MISSISSIPPI STATE UNIVERSITY

JUDY AND BOBBY SHACKOULS HONORS COLLEGE

SPRING 2021

VIRTUAL UNDERGRADUATE RESEARCH SYMPOSIUM

APRIL 8-9, 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. To view the virtual symposium, visit honors.msstate.edu.

WELCOME MESSAGE

The Shackouls Honors College is pleased to sponsor this event twice annually. This symposium is a great way for undergraduate 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. In recognition of Mississippi State University's Carnegie Community Engagement Classification, the Undergraduate Research Symposium is pleased to continue to include the Community Engagement Research track in the spring symposium competition, sponsored by the Center for Community-Engaged Learning. There will also be separate competitions in Public Health Research, sponsored by the Department of Food Science, Nutrition and Health Promotion, and an engineering award sponsored by Theta Tau.

HOW TO NAVIGATE

A few words about navigating the system: **Access** students' projects by clicking on "Presentations" in the upper part of your screen. From there, you can **filter** projects by 4 areas : Arts and Humanities, Biological Sciences and Engineering, Physical Sciences and Engineering, and Social Sciences. You may also filter by one of the three sub-competitions or search by author. Many projects represent interdisciplinary work so do venture into a new area! Submitted projects may include a video as well

as a poster. Feel free to send questions or thoughts through the **comment box** located below each project. Students will be alerted via email that a comment has posted and will have the opportunity to answer any questions.

AWARDS

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

MISSISSIPPI STATE UNIVERSITY™
DEPARTMENT OF FOOD SCIENCE,
NUTRITION AND HEALTH PROMOTION

MESSAGE ABOUT PUBLIC HEALTH COMPETITION

This year, the Undergraduate Research Symposium is taking place during National Public Health Week, a weeklong celebration designed to bring attention to the field of public health and the many ways that we can work to promote health and well-being within our communities and around the world. As part of MSU's National Public Health Week 2021 celebration, we are pleased to host the Public Health Research Competition, which recognizes excellence in undergraduate research in public health-related fields.

Across the university, there are faculty, staff, and students engaged in important work with valuable public health implications. Topics range from food security to mental health, environmental health, health communication, violence prevention, the built environment, and more. We are pleased to recognize the students at Mississippi State University who are conducting this important research. We would also like to thank the faculty mentors who support these students, the volunteers who spend time organizing the competition and serving as judges, and the sponsor of this year's competition, the MSU Department of Food Science, Nutrition and Health Promotion.

Congratulations, researchers!

Holli Seitz, MPH, PhD
Assistant Professor
Department of Communication and the Social Science Research Center

MISSISSIPPI STATE UNIVERSITY™
CENTER FOR COMMUNITY-ENGAGED LEARNING

In 2020, Mississippi State University was recognized by the Carnegie Foundation for its institutional commitment to community engagement through teaching, research, and public service with the Community Engagement Classification. Mississippi State Universityis one of 359 colleges and universities to achieve this elective classification. To support students, faculty, and staff involved in community engagement and engaged scholarship, Mississippi State University created the Center for Community-Engaged Learning (CCEL),under the umbrella of the Office of Student Leadership and Community Engagement. One of CCEL's goals is to promote intentional opportunities for the advancement, production,and publication of research focused on the scholarship of engagement. The Community Engagement track of the Undergraduate Research Symposium is an avenue to highlight the work of students towards this goal.

The commitment to community engagement continues daily at Mississippi State University even during a pandemic. Our students, staff, and faculty create and sustain partnerships with individuals and organizations beyond our campus to discover, develop,and disseminate knowledge that ultimately improves the learning, lives, and conditions of individuals and communities across Mississippi and around the globe. These mutually beneficial partnerships between external collaborators and Mississippi State University scholars are one of our university's greatest assets, and we applaud those involved in research that has the potential to change communities. If you are interested in learning more about community engagement, please contact Michelle Garraway at michelle.garraway@msstate.edu. She strives to help Mississippi State University maintainits position as a nationally recognized leader in community-engaged research, learning, and service.

Kathy S. Jones, M.S.
Director
Office of Student Leadership and Community Engagement

Student Presenters

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ABSTRACTS

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Major: Chemical Engineering
Faculty Advisor, Affiliation: Yizhi Xiang, Dave C. Swalm School of Chemical Engineering
Project Category: Physical Sciences and Engineering,
REU/ Research Program: Office of Research and Development (ORED) and Bagley College of Engineering

Bimetallic Ni/Ga modified HZSM-5 Catalyst for Ethane Aromatization

The shale gas revolution has triggered a great interest in the conversion of light alkane into aromatics (Benzene, Toluene, and Xylene (BTX)). Although the aromatization of C_{3+} alkanes, such as Cyclar™ and Aroforming processes, have been fully demonstrated in industry, an efficient catalyst for the aromatization of ethane, the second most abundant light alkanes in natural gas, remains to be developed. Ga, Zn, or Pt-modified aluminosilicate zeolites are the most utilized catalyst for ethane aromatization because of their unique catalytic performance; however, they still require significant improvements in terms of activity, selectivity, and stability. Here, we introduce bimetallic Ni/Ga modified HZSM-5 as a promising catalyst for ethane aromatization because of its high activity or selectivity and stability. Several bimetallic catalysts consisting of Ni/Ga supported on ZSM-5 zeolite (SiO_2/Al_2O_3 = 30) with various Ni to Ga molar ratios were synthesized via impregnation. The catalyst performance evaluation was performed at 823 K under atmospheric pressure with a gas hourly space velocity (4000 hr^{-1}). The results have shown that the BTX selectivity up to ~75% was achieved for the optimal Ni/Ga molar ratio of 1/1. However, with increasing the Ni to Ga ratio to the values higher than 1, lower BTX selectivity was observed. The higher BTX selectivity and lower activity were obtained for Ni to Ga ratio less than 1. The monometallic Ni/HZSM-5 catalyst exhibits an induction period of up to 10 minutes. However, for the catalyst with Ga to Ni ratio higher than 1, the induction period lasts only a few seconds, which suggested the presence of different catalytically active sites in the bimetallic catalysts. Upon extensive catalysts characterization by XRD, TEM, etc., we hypothesize that the formation of Ni/Ga intermetallic alloy to be responsible for the outstanding catalytic performance.
https://youtu.be/h8sjMV3RC6E

59
Name: Asishana Ajayi
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Prof. Calvin Walker and Prof. Rob Wolz, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Cost Efficient UAVs

This document entails the background and a "how-to" guide for designing a cost efficient UAV, specifically a quadcopter. Research into the history and current uses of UAS technology will be explored to give a basic understanding of UAVs. The design process includes creating a manual for engineering a quadrotor. Experimentation will be conducted with similarly classified UAVs to find out if cheaper sensors would work on defensive UAVs. However, due to limited funds the actual design will not be engineered. Results show that cheaper, off-the-shelf drone sensors can be employed for defensive UAVs.

https://youtu.be/CwdfOY_WN9o

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Name: Adrain Andrews
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Dr. Lauren Priddy, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Sophie Jones, Nathan Risley, Matthew W. Priddy, Lauren B. Priddy
REU/ Research Program: Office of Research and Economic Development Undergraduate Research Program and the Bagley College of Engineering Undergraduate Research Program

Degradation Analysis of Additively Manufactured WE43 Magnesium Alloy for Orthopedic Applications

The use of magnesium alloys as materials for bone fixation is attractive because of magnesium's biodegradability and comparable mechanical properties to those of bone. Degradation is beneficial because it can allow the bone to replace the implant and erase the need for an implant removal surgery on temporary implants. Also, similarities in mechanical properties between magnesium and bone help avoid stress shielding, which could lead to a faster recovery time for the patient. Nonetheless, the rate at which pure magnesium degrades is faster than the rate of bone formation, which poses the risks of poor implant integration into bone and insufficient mechanical properties of the implant. This rapid degradation also can be detrimental from its production of H2 gas. WE43, a magnesium alloy, contains ~8 percent rare-earth elements (yttrium, which confers high corrosion resistance, and zirconium). Our ongoing work involves examining the effects of additively manufactured WE43 processing parameters on degradation rate. Degradation rates of eight WE43 groups (n=3) printed with various processing parameters (i.e., laser power, scan speed, hatch spacing, and layer thickness) were examined. Samples were submerged in cell media at 37°C under gentle shaking, and mass was measured at various time points through 59 days. The pH of the media at those same time points was measured through day 7. In our next steps, we will measure degradation rates and surface roughness defects on additively manufactured WE43 fabricated using low energy or high energy input (results in same density but different sized defects), in comparison to wrought WE43 (control). New to this study, we plan to use a Keyence surface profilometer to obtain a more accurate depiction of surface roughness during WE43 degradation. This work provides a better understanding of how WE43 may react with the body so it may eventually be used as an orthopedic implant.

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Name: Andrew Aronson
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Yang Cheng, Dr. Jichul Kim, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Double gimbal system for camera stabilization on weather balloon payloads
Cameras based on weather balloon payloads are unable to image or video the ground directly below it due to motion blur caused by the sway of the payload. To counter this sway a two-axis gimbal was developed and programmed allowing for clear images and video to be taken. This gimbal used a PID controller augmented with a Kalman filter to control the motors and allow for precise and quick movements to separate the movement of the camera from the movement of the payload. Tests were preformed on the gimbal by hanging it from a string and swinging it to simulate wind gusts. The data gathered showed a quick system response with minimal overshoot. The gimbal and programming provided the necessary quick and precise adjustments to the camera's orientation to keep it steady while it swung.
https://youtu.be/q2AhEulso8U

50
Name: Samantha Avery
Major: Forestry
Faculty Advisor, Affiliation: Dr. Krishna Poudel, Forestry
Project Category: Biological Sciences and Engineering
REU/ Research Program: CFR/FWRC Undergraduate Research Scholars Program

Crown Ratio Models for Loblolly Pine
Growth and production potential of a tree depends on its crown dimension as it is closely related to a tree's photosynthetic capacity. Using data from a genetic and spacing study established by the Mississippi State University in Winston County, MS, we developed and evaluated the predictive performance of nonlinear and generalized linear crown ratio models. Nonlinear crown ratio models were fit using logistic, exponential, Weibull, and Richards functions. Additionally, a new modeling approach using beta regression was applied. Results were compared with the crown ratio model used in a widely used loblolly pine *Pinus taeda L.* growth and yield model (PTAEDA 4.0) in the south. The model based on beta regression had a higher R^2 than the other models and produced smaller root mean square error except at age 17.
https://youtu.be/7FD2QlznC0Q

10
Name: Pradeep B K
Major: Biochemistry
Faculty Advisor, Affiliation: Supervisors: George V. Popescu and Sorina C. Popescu, Mentor: Rezwana Setu, Biochemistry, Molecular Biology, Entomology and Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Rezwana Setu, George V. Popescu and Sorina C. Popescu
REU/ Research Program: REU

Antagonistic activity of bacterial endophytes against soil-borne pathogens of soybean
The rhizosphere is a rich reservoir of microorganisms that exerts a major impact on plant health and growth. Microbial groups found in the rhizosphere include bacteria, fungi, and protozoa, which can associate with the surface of the plant roots or enter the superficial tissue layers as endophytes. Over the last 10 years, the interest in microbial isolates with beneficial effects on the plant has increased steadily. Identification and biochemical characterization of beneficial microbes have attracted the interest of scientists from multiple disciplines. Indeed, the rhizosphere microbial communities are considered a source of health-promoting microorganisms and active compounds that can be utilized to control soil-borne pathogens. In our laboratory, we focus on exploiting the rhizosphere to control soilborne pathogens of soybean. Soybean, one of the major agricultural crops, is recognized as a major source of oil and nutritional food. Soybean production in MS and several other southern states have been impacted significantly by taproot decline, a disease caused by the emerging fungal pathogen, *Xylaria* sp. In this project, we aim to identify bacterial strains with antagonistic activity against *Xylaria*, by screening a library of bacterial strains isolated from healthy soybean roots. During the Spring 2021 semester, we tested 14 isolates using the co-cultivation method and demonstrated that several strains significantly inhibited the growth of *Xylaria* sp. Currently, these beneficial strains are subjected to whole-genome sequencing for identification and taxonomic classification. Further, we plan to test the isolates for their ability to suppress the development of taproot decline in soybean plants.
https://www.youtube.com/watch?v=plot6ECBmts

23
Name: Ethan Baca
Major: Biological Sciences
Faculty Advisor, Affiliation: Amy Dapper, Biological Sciences
Project Category: Biological Sciences and Engineering

