: Dr. Kristine Evans, Wildlife, Fisheries, and Aquaculture)

2nd Place - Madalyn Jennings: Evaluation of antibiotic resistance pattern of Avian Pathogenic Escherichia coli isolated from broiler breeders with colibacillosis from Mississippi (Mentor: Dr. Reshma Ramachandran, Poultry Science)

3rd Place - Samuel Cothron: Metabolites in Sucrose/starch synthesis pathway affect QQS transcript in Arabidopsis (Mentor: Dr. Ling Li, Biological Sciences)

3rd Place - Ibraheem Abbood: Using Mutagenesis to Understand How a Protein Binds to a Polystyrene Surface (Mentor: Dr. Nick Fitzkee, Chemistry)

Physical Sciences and Engineering

1st Place - Ian Johnson: Electrospinning Optically Active Polymer Fibers Containing Perovskite for use in Fibrous LED Devices (Mentor: Dr. Santanu Kundu, Chemical Engineering)

2nd Place - Rudane Griffiths: Efficient propane dehydroaromatization over ultralow loading Pt/HZSM-5 promoted with Cu (Mentor: Dr. Yizhi Xiang, Chemical Engineering)

3rd Place - Bailey Bullard: Testing of Engineered Biochar for the Removal of Phosphorus in Stormwater Runoff (Mentors: Dr. Todd Mlsna, Chemistry; Dr. Timothy Schauwecker, Landscape Architecture)

3rd Place - Katelyn Woodard: A Radical Library: Cataloging Radiation Yield of Acrylates Undergoing Electron-beam Polymerization (Mentor: Dr. Julie Jessop, Chemical Engineering)

Social Sciences

1st Place - Sarah Dulaney: Thematic Analysis of Vaccine Misinformation In Social Media (Mentor: Dr. Holli Seitz, Communication)

2nd Place - Lauren Adams: Eye Tracking Studies on Organic Molecule Representational Competence (Mentor: Dr. Deb Mlsna, Chemistry)

MISSISSIPPI STATE UNIVERSITY™
JUDY AND BOBBY SHACKOULS HONORS COLLEGE

"Research is formalized curiosity. It is poking and prying with a purpose."

- Zora Neale Hurston

Hurston (1891-1960) was an American anthropologist and writer known for her research and writing on slavery, race, folklore and the African-American experience.

Support provided by:

MISSISSIPPI STATE UNIVERSITY™
JUDY AND BOBBY SHACKOULS
HONORS COLLEGE

MISSISSIPPI STATE
UNIVERSITY™

COLLEGE OF ARTS & SCIENCES

MISSISSIPPI STATE
UNIVERSITY™

OFFICE OF RESEARCH AND
ECONOMIC DEVELOPMENT

MISSISSIPPI STATE UNIVERSITY™
OFFICE OF THE PROVOST AND
EXECUTIVE VICE PRESIDENT