Retention of Duplicated Recombination Genes Following Whole Genome Duplication in Yeast
A whole genome duplication is a mutation event that results in the duplication of the entire genome and this presents a lot of problems in meiotic recombination. Reducing recombination rate may help solve this issue and an effective way of doing this is through the

loss of duplicated recombination genes. Our hypothesis was that duplicated recombination genes are more likely to be lost in the generations after a whole genome duplication than other genes in the genome. There were 8 different yeast species studied along with 18 different recombination genes. Each gene was searched for in a yeast gene order data base and it was recorded whether a duplicated gene was maintained in the generations after a whole genome duplication event. It was found that in essentially every gene, a copy was not maintained. This led for us to accept our hypothesis that duplicated recombination genes were more likely to be lost following whole genome duplications.
https://youtu.be/0KUpKDDB5cM

80
Name: Andrew Bain
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker, Mark Janus, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Ballistic Performance of Modern Cartridges Outside of Earth's Atmosphere
Modern ballistic projectiles are optimized for use in Earth's atmosphere and gravitational pull (generally 9.81 m/s^2). The purpose of this project is to determine how three modern cartridges (9mm Luger, 5.56 NATO, and 7.62 NATO) will perform outside of the Earth, such as in orbital microgravity, on the Moon, and on Mars. In order to maintain consistency, a set standard platform will be used to launch each projectile for every environment. In other words, a standard firearm chambered for the cartridge will be used in each of the models. Once the performance has been modeled in the other environments, the projectiles and/or platforms can be optimized to mimic the performance on Earth if possible.
https://youtu.be/VSEEW5SN3Lw

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Name: Taylor Banks
Major: Wildlife, Fisheries, and Aquaculture
Faculty Advisor, Affiliation: Leandro Miranda, Wildlife and Fisheries
Project Category: Biological Sciences and Engineering
Co-Author(s): Nicky Faucheux
REU/ Research Program: Wildlife, Fisheries, and Aquaculture Undergraduate Research Scholarship Program

Niche Partitioning among Native Cyprinid Fishes using Diet Analysis
The Southeastern United States is one of the most biodiverse areas for aquatic species in the nation; however, many streams in the Southeast experience a wildly dynamic hydrologic regime, which, combined with major changes in land use, often leads to homogenization in stream habitat. Habitat homogenization can lead to an increase in exploitative competition as

the diversity in habitat and diet items become restricted, resulting in multiple species competing for limited resources. The Yazoo Basin in Northern MS is a Southeastern watershed that is currently experiencing stream degradation due to the combined latent effects of deforestation and a dynamic hydraulic regime. We will determine whether niche partitioning is occurring among native cyprinid species including the Yazoo Shiner, *Notropis rafinesquei*, which is endemic to the Yazoo basin. We will analyze diets from six cyprinid species caught across a gradient of environmental factors to look for evidence of diet partitioning in different stream types. Habitat preferences of each species could indicate competition avoidance, if partitioning is occurring.
https://www.youtube.com/watch?v=A8fPaUmW5XM

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Name: Phillip Barlow
Major: Horticulture
Faculty Advisor, Affiliation: Dr. JoVonn Hill, Biochemistry, Molecular Biology, Entomology and Plant Pathology
Project Category: Biological Sciences and Engineering
REU/ Research Program: College of Agriculture and Life Sciences Undergraduate Research Scholars Program

Flower Visitation of Spiranthes magnicamporum in the Black Belt Prairie of Mississippi

Understanding the interaction between insects and plants is imperative to the conservation of our dwindling Black Belt Prairies in Mississippi. *Spiranthes magnicamporum,* or Great Plains lady's tresses, is a native orchid to Mississippi's Black Belt Prairie. In Mississippi, *S. magnicamporum* is considered imperiled and the populations found here are considered disjunct from those in the Great Plains. Due to its late fall bloom time, it is often the lone nectar source in these isolated systems. The purpose for this study was to determine flower interactions between insects of the Black Belt Prairie and *S. magnicamporum.* In October and November 2020, a pollinator interaction study took place in Osborn, Mississippi. Four trips were taken in the morning and four after dark to this prairie remnant to observe and collect insects in the act of pollenating *S. magnicamporum*. We observed five different colonies for 30 minutes each. Insect specimens were collected with nets and placed in kill jars or ethanol. Once caught and stored, we took the specimens back to the Entomology lab for identification. Specimens were deposited in the Mississippi Entomological Museum. As a result of this study on *S. magnicamporum* in Mississippi's Black Belt Prairie we found many insect interactions with this flower. The insects found are two different species of *Lasioglossum sp.*, *Xylocopa virginica*, *Bombus fraternus*, *Bombus bimaculatus*, *Urbanus proteus*, *Junonia coenia, Solenopsis invicta, Crematogaster missouriensis,* and *Monomorium minimum*. During this study, *Bombus fraternus* was the only insect found to have definitively pollinated *S. magnicamporum.* This unique study of insect interaction with *S. magnicamporum* is important to understanding the flora of the Black Belt prairie. To date, there was only one documented case of *S. magnicamporum* pollination, this study found multiple species

nectaring at *S. magnicamporum* along with its first documented pollination in Mississippi's Black Belt Prairie.
https://youtu.be/wzXeV3AHR1M

98
Name: Isaac Barnett
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Rani Sullivan, Aerospace Engineering
Project Category: Physical Sciences and Engineering

The Effects of Impact on the Permeability of Cryogenically Cycles Composites
In this study, the effects of impact on the permeation of cryogenically cycled carbon-epoxy composites laminates will be investigated. Twelve 16-ply ($[0/90]_{4S}$) composite laminates were fabricated using IM7/8552 prepreg. Three specimens were tested for permeability at various cryogenic cycles to create a control baseline for testing. The specimens were cryogenically cycled, impacted with intermediate velocity (~75 m/s) at room and cryogenic temperatures, and tested for post-impact permeability. The specimens were then cut into quadrants and examined for damage using optical microscopy. It was observed that the impact temperature does have an effect on the impact damage and permeability. The largest change in permeability occurred after the first cryogenic cycle, however, decreased in the following cycles.
https://youtu.be/Sde7ToOiIQE

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Name: Christopher Basinger
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Rani Sullivan & Dr. Zhenhua Tian, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Aerospace Engineering Department

Out-of-plane Displacement in DCB using Optical Fiber Strains
Optical fiber sensors are a developing technology that has an increasing number of applications since the beginning of their development. The sensing application of optical fibers has revolutionized the industry in structural engineering and their uses are steadily increasing. This project determined whether using optical fiber sensors is a viable procedure to determine out-of-plane displacement for a double cantilever beam. A case study was presented in which optical fiber sensors were used to determine the out-of-plane displacement of three aluminum double cantilever beam specimens. Using the ASTM d5528 testing standard as a reference; load, displacement, and strain was able to be measured using optical fibers. The measured data was then put into a MATLAB code where the deflection was calculated and graphed. The measured and calculated data showed that the approximate

crack position and deflection can be found using optical fiber.
https://youtu.be/KwgTMNWFGOs

70
Name: Thomas Beech
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Shane Brauer, Mechanical Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Bagley College of Engineering

Reducing Energy Consumption Around the Home and Boosting Physical Fitness
A well-known fact is the energy systems of today will not be the energy systems of tomorrow. The transition will not be immediate, but within several generations we will have a paradigm shift in energy production and consumption. Research is needed to explore various areas of application, create and test rapid prototypes, and explore opportunities that could have an impact on the energy systems of tomorrow. Today, there are several mainstream focuses on alternative energy, but there is opportunity to create devices that can harness the energy we waste daily. This research would help bring systems to individual residences to increase energy efficiency around the average home. Data from this research would show that we can reduce the average power consumption from the grid of a home by capturing this lost energy. Various research applications to consider would utilize the heat loss from homes as well as energy lost to water consumption. By studying these areas of energy loss, we can invent new technologies that will help improve our efficiency and bring forward the energy systems of tomorrow.
https://youtu.be/Dh9mDBgRfhM

63
Name: Hannah Belcher
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker and Dr. Rani Sullivan, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Dynetics Gremlin Performance
This Dynetics Gremlin is a new unmanned aerial vehicle still in the developmental phase. It is a UAV that is released from a mother airplane, completes its mission, and then returns to a mother airplane where it is collected midair, taken back to a discrete location for maintenance, and then it goes out for another mission. This poster and video analyzes the performance of the Gremlin and goes over how the project was completed. MATLAB was used to program a code as well as numbers found online to determine the overall performance of the Gremlin. The numbers found online were used to make scaled measurements on printed pictures of the Gremlin to find numbers not given online. These

printed pictures were also used to select a similar airfoil to the airfoil on the Gremlin. After analyzing the performance of the Gremlin, it is found to be a stable aircraft that cannot roll without yawing. The Gremlin performs to standard in flight to be released for duty, but is still not released as the release and capture are still being developed.
https://www.youtube.com/watch?v=Nru1I7WIJ1o&ab_channel=HannahBelcher

112
Name: Nirmal Bhatt
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Dr. Like Li, Mechanical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): David Korba, Dr. Like Li
REU/ Research Program: Office of Research and Economic Development (ORED); Bagley College of Engineering (BCOE)

Thermo-Mechanical Modeling of Tubular Receivers for Solar Energy Storage

This study focuses on modeling the thermal and mechanical stresses experienced by metal and ceramic tubes that transport heat transfer fluid in a concentrated solar power (CSP) plant. Fluids, such as molten nitrate salts, are utilized to absorb and transport CSP as received from a solar power tower. However, since energy transfer and transport occur at high temperatures (>700 °C), the tubes experience high thermal-mechanical stresses, compromising their structural integrity and operational lifespan. Since it is difficult to experimentally measure stresses in high temperature conditions, this study utilizes analytical approaches to create a 3D finite element analysis (FEA) model, which yields a stress field distribution without compromising important geometrical features. Temperature variations in the axial, radial, and circumferential directions are modeled and combined with thermal stress analysis from the static structural model to perform the coupled fluid-thermal structural simulation. This method of analysis is used to validate the model with existing literature and simplified analytical thermal-stress equations. After validation, a representative temperature distribution from a CSP receiver is used to predict the stress state of the tubular receiver. Future work within this study will alter other key design variables, such as tube diameter and thickness, to investigate their impact on the receiver's stress state. Concentrated Solar Power has become a competitive alternative to fossil fuels in recent years, as it allows for the conversion of solar energy to utility-scale electricity. The nature of CSP allows it to be integrated with existing thermal energy infrastructure, ensuring that intermittent sunlight does not impede the flow of electricity. Research to further strengthen the energy transport infrastructure will ensure that power plants are not compromised due to their inability to continuously transport the energy they absorb.
https://youtu.be/9StFZLVVhx0

24
Name: Haley Blische
Major: Wildlife, Fisheries, and Aquaculture
Faculty Advisor, Affiliation: Michael Colvin, Wildlife, Fisheries, and Aquaculture
Project Category: Biological Sciences and Engineering
Co-Author(s): M.E. Colvin, C.G. Dunn
REU/ Research Program: CFR URSP

Distribution and detection of American eels Anguilla rostrata in Mississippi
The American eel, *Anguilla rostrata*, is listed as Endangered by IUCN. It is a catadromous species whose migration is an important indicator of stream connectivity. American eels are difficult to capture especially in non-wadeable streams and therefore distributional status may be underestimated. Understanding the current distribution and capture methods is important to evaluate population distribution. The objectives of this project were to evaluate American eel distribution in interior Mississippi Rivers and evaluate passive capture methods for non-wadeable streams. Historic detections of American eels were evaluated from distributional databases. American eels have been detected throughout in the state with the highest number of current and historical detections in rivers draining to the Gulf of Mexico. Detections occurred in 259 out of 22256 sampling efforts withing Mississippi. The Noxubee River is a non-wadeable river in the Mobile basin that is representative of interior Mississippi Rivers. American eel was not commonly detected in the Noxubee River, with detections occurring in 2 out of the 363 samples conducted between 1880 and 2018. The last American eel detection in the Noxubee River was in 1983. Few detections in the Noxubee River despite over 300 sampling efforts suggest that American eels are rare and possibly declining or difficult to capture using conventional stream fish sampling gears. We evaluated several passive capture gears were in the Noxubee River at an American ell historical locality. Net traps, wire box traps, tube traps, and modified limb lines all with varying baits were evaluated for American eel catch. A single American eel was captured in a net trap. This preliminary result indicates that historical locality remains occupied by American eels and suggests that capture and detection is difficult.
https://youtu.be/EcVFH9qdv1M

14
Name: Amy Brown
Major: Microbiology / Biochemistry & Entomology
Faculty Advisor, Affiliation: Jonas G. King, Biochemistry, Molecular Biology, Entomology & Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Hunter K. Walt, Santosh Kumar T. K.

Global analysis of N-glycan biosynthesis pathway inhibition on human Hepatocellular carcinoma

Hepatocellular carcinoma (HCC) cell lines can be useful models for toxicology and infectious disease research; therefore, a basic understanding of their biology is useful. HCC also is the fourth most common cause of cancer death worldwide, so along with improvements in targeted therapy and precision medicine, the search for highly specific inhibitory compounds has heightened. Swainsonine is a specific inhibitor of alpha-mannosidase II (MAN2A), a Golgi enzyme at one of the major hubs for the biosynthesis of complex N-glycans, and it has been reported as a potential treatment for HCC and other cancers and has shown promise when used in conjunction with other anti-cancer drugs. It also has been reported to modulate the expression of epithelial-mesenchymal transition genes (EMT) that are important with regards to cancer metastasis and tumor progression. In this study, we hypothesize that swainsonine will affect HCC genes involved in EMT, and we conducted the first comprehensive transcriptomic study of one of the most commonly used human HCC cell lines, HepG2. We measured mortality and morphology using fluorescence microscopy, and RNA-seq was used to directly measure the transcriptomic effects of swainsonine treatment at a low and high dosage. Our results suggest that HepG2 is less susceptible to swainsonine-induced mortality than previous studies suggest, and that specific inhibition of complex N-glycan biosynthesis pathways leads to significant transcriptomic responses in the HepG2 transcriptome. We see also see specific changes in the expression of genes related to EMT biological processes related to cell proliferation and response to chemicals.
https://youtu.be/Uto7Lbu6kSw

134
Name: Gabrielle Brown
Major: Psychology
Faculty Advisor, Affiliation: Dr. Carolyn Adams-Price, Psychology
Project Category: Social Sciences
Co-Author(s): Anna Massey

"How I Know I'm Healthy: A Qualitative Study Examining Older, Rural African Americans in Mississippi"

Lately, awareness of healthcare disparities between racial subgroups and rural versus urban residents has increased. Not much is known about health in older rural African Americans, who may be at high risk for disparities. Older rural African Americans may have limited access to healthcare, limited income, and historical reasons to distrust the health care system. However, given that not much is known about cultural values and expectations associated with health in this population, we examined older rural African Americans' own perceptions of their health. This study examined qualitative definitions of health in older rural African Americans. Our sample included 47 African Americans aged 52-79 (20 male; 27 female, median age = 66) from nonmetropolitan counties in northeast Mississippi. Participants rated their health on a 5-point scale; only 1 person rated their health as excellent. On average, they rated their health as fair. Most reported significant health problems, including 17 (36%) who reported a diabetes diagnosis. Participants were asked

"how they know they're healthy," and responses were recorded, transcribed, and then coded recursively into the following naturalistic themes: Performing Basic Tasks is Sufficient/I'm OK (12), Good Health Due to Health-Promoting Behaviors (8), Healthy Due to Social Support or God (11), Healthy Despite Medical Issues (6), and I'm Not OK (7). These results suggest that definitions of health in this community vary considerably, with some individuals describing health as being able to get up and get by, others attributing good health to social support or God, and a few associating health with healthy behaviors. These results lead us to speculate that some older rural African Americans have low expectations for good health. Interventions to improve the health of this group should concentrate on implementing the fusion of social support and community health programs as well as increasing self-efficacy and health expectations.
https://youtu.be/o5LCyTDkNQY

5
Name: Sloane Bush
Major: Art - Photography
Faculty Advisor, Affiliation: Professor Marita Gootee, Art
Project Category: Arts and Humanities

Their Tormented Eyes: Post Traumatic Stress Disorder
Post-Traumatic Stress Disorder - it is a feared diagnosis within the military. It is one associated with weakness and ends careers. The stigma is so strong within those four words that it has led America to a place where we are burying on average over 6,000 troops a year. Men and women who fight for America's freedom, and see things that no man should ever have to see, are the heroes of this nation, and yet this nation is failing them. It is time to stand with those who suffer from a mental illness. Standing with them and supporting all who come back, even when they come back physically and struggle to come back mentally. No one is alone in this. Others suffer from the same things, and others want to lend a helping hand. It is time for us to know that leaning on others is not a weakness but a strength that not all have within them. Post-Traumatic Stress Disorder is not a death sentence. Helping to end the stigma is hoping to help to save lives.
https://youtu.be/4otkzD1cRxg

99
Name: Jacob Butera
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker and Rob Wolz, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Flight Performance of a Novel Fixed Wing UAS

The purpose of this paper is to analytically determine the performance of a fixed wing unmanned aircraft system (UAS). The analysis was broken down into six flight regimes: takeoff, climb, cruise, turning, glide, and landing. The performance during each regime was independently analyzed via a MATLAB script. Based on the results, it was determined whether the UAS could suitably complete the mission for which it was designed. A possible flight test plan to verify the computations is explored. In addition, potential limitations of prefabrication analysis are discussed.
https://youtu.be/_niG4XWf_UQ

86
Name: Catalina Carrasco
Major: Biochemistry, Chemistry
Faculty Advisor, Affiliation: Dr. Todd Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Sean Stokes, Charles U. Pittman Jr.
REU/ Research Program: National Science Foundation REU

Simultaneous Sorption of Multioxyanions (arsenate, phosphate, selenate, and chromate) using Magnetic Douglas Fir Biochar

Phosphates originate from food plants as well as wastes from humans and animals and produce an overgrowth of algae in the waters which lead to eutrophication. Selenate is an inorganic form of selenium found in soils and can be beneficial to humans in small doses. However, repeated exposure of selenate negatively affects thyroid hormones and can lead to negative neurological effects. Arsenate and Chromate enter groundwater through anthropogenic sources which can lead to cancer and are associated with cardiovascular and kidney diseases. Only few studies report the simultaneous sorption of contaminants onto adsorbents. In this work high temperature fast pyrolysis (900 ℃ and 30 secs) commercial Douglas fir biochar (S.A. 700 m^2/g, syn gas by product) was magnetized by chemical co-precipitation of iron oxides [magnetite, particle size (16-18) nm] (MBC) using $FeCl_3$ and $FeSO_4$. MBC was used in simultaneous removal of phosphate, selenate, arsenate and chromate from aqueous solutions. Sorption was studied against different initial solution pH (1-13), equilibrium time (0-240 mins) and initial concentration (1, 10 and 100 µM). Remaining ion concentrations were quantified using an ICP-MS instrument (detection limit <10 ppt). pH dependent iron leaching was also considered. Preliminary data suggest that MBC has a potential to simultaneously adsorb above-mentioned oxyanions. Sorption is sought to govern mainly by chemisorption onto iron oxide surfaces. MBC's potential for cyclic sorption, fixed-bed sorption will be assessed in future studies.
https://youtu.be/1uzvl2XzvHo

71
Name: Tyler Carrigan
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker, Dr. Adrian Sescu, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Performance Analysis of the X-15
This study observes the use of SolidWorks and MATLAB to develop a flow analysis and performance analysis of the X-15. The X-15 was an experimental aircraft developed by NASA to test the capabilities of manned hypersonic flight, as well as effects of aerodynamic heating and the capability of flying an aircraft into space. In this analysis, it is shown how SolidWorks is not a reliable tool to develop the flow regime desired for the performance of this aircraft. Additionally, it is revealed that the supersonic performance equations do not accurately simulate the cruise or glide performance of a hypersonic aircraft due to false assumptions of the drag, the ability to maintain hypersonic speeds for extended periods of time, and the assumption the X-15 behaves as a typical supersonic aircraft. It is concluded that the aircraft behaves as a boost-glide ballistic missile and as such future tests will be conducted to better model the capabilities of the aircraft.
https://youtu.be/4Jrhcnt61M4

20
Name: Cassidy Catrett
Major: Animal and Dairy Sciences and Poultry Science
Faculty Advisor, Affiliation: Dr. Brandi Karisch, Animal and Dairy Sciences; Dr. Garrett Street, Wildlife, Fisheries, and Aquaculture
Project Category: Biological Sciences and Engineering
Co-Author(s): Ira Parsons, Jane Dentinger, Durham Norman, Stephen Webb, Amanda Stone, Garrett Street, Brandi Karisch
REU/ Research Program: CALS Undergraduate Research Scholars Program

Identifying behaviors and the 'normal' daily ethogram using accelerometers on grazing animals
Animal behavior plays a crucial role as an indicator of animal health and nutritional status and serves as an indicator of animal growth. The objective of this study was to build an ethogram describing behavior in grazing cattle. We collected video and accelerometer data from crossbred steers (n = 10) used as part of a larger grazing study on the HH Leveck Animal Research Center, Mississippi State, MS. Daily Diary accelerometers (Wildbyte® technologies, Swansea) were programmed to collect magnetometer and accelerometer data at 40 Hz and attached to the GPS collars fitted on the animals prior to their release into a 10-hectare pasture of Tall Fescue and Bermudagrass, overseeded with Annual Ryegrass. Automated camera traps (Bushnell Essential®) were synced with UTC time and programmed to record 30-second video clips when triggered. Approximately 387,000 accelerometer signals representing 161 minutes of behavior from 10 animals were recorded, and behavior was

classified according to 1 of 5 categories: traveling, foraging, resting, ruminating, and grooming (Kilgour et al., 2012). Categorized accelerometer data was used to train a random forest model (Liaw and Weiner, 2002) in Program R (R Core Team, 2020), which resulted in a model sensitivity of 0.97, 0.93, 0.90, 0.87, and 0.80 for Traveling, Foraging, Resting, Ruminating, and Grooming, respectively, and an overall model accuracy of 0.95. Behaviors were aggregated into behavior bouts, and a daily ethogram was calculated for March 2019. This revealed that the steers spent the most amount of time traveling, an average of 1,026 minutes per day. This behavior was followed, in the average length of time, by foraging and resting for 205 ± 52.8 minutes and 31.8 ± 28.2 minutes per day, respectively. These results indicate the ability to accurately build a behavioral ethogram for grazing cattle and warrant further study in future research and livestock management.
https://youtu.be/tD17DE5Kkzw

124
Name: Ann Chapman
Major: Psychology
Faculty Advisor, Affiliation: Acacia R. Lopez & Danielle K. Nadorff, Psychology
Project Category: Social Sciences

Perceived Stress & Traumatic Life Events in College Students Raised by Grandparents
Prolonged exposure to traumatic stressors is associated with adverse outcomes, including increased stress, depression, and possible diagnosis of post-traumatic stress disorder (PTSD). Previous literature articulates the effects of concurrent stressors as part of the Cumulative Risk Hypothesis, which states that multiple risk factors concurrently in a child's life are more detrimental to the child's developmental outcomes than one singular risk factor. This hypothesis may apply to children raised by grandparents, as there are potential added stressors due to family disruption. Family disruption and subsequent guardianship by a grandparent are often due to traumatic life events, including a parent's divorce, desertion, drug use, death, delivery, detention, deployment, and disease. As of 2019, roughly 6,200,000 children are cared for by a grandparent. In line with the Cumulative Risk Hypothesis, this study aims to compare mean group differences of stress and trauma histories in children raised by grandparents to their peers, and hypothesized that compared to those not raised in kincare, college students raised by grandparents would have increased levels of both traumatic life events and perceived stress. Participants were recruited from a college sample (N = 370; 33.2% raised by grandparents) and completed self-report measures of Trauma History Questionnaire and Perceived Stress Scale online. Using Independent Samples T-tests, significant mean group differences were found in the number of traumatic life events between college students raised by grandparents and their peers ($t(368) = -2.64$, $p = .009$). However, no significant differences were found in levels of perceived stress ($t(368) = 1.54$, $p = .124$). These results suggest that prior caregiving environment is associated with traumatic events, but maybe buffered from contributing to adult perceived stress levels by other

factors. Future research is encouraged to examine caregiving status as a potential moderator in this relation, as well as examining potential protective factors.
https://youtu.be/FvsdWodktFQ

12
Name: Alexandria Clary
Major: Biochemistry-Forensics
Faculty Advisor, Affiliation: Hongxu Dong, Plant and Soil Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Geoff Lalk and Lovepreet Singh
REU/ Research Program: Undergraduate Research Scholar Program

Identifying simple sequence repeat markers for bermudagrass (*Cynodon spp*.)
Bermudagrass (*Cynodon spp.*) is a major warm-season turfgrass that has been extensively used in southern United States and increasingly used in the transition zone. Though, bermudagrass are largely cross-pollinated, giving rise to high heterozygosity amongst individual plants. This makes cultivar identification based on physical observation (morphology) difficult and requires alternative, molecular methods for plant selection. Thus, the use of simple sequence repeat (SSR) molecular markers to detect genetic diversity are commonly used in plant breeding, genetics, and genomics. This project served as a preliminary study to screen primer pairs and identify polymorphic SSR for bermudagrasses within Mississippi State University's breeding program in collaboration with Sod Solutions. A total of 54 bermudagrass samples were used in DNA extraction and were diluted to a uniform concentration (10 ng/µl). Of those, eight randomly selected samples were run through polymerase chain reaction (PCR) using 12 DNA primer pairs. Two primer pairs, CDGA–1601/02 and CDGA–807/08, successfully amplified DNA fragments that are polymorphic among the tested samples. The samples were then genotyped using 2% agarose gel electrophoresis to confirm the polymorphic SSR marker reliability.
Based on the electrophoresed gel, the following was concluded:

- Both primers can be polymorphic SSR markers.
- CDGA-807/08 may be used as a polymorphic SSR marker more effectively than CDGA-1601/02.
- Because primer reliability varied amongst individual samples, one primer may be favored over the other and further research will increase verification on marker reliability.

The results may have been impacted by DNA extraction success, the primers' ability to recognize their respective repeats, and whether the sample concentration was high enough to receive a result. Continued research will be adjusted based on possible errors in the protocol.
https://youtu.be/vP1b6OSObKg

125
Name: Anna Conner
Major: Business
Faculty Advisor, Affiliation: Dr. Georgianna Mann, Nutrition & Hospitality Management; Dr. Anne Cafer, Sociology & Anthropology, University of Mississippi,
Project Category: Social Sciences
Co-Author(s): Dr. Georgianna Mann, Dr. Anne Cafer
REU/ Research Program: Sally M Barksdale Honors College

Healthy Food Accessibility in Rural Mississippi and Potential For a Corner Store Intervention
Some areas of the United States have poorer food environments that others. The Mississippi Delta has limited access to nutritious food, often relying on corner stores for sustenance. The impact of a poor diet can increase chronic disease prevalence, creating additional barriers to health and nutrition for Mississippians. The purpose of this study was to document and explore the rural food environment and discuss urban intervention studies in light of the current state of stores in the Delta. An adapted version of the Baltimore Healthy Kids survey and store impact questionnaire was used to record owner perceptions and food availability. Findings suggest that there is a lack of adequate amounts and types of food needed for a nutritious diet in northwest Mississippi corner stores. Stores also faced challenges in selecting and stocking healthy foods, such as facing low customer demand and obtaining proper storage. The results of this study are similar to a pre-interventional status of Baltimore stores. They suggest a lack of nutritious options, making northwest Mississippi stores appropriate targets for intervention. A rural corner store intervention with modifications that address regional barriers to nutrition could be an effective method to improve access and consumption of a nutritious diet in the Delta.
https://youtu.be/VXgslY6Inzo

116
Name: Ryan Cook
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker, Aerospace Engineering
Project Category: Physical Sciences and Engineering

In-Depth Aerodynamic Analysis of the F-14 Tomcat
Beginning in the late 1950s, the United States Navy was seeking an interceptor that had high endurance as well as long range capabilities. The F-14 Tomcat itself was first developed by Grumman for this project, from its F-111 platform. Grumman and McDonnell Douglas were selected as finalists for the contract. When Grumman finally won out the contract in 1969, the F-14 began further development and testing. Boasting an unofficial record of around 135-4-4 in combat, the F-14 was one of the most successful aircraft ever. Among other things the F-14 had the ability to fire the AIM-54 Phoenix, the longest ranged AAM in the world. The design of the airplane, a variable-sweep wing, allowed for better control in slower or faster operation as well as being one of the most recognizable airframes in the history of jets. Using

the aerodynamic software available in the aerospace department, the F-14 will undergo more elaborate scenarios from its past and the results of this will be documented and explained. These scenarios would include when the airplane was operating in less than ideal conditions, when the airplane is carrying a larger payload, maneuvering while carrying or not carrying payload, or best performance. These scenarios will then be documented and reported. https://youtu.be/X6Elastmz_o

95
Name: Greg Cooper
Major: Chemistry
Faculty Advisor, Affiliation: Colleen Scott, Daijun Feng, Chemistry
Project Category: Physical Sciences and Engineering
REU/ Research Program: REU

Upcycling of Polystyrene: From Waste to Valuable Commodity Products
Beginning in the late 1950s, the United States Navy was seeking an interceptor that had high endurance as well as long range capabilities. The F-14 Tomcat itself was first developed by Grumman for this project, from its F-111 platform. Grumman and McDonnell Douglas were selected as finalists for the contract. When Grumman finally won out the contract in 1969, the F-14 began further development and testing. Boasting an unofficial record of around 135-4-4 in combat, the F-14 was one of the most successful aircraft ever. Among other things the F-14 had the ability to fire the AIM-54 Phoenix, the longest ranged AAM in the world. The design of the airplane, a variable-sweep wing, allowed for better control in slower or faster operation as well as being one of the most recognizable airframes in the history of jets. Using the aerodynamic software available in the aerospace department, the F-14 will undergo more elaborate scenarios from its past and the results of this will be documented and explained. These scenarios would include when the airplane was operating in less than ideal conditions, when the airplane is carrying a larger payload, maneuvering while carrying or not carrying payload, or best performance. These scenarios will then be documented and reported. https://www.youtube.com/watch?v=-I5h0ro9rJA

51
Name: Samuel Cothron
Major: Agronomy
Faculty Advisor, Affiliation: Dr. Lei Wang, Dr. Ling Li, Biological Sciences
Project Category: Biological Sciences and Engineering

Metabolites in sucrose/starch pathway affect QQS transcription in *Arabidopsis*
Protein and starch content are critical qualities of domesticated crop plants, and the ability to modulate carbon and nitrogen allocation in crop produce is of great economic importance. The orphan gene qua-quine starch (*QQS*) in *Arabidopsis* has been identified as a regulator of

carbon-to-nitrogen partitioning when overexpressed in plant species. While its molecular mechanism via interaction with the conserved transcription factor family NF-YC is well studied, the regulation of the *QQS* transcription level is still unclear. Our lab's previous data showed that *QQS* transcript level is obviously increased in the *Arabidopsis thaliana* knock-out mutant Starch Synthase 3 (ss3), which results in a change in concentration of multiple metabolites in the sucrose/starch synthesis pathway. To identify the role of these metabolites in altering the rate of transcription of *QQS* in *A. thaliana,* select cultivars were grown, and the relative expression of several genes of interest was analyzed via qPCR. We found that *QQS* transcript level is reduced in the trehalose knockout mutant *(Trehalose KO).* 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 trehalose 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 sucrose and trehalose concentration and signaling PIFs, which act to regulate resource partitioning and alter hypocotyl development in *in vitro A. thaliana.* Our findings shed light on the interrelations of sucrose related metabolites, transcription factors and *QQS* transcript in *Arabidopsis*.
https://youtu.be/mNmSCGHebhE

149
Name: Shelby Cox
Major: Psychology
Faculty Advisor, Affiliation: Dr. Deborah Eakin, Psychology
Project Category: Social Sciences
Co-Author(s): Mary Katherine Miller

What's That Outside the Window? Understanding Context Reinstatement Effects with Window Scenes

When information is learned and retrieved in the same environmental context, recall is higher than when the environmental context is changed. This result is known as the *context reinstatement effect* (Smith, Glenberg, & Bjork, 1978; Smith & Vela, 2001). Godden and Baddeley (1975) performed an experiment in which people studied a list of words on land or underwater. When asked to recall the list of words, they found that individuals recalled more words when the environmental context matched than when it did not match. Our research question is, does reinstatement of window scenes as environmental context cues during study result in superior memory on a recall test as compared to window scenes are not present? In our study, participants studied a list of 24 words with a different window scene for each word as the environmental context. At recall, half of the window scenes were shown again, and the other half were not. The results show that memory was better when the context was reinstated, showing that context reinstatement effects can be obtained when

using window scenes. Also, this provides support that the environmental context and studied information form associations that support memory retrieval.
https://youtu.be/r4pjJoa9lPg

45
Name: Olivia Cresswell
Major: Animal and Dairy Sciences (Pre-Vet)
Faculty Advisor, Affiliation: Barbara Kaplan, Comparative Biomedical Sciences, CVM
Project Category: Biological Sciences and Engineering
REU/ Research Program: NIH R15 027650

Development of an In Vitro Peptide-stimulated T Cell Model to Study Cannabinoid Effects
Myelin oligodendrocyte glycoprotein (MOG) peptide is a myelin protein used to induce experimental autoimmune encephalomyelitis (EAE), an experimental model of multiple sclerosis. Previous studies showed that marijuana compounds such as D9-tetrahydrocannabinol (THC) or cannabidiol (CBD) suppressed clinical disease in the EAE model due, in part, to their immunosuppressive effects. These studies are important, but are limited by costs, time, and animal use. Thus, we investigated whether the MOG peptide could induce cytokines in vitro and showed that both CBD and THC inhibited cytokine production. Part of the model development was to determine how MOG stimulation in vitro altered splenocyte populations. Splenocytes were stimulated with MOG peptide for 4 or 7 days, and flow cytometry was used to identify the percentage of CD4+ T cells, CD8+ T cells, F4/80+ macrophages, CD19+ B cells, and MOG-specific T cells using tetramer staining. Day 4 MOG-treated splenocyte populations looked like a typical mouse spleen, but by day 7, CD4+ T cells and CD8+ T cells quantities increased and F4/80+ macrophages and CD19+ B cells decreased. While macrophage populations decreased slightly, there was more expression of F4/80+ on day 7 than day 4. These results support that MOG treatment caused T cell increases and B cell and macrophage decreases sometime between day 4 and 7. There was also a slight increase in MOG-specific T cells with positive tetramer, suggesting that at least a subpopulation of T cells recognized MOG. Together these data show that MOG peptide can induce cytokine production in vitro and can be used to evaluate peptide-specific immune responses. Additional characterization is necessary to use this model more broadly.
https://youtu.be/BE9ESnbSHEA

74
Name: Ajaya Dahal
Major: Electrical and Computer Engineering
Faculty Advisor, Affiliation: Dr. John Ball, Electrical and Computer Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: ORED

Using Deep Learning to identify road lanes for autonomous vehicles

One of the most important tasks for an autonomous vehicle while driving on the road is to be able to detect lanes. Lane detection is a primary technique that must be adopted to make a vehicle autonomous of any level. The key reason to use lane detection in an autonomous vehicle is to keep the vehicle in its lane while it is on the road. There are more critical tasks for a self-driving vehicle to drive safely on the roads. All other critical tasks such as path planning and control actions (braking and steering) are possible after the system can efficiently detect lanes. The pipeline is created with Python and OpenCV (Open Computer Vision) and the experiment was performed with the images collected using LiDAR around the Starkville area. The automotive market is moving toward higher levels of autonomous vehicles. To adopt all the features that make a vehicle, a self-driving vehicle, the vehicle must be equipped with wide varieties of sensors, radars, cameras, and so on. With the use of these features, a vehicle can retrieve as much information about its surroundings and give a response as per the requirement. Enabling technologies such as LiDAR's, radars, and low-cost cameras, as well as powerful graphical processing units (GPUs) and the explosion of deep neural networks' ability to learn from data and provide results has propelled these efforts forward at a rapid pace. One item required for automotive autonomy is identifying road lanes, which is easy for human drivers but very challenging for computers to do.

133

Name: Emily Davis
Major: Chemistry
Faculty Advisor, Affiliation: Dr. David Buys, Mrs. Ann Sansing, Ms. Jasmine Harris-Speight; Food Science, Nutrition, and Health Promotion
Project Category: Social Sciences
REU/ Research Program: MSU Extension Apprenticeship Program

Implementing Empathy in Future Healthcare Workers: Injury and Illness (I2) Simulation

The Illness and Injury (I2) Simulation is an interactive training tool which targets future healthcare leaders in an effort to increase understanding of some of the most prevalent health issues in Mississippi. The I2 Simulation also seeks to teach participants empathy for individuals with these health issues. The I2 Simulation was implemented during the Rural Medical and Science Scholars Program in a face-to-face format in 2019 and virtually in 2020. Scholars received an introductory illness, injury, and empathy lesson and were then randomly assigned an injury or illness to experience for the next 24 hours. After this time period, scholars participated in a guided reflection discussion. To measure students' empathy growth, the Toronto Empathy Questionnaire and a general survey were given before and after the simulation. Examining the 2019 and 2020 data provides great insight into how empathy can be taught. The general I2 Simulation surveys revealed that completion of the simulation led to participants providing more intuitive written responses that fully distinguished between illnesses, injuries, and empathy. The Toronto Empathy Questionnaire scores revealed that

2019 scholars showed an average increased empathy score of 1.76 points while 2020 scholars showed an average increased empathy score of 4.32 points. By examining the probability distributions for 2019 and 2020 scores, data also indicates that 2020 scholars had a higher probability of students within the mean increased range. This relationship is likely due to 2019 scholars experiencing the simulation in a more isolated environment while 2020 scholars experienced the simulation in a more realistic environment with individuals unaware of their assigned health issue. This led to a greater increase in empathy scores. Future research should examine the possibility of a hybrid simulation model to provide a balance between more positive attitudes with in-person lessons and a more realistic, community experience.
https://www.youtube.com/watch?v=nKhKU1D2fyA

139
Name: Jordan Davis
Major: Child Life
Faculty Advisor, Affiliation: Alisha Hardman, School of Human Sciences and Extension
Project Category: Social Sciences
Co-Author(s): Alisha M. Hardman (Ph.D., CFLE), Lori Elmore-Staton (Ph.D.), & Izzy Pelligrine (M.S.)
REU/ Research Program: MSU Extension Undergraduate Apprenticeship Program

Meta-Analysis of Adverse Childhood Experiences Research
This study examined the literature about adverse childhood experiences (ACEs). ACEs are traumatic experiences or events that happen before the age of eighteen and have been associated with negative outcomes in adulthood. Examples include physical and psychological abuse, parental separation, neglect, and many more. Our study wanted to better understand how ACEs have been collected and explore the research that already existed pertaining to ACEs. A meta-analysis was conducted to survey data collection methods and instruments measuring childhood adversity. Databases such as PubMed, Eric, psychinfo, socindex, EBSCO, were searched and provided a sampling frame of 5,007 articles that included the term "Adverse Childhood Experiences". The variables of interest included whether the data was contemporaneous or retrospective, was collected via proxy or participant self-report, and the frequency of various types of ACEs. Using this form, students conducted the preliminary analysis of 219 manuscripts. Our results showed that among studies involving ACES data, 82% collected retrospective data about ACES, and 9% collected contemporaneous data about ACES. Our results also showed that only 9% of the overall sample involved ACEs data collected through a proxy respondent. Evaluating the 20 ACES subitems coded in the instrument, abuse and household dysfunction were reported most frequently in research. The results from the preliminary meta-analysis suggest that certain ACEs are more frequently reoccurring in research literature. This could be due to the wide-spread adoption of the original 10-item questionnaire created to assess for ACEs. When considering the low number of contemporaneous data and proxy respondents in comparison to retrospective and self-report, it is important to consider the sensitive nature of the data that is being collected.

Because of the nature of the data, contemporaneous data and proxy respondents may be difficult to collect because caregivers may not be willing to report on or incriminate themselves.
https://youtu.be/O7PESP5SH2I

76
Name: Allyssa Dees
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Rani Warsi Sullivan, Dr. Daniel Drake, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: NASA Space Grant

Mode I Fracture of Additively Manufactured DCB Test Specimens
The purpose of this study is to evaluate the ability to use digital image correlation in obtaining the traction separation law for a material and to investigate fracture characteristics of a 3D printed nanocomposite. The research problems are to determine the traction separation law for a 3D printed nanocomposite using digital image correlation and to determine the fracture energy of the material. A literature review was conducted. Three 3D printed double cantilever beam test specimens were prepared and tested per ASTM 5528. Load, displacement, crack length, and rotation angle were noted. Digital image correlation was used to collect out-of-plane displacement data for calculating the traction stresses at the crack tip. The fracture energy was estimated, and the traction stress data was plotted versus out-of-plane displacement. The traction separation law was modeled based on the experimental traction stress data. The traction separation law developed from the experimental data is similar to the general trend found in a bilinear traction separation law but can be modeled more accurately by two linearly increasing sections and a nonlinearly decaying section. The fracture energy of the 3D printed material was found to be approximately 600 J/m^2. Modified beam theory over-predicted the fracture energy due to its linear-elastic assumption. The J-integral is likely more appropriate for characterizing the fracture energy in this material due to its ability to be used in the case of a larger plastic zone size.
https://youtu.be/9N50U8Rg3_A

81
Name: Ankit Dhakal
Major: Chemical Engineering
Faculty Advisor, Affiliation: Dr. Santanu Kundu, Dave C. Swalm School of Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Dineshkumar Sengottuvelu
REU/ Research Program: Bagley College of Engineering, National Science Foundation

Tunable Full Color Emissive Heteroatom Doped Carbon Quantum Dots and their Optical Properties.

Carbon quantum dots (CQDs) have gained much attention due to their unique optical properties and exciting characteristics such as high chemical stability, less toxicity, ease of synthesis, and biocompatibility. CQDs' unique optical properties have made them a potential candidate in many applications such as bioimaging, optoelectronics, drug delivery, and sensing. Here, highly luminescent Heteroatom Doped CQDs were synthesized from 1,2-diamino-4,7-Dibromobenzo[*c*]-1,2,5-thiadiazole and citric acid precursors by solvothermal method. The synthesized CQDs were filtered through a 0.2µm pore-sized PTFE membrane and then the supernatant solution was dialyzed for three days in a 3500 MW cut-off cellulose ester membrane to remove unreacted monomers and larger size particles. The synthesized CQDs were found to have a unique optical property of solvatochromism which can emit multicolor in different solvent polarity. CQDs emit red and yellow color when we adjust the pH of the solution by adding 1M NaOH and dilute HCl solution. The absorption spectrum of CQDs in water was recorded using a UV-visible spectrophotometer. The absorption spectrum exhibits two to three absorption maximum from 200-450 nm. The strong absorption bands 200-250 nm corresponds to the p-p* transition in the p conjugated system (-C=C-) of the carbon dots. The absorption bands at 330 and 370 nm ascribed to the non-bonding orbital n-p* of -C=O/-C=N- and -NH_2 groups. The emission color changes with the solvent polarity and pH and these phenomena have been monitored in the spectrophotometer instrument. CQDs in DMF exhibited cyan color emission centered at 475 nm and in water the emission red-shifted to 515 nm (green color). This observation makes these carbon quantum dots useful in pH sensing.
https://youtu.be/U95yhQb5YZw

13
Name: Alexis Dillender
Major: Animal and Dairy Science
Faculty Advisor, Affiliation: Erdogan Memili, Madison Hardcastle, Muhammet Rasit Ugur, Animal and Dairy Science
Project Category: Biological Sciences and Engineering
Co-Author(s): Madison Hardcastle, Muhammet Rasit Ugur, Erdogan Memili
REU/ Research Program: CALS/MAFES URSP

Sperm Nuclear Dynamics: Discovering Molecular Biomarkers for Bull Fertility
Bull fertility is crucial for the reproduction of cattle and it is influenced by sperm molecular characteristics and freezability. The objective of this study was to test the hypothesis that sperm nuclear dynamics are associated with sperm freezability. To accomplish this goal, sperm decondensation experiments were set out using cryopreserved sperm from 16 mature Holstein bulls with different sperm freezability phenotypes. To determine the correlation between sperm nuclear decondensation and sperm freezability, the numbers of decondensed cells out of 200 sperm/bull of the 16 bulls for 46 trials were observed. Sperm nuclear chromatin decondensation tendency between good freezability and poor freezability sperm was evaluated. Means were separated by a t-test, and the correlation between sperm decondensation and sperm freezability was determined by a linear regression model using

SAS University Edition for Windows. The average numbers of the decondensed cells in the poor freezability group were 84.21 ± 23.29 while those numbers in the good freezability group were 81.97 ± 15.83. There were no significant differences between good and poor freezability groups in terms of decondensation state (P = 0.64). Also, there was no correlation between the post-thaw viability and the decondensed sperm (r = 0.0002; P = 0.93). The results of this are important because they shed lights into the molecular and cellular underpinnings of sperm physiology and fertility. Acknowledgment: This research was funded in part by CALS/MAFES USRP at Mississippi State University
https://youtu.be/XzrGlahSZ24

26
Name: Hannah Douglas
Major: Biomedical Engineering
Faculty Advisor, Affiliation: LaShan Simpson, Filip To, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): LaShan Simpson
REU/ Research Program: Summer Research Fellowship/Undergraduate Research Grant

Mechanical Bioreactor Repair for High Blood Pressure Simulations
Endothelial to mesenchymal transition (EndMT) is the process in which endothelial cells (EC's) undergo a transition and transform into more mesenchymal-like cells (MC's). Contrary to most cells, MC's are adult stem cells that can differentiate into various other cell types. Due to this characteristic, they are key in the repair and building of bone, cartilage, fat, and other tissue types. Because EC's have the ability to prevent cardiac diseases such as calcification, this transition leads to a higher risk of many diseases, including vascular calcification. When factors like high blood pressure cause disturbed laminar flow in the body's vasculature, the mechanical stress promotes EndMT in EC's via mechanotransduction. However, the exact mechanisms behind EndMT and mechanotransduction are unknown. My work focuses on repairing a mechanical bioreactor that simulates the effects of mechanical strain on cells due to high blood pressure. This bioreactor will later allow us to study the effects and mechanisms of mechanotransduction in EC's and, subsequently, vascular calcification.
https://youtu.be/kQaED17I3c8

2
Name: Lindsey Downs
Major: English
Faculty Advisor, Affiliation: Dr. Kelly Marsh, English
Project Category: Arts and Humanities

Loss, Reckless Behavior, and Jane Austen's Realism in Sense and Sensibility and Persuasion
Despite the fact that the characters in both Jane Austen's *Sense and Sensibility* and *Persuasion* must contend with the death of a parent, critics rarely write about these two novels together. Additionally, there has been very little said about the themes of grief and mourning in either of the two novels. I argue that, despite the rather extreme differences among the characters in each novel, they all have a very similar reaction to death: even the characters who seem the most prudent behave uncharacteristically and recklessly in response to their losses. By creating the characters in both novels with this underlying similarity, Austen works to humanize her protagonists and create sympathy for her minor and often unlikeable characters. Her protagonists—Elinor and Marianne Dashwood and Anne Elliot—are often set apart from the rest of the characters. Each heroine possesses a sense of morality and intellect that sets them above the people around them, as well as a greatness of spirit that others wish to emulate but often find it difficult to do so. In creating them with an underlying similarity to the often unlikeable minor characters typically considered beneath them, Austen makes the protagonists more human. Simultaneously, she makes those minor characters more complex than their unlikability usually allows, thus making minor characters more sympathetic. Additionally Austen's work is understood to balance realism and satire, but, while other critics consider her characters to be divided into admirable protagonists and unlikeable, morally inferior minor characters, I argue that the characters' similar reaction to death demonstrates a balance of satire and realism that emphasizes the common humanity among Austen's characters, while simultaneously demonstrating the intense impact death can have on those left behind.
https://youtu.be/WFkfkgaPv4A

154
Name: Whitney Duncan
Major: Civil Engineering
Faculty Advisor, Affiliation: Saeed Rokooei, Building Construction Science
Project Category: Social Sciences

Exploring Factors Impacting Gender Disparity in Engineering and Construction (EC)
There are many factors that influence Engineering and Construction (EC) students' choices when choosing a major or career with gender playing a major role. Gender disparity has been a complex issue and continues to be in construction and engineering programs. At Mississippi State, 19 percent of students in the College of Engineering and 6 percent in the Building Construction Science program are female. Several groups of females have been surveyed about why they chose a certain major and what factors led to job satisfaction and commitment. A key takeaway was the lack of knowledge and understanding of EC professions. Also, women feel important and accomplished in their professions when challenges are given and when they feel valued and needed for a job. The next step will be to look at the different elements guiding the perception of female students in EC programs compared to non-EC students at Mississippi State. A study will be conducted to gather data from these groups of students. The goal is to better understand why female students choose

a major so that the Engineering and Construction (EC) programs can make the necessary changes to attract the attention of potentially more and more female students in the future.
https://youtu.be/vQWgD6jQrS8

49
Name: Reese Dunne
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Matthew Priddy, Mechanical Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Logan Betts, Addison Green, Lauren Priddy, Matthew Priddy

Development and Implementation of a Magnesium-Based Finite Element Degradation Model for Orthopedic Implants

The emergence of degradable bone implants in a surgical setting could have significant impacts for the future of osteopathic implants, reducing the need for an implant removal surgery and serving as a safer and cost-effective alternative to titanium bone implants. Magnesium (Mg) WE43 is explored as a potential biomaterial for bone implants, and predicting Mg WE43 degradation through modeling and simulation is critical to provide patient-specific degradable bone implants. The goal of this work is to develop and implement a finite element (FE) degradation model for Mg alloys that can be used with complex geometries from additive manufacturing for the purpose of ultimately synthesizing degradable bone implants. The damage evolution law for pitting corrosion is used to model and predict the degradation of Mg WE43. Finite element analysis is performed on a 33.8 mm Mg WE43 rod through Abaqus/Standard software to incrementally monitor the damage value of each Mg element and subsequently delete elements that have fully degraded from the simulation. A Fortran user-material (UMAT) subroutine assigns each element a random pitting parameter, controlling the rate of degradation throughout the simulation and providing necessary input of Mg WE43 elastic material properties and degradation model parameters into Abaqus. A corresponding Python script obtains data from the UMAT and pushes code back to Fortran to model realistic corrosion patterns in the Mg WE43 rod (i.e., higher degradation rates on edge/corner elements, pitting corrosion patterns). The simulation results demonstrate the increase in degradation rate for sharp edges and corners because of their increase in surface area. Simulation methodology and results are currently being validated with ongoing experimental work on Mg WE43 degradation. This research displays the capabilities of finite element analysis in effectively modeling the degradation of Mg WE43 for the purpose of producing patient-specific degradable bone implants.
https://youtu.be/x7GG2Lfgps0

101
Name: James Dye
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Zhenhua Tian; Jichul Kim, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Engineering Undergraduate Research Stipend

Acoustic Levitator in Motion
Acoustic levitation is a relatively new field of research which has a lot of potential in being used in both the medical and engineering fields due to its non-intrusive properties and ability to be created relatively easily. Its main constraints are size of the particle being levitated and the trapping stiffness generated by the device which is directly proportional to the power given to the transducers. Transducers generate sound waves and are used to create the acoustic tractor beam through careful manipulation of their placement relative to other transducers and their respective phase angles. Through experimentation, an acoustic levitator is created and tested for its ability to keep a particle trapped while in motion. The acoustic levitator's design and fabrication process is also discussed in detail. While currently the device was not able to successfully pass all testing situations, recommended modifications to the device and data collected from other tests will prove useful in future experiments.
https://youtu.be/SHVzPpoOBmU

136
Name: Grayson Edwards
Major: Psychology
Faculty Advisor, Affiliation: Michael R. Nadorff, Courtney J. Bolstad, Psychology Department
Project Category: Social Sciences
Co-Author(s): Min Kim

Students' Psychopathology is Related to Less Knowledge of Mental Health Services On Campus
Mississippi State University (MSU) provides various free mental health services to students, and many other mental health clinics are readily available in the Starkville area. However, it is unclear how many students know of these services and whether students with clinically significant symptoms are aware of options available to them. The aim of this project was to examine what percentage of MSU students are aware of mental health treatment options on campus and whether the students who may benefit from treatment were equally aware as students without clinically significant symptoms. To do this, data from 1,715 MSU students enrolled in at least one psychology class in 2016 were examined. Of this sample, approximately 80% of students were aware of several resources, including Student Counseling Services. Logistic regressions were used to compare students' knowledge of mental health treatment options on campus based on whether the student endorsed clinically significant symptoms of suicidality (12% in clinical range), nightmares (7% in clinical range), alcohol use (6% in clinical range), trauma (33% in clinical range), depression (42% in

clinical range), and insomnia (10% in clinical range). Results found that students in the clinical range for suicidality, nightmares, alcohol use, and PTSD were approximately 62-92% less likely to know about mental health treatment options on campus than students without clinically significant symptoms (all *p*s < .02). Student knowledge did not differ as a function of clinically significant symptoms of depression or insomnia. Alarmingly, close to half of the students sampled endorsed clinically significant depressive symptoms, and one-third endorsed clinically significant symptoms of post-traumatic stress disorder, yet only 2.6% of students reported currently receiving therapy services. Certainly, these results support the need to increase students' awareness and utilization of mental health resources on campus and provide direction on which students may need this information most.
https://youtu.be/xQdy94US-5A

31
Name: Katie Evans
Major: Microbiology
Faculty Advisor, Affiliation: Dr. Shecoya White, Food Science, Nutrition, & Health Promotion
Project Category: Biological Sciences and Engineering
Co-Author(s): Kyla Asher, Taylor Ladner
REU/ Research Program: Mississippi Agricultural and Forestry Experiment Station Special Research Initiative

Efficacy of Plant-Based Antimicrobial against Foodborne Salmonella spp. in Hummus Stored at Refrigerated and Abusive Temperatures

Hummus is a traditional Middle Eastern food typically made of mashed chickpeas, tahini, lemon juice, and spices (Yamani & Mehyar, 2011). As a ready-to-eat food product, hummus is not further cooked after purchasing, which makes it particularly dangerous if contaminated during or after processing. In this present study, carvacrol was tested either 0.5% (w/w) 1.0%, or 2.0% in store-bought hummus at both 4℃ and 10℃. A three-strain *Salmonella* cocktail was used*;* triplicate cocktails were made using the same cocktail. Ten-gram samples of Sabra® Classic style hummus were taken and stored in sterile bags. Samples were designated one of four groups: 2.0% carvacrol, 1.0% carvacrol, 0.5% carvacrol, positive control. Then 100µl of the *Salmonella* cocktail was added to each sample. Samples were then stored at either 4℃ or 10 ℃ for ten days. On days 0, 1, 4, 7, and 10, samples were plated onto Xylose Lysine Deoxycholate (XLD) selective media, to determine the effectiveness of carvacrol against *Salmonella* species. After incubating for 24 hours at 37℃, colonies were counted and CFUs (colony forming units) determined. Non-inoculated samples were also used to test for changes to the pH using a pH meter. Results showed that there was no growth for all 2% groups by Day 4 for both temperatures, and that there was no growth for all 1% carvacrol samples by Day 10 at both temperatures. This translates to a 4.5 log reduction for both 2.0% and 1.0% groups by Day 10. No significant pH changes were found after the addition of carvacrol. Further study will be needed to determine consumer perception of carvacrol

treated hummus. This study shows that carvacrol can be used to reduce pathogen counts in store-bought hummus.
https://youtu.be/4eUWY02VR7I

102
Name: Jason Farmer
Major: Electrical and Computer Engineering
Faculty Advisor, Affiliation: Dr. Bo Tang, Electrical and Computer Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: National Institute of Justice

Development of Low-Cost Remotely Operated Underwater Vehicles
With the increase in underwater research, fisheries, and other aquatic industries, remotely operated (ROV) and autonomous underwater vehicles (AUV) are needed for exploration, surveillance, and various other tasks. The recent production of reliable, low-cost underwater components has created an opportunity to develop the next generation of ROV's and AUV's. The research performed was the development of a relatively low-cost and electronically controlled ROV prototype. One requirement for the ROV was hardware support for artificial intelligence and neural networks. This hardware is necessary for future research in autonomous navigation and the development of an AUV. There are many challenges with developing this type of ROV and the presented research addresses these issues. The research does not go in depth on any specific topic but touches on many crucial aspects of developing ROV's with modern components. The ROV is small, roughly 18 inches in length, to reduce development cost while increasing the depth rating. Size is important because increasing the ROV's surface area increases the pressure on the hull which significantly increases material cost to make the hull thicker. It has a camera, temperature sensor, pressure sensor, and inertial measurement unit (IMU) for data collection and vehicle control. It is powered by a custom-made lithium-ion battery pack, which eliminates the need for a large power tether. However, a data communication tether is still required because wireless underwater communication methods do not meet the data rate required by the ROV. The tether is a slim fiber optic cable that reduces drag and allows high-speed communication with the surface for streaming video. Onboard the ROV is a NVIDIA Jetson Xavier NX, an embedded system that is specially designed for running neural networks. The development of this ROV has shown that modern electronics provide the capability for a new generation of ROV's.
https://youtu.be/lQiDV2PdXfU

103
Name: Jeffrey "Parker" Ford
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Timothy Moore, Calvin Walker, Aerospace Engineering
Project Category: Physical Sciences and Engineering

External Ballistics of 6.5 mm Projectile

I will be calculating the trajectory of a given projectile using previously learned information and techniques as well as my own research. The projectile I will be analyzing will be a 140 grain Hornady ELD Match with a G7 ballistic coefficient of .326 and a diameter of 6.5 millimeters. Using variables such as relative humidity, barometric pressure, temperature and muzzle velocity. I will write a MatLab code that calculates bullet drop vs distance.
I will then test my code at various ranges.
https://youtu.be/RwmcC9piE8Y

111
Name: Nathan Frey
Major: Chemistry
Faculty Advisor, Affiliation: Edwin Webster, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Robert W. Lamb, Eric Van Dornshuld, Kelsie E. Krantz, Sarah L. Weisflog, Wenlong Yang, Diane A. Dickie, Robert J. Gilliard, Jr.
REU/ Research Program: NSF, NSF S-STEM

Computational analysis of benzene-fused and extremely twisted pyrene-fused N-heterocyclic germylenes and boranes

Polycyclic aromatic hydrocarbons (PAHs) have applications in a wide variety of electronics, including organic light emitting diodes and field-effect transistors. These arenes tend to deviate from planarity, especially when sterically hindered, thereby forming twisted and/or bowl-shaped structures. In this computational study utilizing DFT and TDDFT, the structural, electronic, and photophysical properties of various benzene- and pyrene-fused N-heterocyclic boranes and N-heterocyclic germylenes will be discussed.
https://youtu.be/N7UhHeoVp0Q

85
Name: Cameron Gaito
Major: Physics
Faculty Advisor, Affiliation: Dr. Chuji Wang, Physics and Astronomy
Project Category: Physical Sciences and Engineering
Co-Author(s): Rongrong Wu, Dr. Chuji Wang, Dr. Theodore Tibble
REU/ Research Program: National Science Foundation

Kinetic Study of the Atmospheric Reaction of HgBr Radical With O3

The first experimental kinetic study of the important atmospheric reaction of BrHg + O_3 was conducted using laser-photolysis laser induced fluorescence (LP-LIF). The rate constant of the

reaction was measured against a temperature range of 313-363K and a pressure range of 50-450 Torr. The reaction was found to have two major channels:

a) $BrHg + O_3 \rightarrow BrHgO + O_2$

b) $BrHgO + O_3 \rightarrow BrHg + 2O_2$.

The decay of fluorescence intensity for the reaction $BrHg + O_3$ was found to gradually decrease with the duration of the reaction.
https://www.youtube.com/watch?v=nQ9yPoWCeg0

15
Name: Anna Gamblin
Major: Wildlife, Fisheries, and Aquaculture
Faculty Advisor, Affiliation: Dr. Raymond Iglay, Wildlife, Fisheries, and Aquaculture
Project Category: Biological Sciences and Engineering
Co-Author(s): Dr. Raymond Iglay, Dr. Abigail Darrah, Dr. Mark Woodrey
REU/ Research Program: Undergraduate Research Scholar's Program

Annual Coastal Bird Community Response to Natural Vegetation Succession on Dredge-Spoil New Round Island

For decades, coastal bird communities have been affected by human disturbances such as oil spills, recreational beach use, and coastline urbanization. Dredge-spoil islands can be used as restoration management strategy for coastal bird species that provide viable habitat away from these disturbances. Dredged islands have been found to be more resistant to flooding than inland beaches, offering safer nesting sites for ground-nesting coastal birds. We monitored five species of high conservation concern [Least Terns, Black Skimmers, Piping Plovers, Wilson's Plovers, Snowy Plovers] and three species of low concern [Gull-Billed Terns, Royal Terns, Sandwich Terns] from 2017 to 2019 to understand the impact of dredged islands for shore bird conservation and change in use over time in the Gulf of Mexico.
https://www.youtube.com/watch?v=tWdIJCWHW-M

75
Name: Allyn Garrett
Major: Biological Sciences
Faculty Advisor, Affiliation: Dr. Sean Stokes, Dr. Joseph Emerson, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Patrick Sheridan, Alanna Hauer, Dr. Sean Stokes, Dr. Joseph Emerson
REU/ Research Program: ORED

Derivatizing Novel Bioactive Molecules Using the Chan-Evans-Lam Coupling

Many molecules used in the pharmaceutical industry contain carbon-nitrogen bonds1. By using the copper(II)-catalyzed Chan-Evans-Lam (CEL) coupling we plan to build a library of new compounds using 2-nitromidazole. This compound has the potential to act as an

antibacterial, antiparasitic, antiviral, and anticancer agent3. We hypothesize that this molecule can be coupled using the CEL method with fifteen boronic acids containing different functional groups to produce an array of bioactive molecules holding the potential to serve as antifungal or antibiotic agents.
https://youtu.be/UJdLJrYSFuk

41
Name: Malley Gautreaux
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Lauren Priddy, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Luke Tucker, Xavier Person
REU/ Research Program: National Institutes of Health Center for Biomedical Research Excellence (grant number P20GM103646-07), Office of Research and Economic Development Undergraduate Research Program

Chitosan-Fosfomycin Hydrogel for Osteomyelitis Treatment
Osteomyelitis, a bone infection commonly caused by *Staphylococcus aureus* (*S. aureus*), generally requires intense treatments, such as long-term antibiotics and bone and soft tissue removal. Not only are these treatments invasive, the risk of systemic toxicity, increased antibiotic resistance of bacteria, and presence of infection in avascular areas complicates intravenous (IV) delivery of antibiotics. Chitosan, the innately antimicrobial, deacetylated derivative of naturally occurring chitin, is a promising drug-delivery biomaterial and can be made into a thermosensitive hydrogel when combined with beta-glycerol phosphate (β-GP). Chitosan hydrogels loaded with fosfomycin offer potential for localized treatment that could increase retention of antibiotics, prolonging efficacy at the infection site. Fosfomycin was chosen because its method of killing differs from other antibiotics, reducing the potential for bacterial resistance. The hypotheses were (1) loading fosfomycin into chitosan-hydrogel would increase overall antimicrobial efficacy, (2) some fosfomycin would be inactivated by chitosan, but the chitosan could be saturated, and (3) differing β-GP concentrations would not change antimicrobial efficacy. Results to date indicate that chitosan-fosfomycin hydrogel demonstrated significant killing on a lawn of *S. aureus* ATCC 6538-GFP bacteria and inhibition of growth of bacteria in planktonic (floating) form, when compared to chitosan gel alone. In the Kirby Bauer assay, at the low β-GP concentration, there was reduced killing with the high fosfomycin concentration, in comparison to the low fosfomycin concentration. Unlike in the Kirby Bauer assay, fosfomycin concentration did not affect antimicrobial efficacy against planktonic bacteria. The addition of a polymeric scaffold membrane, which would wrap around the bone to hold the chitosan-fosfomycin treatment in the defect, is being investigated. Both 3D-printing and electrospinning fabrication methods for polycaprolactone (PCL) scaffolds are being evaluated. Future testing includes anti-biofilm assays, release kinetics of fosfomycin from biomaterial constructs, and biomaterial testing in an established osteomyelitis rat model.
https://www.youtube.com/watch?v=ySWfaQuYgVU

151
Name: Ginny Grace Gibbs
Major: Elementary Education
Faculty Advisor, Affiliation: Dr. Kristin Javorsky, Curriculum, Instruction, & Special Education
Project Category: Social Sciences

Measuring Teacher and Family Perceptions of Essential Conditions for Successful Online Learning

The overall purpose of this pilot study was to see whether the Essential Conditions for successful technology use in schools identified by the International Society for Technology in Education (ISTE) could be turned into an instrument to reliably measure teacher and family perceptions of those conditions in their own school. The School Conditions for Online Learning (SCOL) survey asked respondents to rate simple statements using a Likert scale according to how well each described the conditions at their own school. Two of the fourteen Essential Conditions were condensed into a single statement on the SCOL resulting in a thirteen-item survey. A readability analysis was done on both the original ISTE Essential Conditions and the SCOL survey, with the SCOL survey shown to have easier readability. A total of nineteen surveys were completed by seven teachers and twelve parents of 2nd-4th grade students participating in a digital literacies camp in Summer 2020. This data was collected using Qualtrics and imported into IBM SPSS Statistics v. 27. Early statistical analysis indicated the Essential Conditions were multidimensional so the SCOL items were grouped by factor for reliability analysis. Factor 1 with 3 items had a Cronbach's alpha of .835 while Factor 2 with 10 items had a Cronbach's alpha of .957. SCOL items under Factor 1 appear to address conditions related to technology access while items under Factor 2 address conditions related to technology intentions and planning. Additional research on reliability should be done with a larger sample size and a more diverse population. It might be possible to further simplify the sentences to increase readability. Once more reliability data is obtained, administrators from various schools and school districts may be able to use the SCOL to determine families and teachers' perceptions of their school's capacity for successfully using technology in education.
https://youtu.be/j_AekXhMSaQ

87
Name: Chris Gill
Major: Computer Engineering
Faculty Advisor, Affiliation: Seungdeog Choi, Electrical and Computer Engineering
Project Category: Physical Sciences and Engineering

Using AI for Cyber Security in Cyber Physical Systems

Cybersecurity in Cyber Physical Systems (CPS) is essential moving forward. Since more technology is being developed and automated based on the CPS design, such as autonomous vehicles, better security of these devices needs to exist. To approach this, first a better understanding of the difference between current devices that cyber security focuses on and a

CPS is needed. Most cyber security focuses on communication technology, which is not the same as a CPS since these systems have a closed control loop. After this is established, a way to detect when a system is under attack is needed. This is the IDS, or intrusion detection system. I looked in to four methods which use artificial intelligence to detect intrusions. Once an IDS has been implemented, the system response to the intrusion will vary so there is not a lot of focus on that. One of the major trends in IDS is that they use a behavior trend model to establish a baseline for the system, whether it be focused on bad behavior or deviation for normal behavior. In conclusion, behavior definition of a system is one of the best ways to detect intrusion. Whenever abnormal behavior is detected, flags are thrown and the system can respond however it is defined.
https://youtu.be/1_16W0tGeO4

39
Name: Madison Gnoose
Major: Wildlife, Fisheries & Aquaculture
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Project Category: Biological Sciences and Engineering
REU/ Research Program: URSP

Double-crested Cormorant migration and habitat suitability through the Atlantic and Mississippi Flyways

The Double-crested Cormorant (*Phalacrocorax auratus;* hereafter DCCO) is a fish-eating bird that migrates annually between its summer breeding grounds in the Great Lakes and its wintering grounds in the lower Mississippi Alluvial Valley (LMAV). DCCOs are listed as a pest species because the large population preys on channel catfish in the LMAV's commercial fisheries, causing economic damage. Moreover, their over-abundant feces destroy habitat for other species in the Great Lakes. With this economic and ecological damage, it is important to investigate the climatic drivers of DCCO migration to predict their migratory routes through stopover habitat to destination sites. Seasonal climatic habitat suitability models (HSMs) were created using machine learning algorithms (ENFA, SVMs, and RFs) for breeding grounds, wintering grounds, and intermediate stopover sites from the following input: presence locations, pseudoabsence locations, and climatic features like wind strength, temperature maximums and minimums, solar radiation, and precipitation. Then, spring migration routes were predicted from the winter HSM climatic connectivity and least cost methods in program R's gdistance package. These simulated routes were then compared to observed routes. The predicted spring Random Forest model suggests suitable stopover sites are plentiful when based on climatic features. Additionally, ~32% of spring predicted routes almost overlap with observed routes. Further work will compare predicted autumn routes to observed autumn routes, and since it is evident from how few predicted routes overlap with observed routes, we will need to explore other influences for DCCO migration routes, such as topographical features and distances to wetlands.
https://youtu.be/Sr7a3UtJfcg

66
Name: Karl Grebner
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Omid Askari, Mechanical Engineering
Project Category: Physical Sciences and Engineering

Electrode Discharge and Plasma Structure
Internal combustion is responsible for providing most of the transportation in contemporary society. Most of these processes require electrical stimulation to begin. Electrical discharge is responsible for creating a cloud of plasma in a combustion chamber. One important relationship within this entire process is between the shape of the electrical discharge and the structure of the ionized gas around the electrodes. To find relationships between discharge and plasma distribution, a camera-mirror configuration was designed to record discharge. Many tests occurred to show that the distribution of plasma is reliant on the location of the electrical discharge and the current of the system.

61
Name: Brian Green
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Mark Janus, Dr. Keith Koenig, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Analysis of gas properties in hypersonic planar nozzles
The hypersonic test environment allows for a wide range of test scenarios and analyses to occur. One situation of particular interest in the hypersonic environment is a chemical analysis of flows entering the hypersonic region. A concern of this region is the liquification of flows past Mach 7 and is a theoretical concern of the National Center for Physical Acoustics. Using Method of Characteristics (MoC) and Chemical Equilibrium with Analysis (CEA), chemical properties and changes can be analyzed in a theoretical high Mach number nozzle. However, examination for the theoretical wind tunnel shows error/deviation when compared between cases.
https://youtu.be/gsV2ItnGoTs

56
Name: Will Greer
Major: Animal and Dairy Sciences
Faculty Advisor, Affiliation: Dr. Attila Karsi, Comparative Biomedical Sciences, CVM
Project Category: Biological Sciences and Engineering
Co-Author(s): Adef Kordon, Lesya Pinchuk, Attila Karsi
REU/ Research Program: Mississippi State College of Veterinary Medicine

Morphological and Functional Characterization of Dendritic Cell-like Cells in Immune-Related Organs of Channel Catfish

Dendritic cells (DCs) are the most potent antigen-presenting cells (APCs) that bridge innate and adaptive immune responses in vertebrates. Recently, DCs have been characterized both morphologically and functionally in several teleost fish such as zebrafish, rainbow trout, salmonids, and barramundi. Also, Langerhans cells, a unique subset of DCs in mammalian skin, have been identified in immunocompetent tissues of channel catfish by our group. In this study, we aimed to characterize DCs based on their morphology and function. Initially, we adapted mammalian protocols to generate DCs in culture from hematopoietic tissues of catfish. We observed non-adherent cells with a dendritic morphology in culture by differentiation of anterior kidney and spleen-derived monocytes. Morphological characterization was performed by light microscopy of cytospin slides prepared from these tissue cultures. Later, flow cytometry and light microscopy analysis showed that these cells could phagocytose *Edwardsiella ictaluri*. Moreover, *E. ictaluri* strains induce the formation of phagosome and/or phagolysosomes in the cytoplasm of catfish DC-like cells. Our data suggest that the catfish DC-like cells may share morphological and functional similarities with teleost and mammalian DC-like cells. More knowledge on catfish DC-like cells will help gain insight into the evolution of adaptive immunity within vertebrates.
https://youtu.be/ibecRjXNZLE

21

Name: Cristina Griffith
Major: Agribusiness; Agriculture Engineering Technology
Faculty Advisor, Affiliation: Dr. Jeff Johnson, Agriculture Economics; Dr. John Wes Lowe, Agricultural & Biological Engineering
Project Category: Biological Sciences and Engineering

Precision Agriculture Technologies for Small Farmer Adoption

Field variability has always been a problem for consistent and efficient farming. Spatial variables collected by observation and sensors can be used to identify and analyze changes in an area. Crop nutrients can be managed with soil sampling, moisture measurements, and fertilizer or spray applications in management zones to improve yields with optimal use of varying input levels. Precision agriculture technologies have faced slow adoption; the fastest growing accepted equipment are tractor guidance systems by growers and variable rate technology by supply retainers. Large farms have been early adopters because they can absorb fixed costs across more acres than smaller farms. Inequality in adoption of technologies in agriculture results from a minimum farm size capable of absorbing large investments in technologies. The primary objective of this study is to identify and analyze precision agriculture technologies being used in crop production to assess the profitability and effectiveness of adoption. The specific objectives are to evaluate potential technologies for use by small-scale farmers and develop an adoption plan for representative farms. By

interviewing farmers, it was noted that they are beginning to realize the economic and environmental benefits of adopting precision agriculture practices. Their willingness to adopt and their plans for future technology adoption were recorded. Partial budget analysis reveals relevant, unique farm solutions to integrate further precision agriculture technologies. The sharing of technology between farms allows small operations to take advantage of more expensive options. By forming co-op groups, the farms can benefit from economies of scale. Lower cost options to integrate precision agriculture technologies include smartphone apps, sensors, and hiring a precision agriculture service. Small farmers benefit from lower labor costs, more efficient use of resources, and an understanding of what is happening in each field during the season.
https://youtu.be/MnUX_UUCPyE

153
Name: Benjamin Gunter
Major: Landscape Architecture
Faculty Advisor, Affiliation: Cory Gallo; Landscape Architecture
Project Category: Social Sciences
REU/ Research Program: CALS Undergraduate Research Program

Review of School Learning Garden Elements and Objectives in the Southeast
While there has been research done regarding the benefits of learning gardens, there has not been much research done about the materials, design, and amenities of school learning gardens. This research project consisted of 12 case studies of learning gardens throughout the southeast. The purpose of the case studies was to assess each garden's program, elements, and design. By documenting the gardens' growing methods, layout and design, seating, amenities, signage, and water and irrigation, we can reveal relationships between school grade, program needs, and spatial amenities.
https://youtu.be/jMMx_g3I2IE

69
Name: Sunny Gurung
Major: Computer Science
Faculty Advisor, Affiliation: Dr. Haifeng Wang, Industrial and Systems Engineering
Project Category: Physical Sciences and Engineering

A Systematic Analysis and Review of Blockchain Technology in Healthcare
Blockchain is a list of immutable digital records of transactions that are linked to each other through cryptographic hash functions. Through cryptocurrencies, blockchain has gotten hugely popular. The research focuses on the application of blockchain in healthcare and healthcare related areas. The research analyzes and reviews on recent available research papers related to blockchain and healthcare. The papers are collected through google scholar,

IEEE Xplore, and Academic Search Complete (EBSCO). Findings are analyzed and stored through Microsoft Excel and Zotero. The research looks and summarizes different areas in healthcare, blockchain can be utilized to. Finding reveals that majority of the research papers are focused on streaming, storing and sharing Electronic Health Records (EHRs) and Electronic Medical Records (EMRs). The findings also indicate the favorable position toward healthcare oriented blockchain and increasing popularity of blockchain in Healthcare sectors. As such, Blockchain may provide new way of storing and sharing electronic health data and information for healthcare institutions.
https://youtu.be/1kgBr9_MBG4

65
Name: Jonathan Harjono
Major: Computer Science
Faculty Advisor, Affiliation: Junfeng Ma, Industrial and Systems Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: EPA

VR for Environmental Preservation Education
Although preserving our environment is important, education regarding environmental preservation is not optimal. With the rise and advancement of virtual reality games and applications, education regarding environment preservation could have a further impact and accessibility through virtual reality. For the project, we will be using the Unity Virtual Reality engine and the assets from the Unity store to simulate the environment and allow for user interaction. By using virtual reality programs, education regarding environment preservation will not only be more accessible but also more engaging and fun. Preserving the environment is very important and the education of such should be more widespread and accessible.
https://youtu.be/UzTCX-0yegM

148
Name: Owen Hartness
Major: Landscape Architecture
Faculty Advisor, Affiliation: Jason Walker; Landscape Architecture
Project Category: Social Sciences
REU/ Research Program: CALS Undergraduate Research Scholars Program (URSP)

Non-motorized Transport: An Analysis of Use and Equity
Planning and designing for non-motorized transportation alternatives is crucial for fostering a healthy, socially equitable, and enhanced public realm that benefits the local economy. Current literature defines walkability/bikeability as the degree to which the urban environment transportation alternatives. In order to achieve sufficient levels of walkability/bikeability, accurate and efficient user data must be collected and areas of high or

low activity must be identified. This research begins to examine local non-motorized transportation infrastructure throughout Starkville, Mississippi (home of Mississippi State University) in order to assess the utility and equity of these networks, and their relationship with the university. User data is examined using street view imagery, obtained from the City of Starkville, and the results were compared to a review of current literature regarding walkability/bikeability characteristics, including the differences between pedestrian and bicycle infrastructure. This research calls into question the relationship between university campuses and non-motorized transportation: previous literature has found that proximity to campuses tends to increase pedestrian and bicycle usership, specifically when students are in session. The results of this study indicate that Mississippi State University contributes to the levels of non-motorized transportation usership and influences the degree of racial representation across each of the street segments in study, regardless of proximity to campus.
https://youtu.be/5aCYd1U2RDI

60
Name: Benjamin Henkel
Major: Physics and Professional Meteorology
Faculty Advisor, Affiliation: Benjamin Crider, Physics & Astronomy
Project Category: Physical Sciences and Engineering
Co-Author(s): B.P. Crider, A. Randle, R.J. Unz, S.D. Lusby
REU/ Research Program: US Army Corps of Engineers Engineering Research and Development Center

Development of Software for analyzing GeGI Detector data
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 usable form through analysis processes without interaction with the built-in GeGI software that runs on an accompanying tablet that also limits its throughput capabilities. 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 the next step in the progress will be presented.
https://youtu.be/vDQpzIjQI8I

52
Name: Sarah Hobbs
Major: Animal and Dairy Science pre-veterinary concentration
Faculty Advisor, Affiliation: Dr. Shien Lu, Biochemistry, Molecular Biology, Entomology, and Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Authors: Dr. Shien Lu, Jiayuan Jia, and Kate Phillips
REU/ Research Program: CALS URSP program and the National Corn Growers Association

Characterization of Antifungal Activity of Strain A against aflatoxin producer *Aspergillus flavus*
The fungal toxins are produced by plant pathogen *Aspergillus flavus* and its close relatives, which contaminate agricultural products and threaten food safety. There are antifungal fungicides that can control the fungal pathogens. However, biological-based and environmentally safer approaches are in demand. Bacterial strain A isolated from a heathy soybean plant shows antifungal activities against a broad range of fungi including *A. flavus*. The objectives of this research includes identification of the bacteria identity and characterization of the antifungal activity against *A. flavus*. Phylogenetic analysis of the 16S rDNA sequences showed that strain A is clustered together with the bacterial strains of *Burkholderia pyrrocinia.* The antifungal activity of strain A against *A. flavus* was further confirmed based on plate assays. Co-inoculation of *A. flavus* and the bacteria on corn ears revealed that strain A could inhibit growth of the fugal pathogen significantly. Corn kernel assays demonstrated that growth of *A. flavus* was inhibited and aflatoxin production was reduced significantly. The findings of the research have provided the proof of concept for development of bio-fungicide using the antifungal bacteria.
https://www.youtube.com/watch?v=rpfL9vjFlns

100
Name: Jacob Hodges
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Rani Sullivan, Dr. Zhenhua Tian, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Development of DIC Procedure for Large Field of View
This project designed a procedure to expand the field of view of the ARAMIS Digital Image Correlation system by investigating the influence of various calibration parameters on the

calibration process. Displacement tests were performed while varying different ellipse parameters to determine the optimal parameters for each field of view. The results were compared to the original standard calibration values to determine error associated with the change in the field of view. Once the displacement tests were concluded and the results were compiled, two tensile tests were conducted to compare the new and old field of views to determine if the accuracy of the system had been affected by the changes in the field of view.
https://youtu.be/7soeEGpEEsk

110
Name: Molly Holtcamp
Major: Biochemistry
Faculty Advisor, Affiliation: Amanda Patrick, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Matthew Carlo, Amanda Patrick
REU/ Research Program: Partnership for Clean Competition, Pilot grant, ORED Undergraduate Research Program

A Pharmaceutical and a Performance-Enhancing Drug: Fundamental Gas-Phase Studies of Albuterol

Beta- 2 agonists are a drug class frequently used to treat bronchial asthma, chronic obstructive pulmonary disease (COPD), and other respiratory diseases. Beta- 2 agonists can also be abused and used as performance-enhancing drugs (PEDs) and, therefore, are currently monitored by WADA (World Anti-Doping Agency) under anti-doping initiatives. Salbutamol (known in the US as albuterol) is a common compound of the beta- 2 agonist class of pharmaceuticals. While various detection and quantification methods have been developed using LC-MS/MS, the chemistry underlying the observed dissociation patterns common to this drug class is relatively unexplored. Understanding such underlying chemistry could pave the way to predicting dissociation patterns of yet unknown “designer drug” structures within this same compound class. Our group has recently published a survey of dissociation patterns across several examples of beta-2 agonists. The work presented herein aims to build upon this recently published work to fully characterize the dissociation chemistry of protonated salbutamol. In this project we apply collision-induced dissociation mass spectrometry and complementary computational chemistry calculations to elucidate these pathways. The dissociation of protonated salbutamol was found to proceed via loss of water, followed by loss of the tert-butyl group, and finally followed by a second water loss. This poster focuses on the first water loss product ion, which was found, through a conformational search, to be represented by four different possible structures. Ongoing work includes additional computational chemistry, as well as additional experimental approaches, such as infrared ion spectroscopy.
https://youtu.be/Y1t4tkO77Qw

57
Name: Maya Hooks
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Ben Xu, Mechanical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Ben Xu
REU/ Research Program: Bagley College of Engineering

Design of Quadrupole Electrodynamic Balance Device
The design of a quadrupole electrodynamic device and acoustic levitation device is going to be made. The two devices are used to levitate water droplets. The acoustic levitation device is used to control the water droplets and move them along the electric field. Generating the force balance equations, the representation goes to show what forces are acting on the water droplet during levitation. More equations are seen in this presentation in which it shows how to find the charge of the droplet and the required AC/DC voltages needed for this experiment. With the information given in this experiment, some benefits can come out involving in-space manufacturing.
https://youtu.be/Lw5bfT-y1LI

64
Name: James Hovater
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Jichul Kim/Kyle Ryker, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Raspet Flight Research Lab

On-Orbit Modular Arm
Space exploration is ever growing and ever expanding. The amount of people that are doing research in space is growing as well and that will require living space and addons to the space station or new ones that may soon be talked about in the near future. With the task of space exploration being research, a lot of time is used that is not directly related to the research such as tools or equipment malfunctioning, or a repair/replacement needed to be made on the outside. As safe as the practiced space walks are, there is always the chance of an event to happen that could not be predicted or prevented that could put the people on the space walk at risk. With technology growing rapidly and the exploration into space getting deeper and deeper, the tools that will be the most helpful to the future can be modular robotic systems. Such systems could repair or replace these parts that are on the outside without having to waste time getting prepared for the space walk. Time can be saved, and risk can be greatly reduced. Such systems could also function in redirection of docking satellites if the entry docking is not accurate. These on-orbit robotic systems can be used to help the development of the future of space exploration and discovery by providing faster work with less of a risk everywhere.
https://www.youtube.com/watch?v=rz4neEcMfKY&ab_channel=JamesHovater

105
Name: Johnathan Huff
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Greg Burgreen, CAVS
Project Category: Physical Sciences and Engineering
REU/ Research Program: UG research program

Effects of injector deposits on fuel spray¬†
The automotive industry continually seeks minimum emissions by optimizing air-fuel mixtures during combustion. In a gasoline direct injection (GDI) engine, fuel is sprayed at over 3000 psi, so any deviation in spray characteristics can have great effect on combustion and emission characteristics. In GDI engines, carbonaceous deposits from fuel dribble called coking build up within the injector, eventually causing liquid film formation and a significant amount of particulate matter emissions. The primary objective of this study was to establish a fundamental understanding of injector fouling effects on spray process and to suggest better nozzle geometry based on computational fluid dynamics (CFD) simulations. This work involved creating a parameterized geometry of both clean and fouled injector shapes (i.e., different depths and diameters of the injector counterbore and inner nozzle), running multiple CFD cases on the MSU HPC clusters using the CONVERGE software, and post-processing CFD results to determine nozzle flow and spray characteristics as a function of the different GDI injector shapes. This project generated preliminary data to be used by Dr. Joonsik Hwang for a future proposal submission to the DOE.
https://youtu.be/-xpebRCQdG0

152
Name: Nate Hyams
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Matthew Priddy, Mechanical Engineering
Project Category: Social Sciences
Co-Author(s): Elizabeth Whitehurst

Optimization of Groupwork within Engineering Education
Group work has become increasingly vital in engineering, as interdisciplinary collaboration has become commonplace in many engineering fields. The engineering education curriculum implemented in universities has mirrored this trend by introducing students to group-based work in order to cultivate group related skills necessary for post-graduate work. A study was conducted within Mississippi State University's Department of Mechanical Engineering with a goal of better understanding the group work experience for ME undergraduate students. A general survey was distributed throughout the ME curriculum (n = 215) to survey all classifications. The survey consisted of 30 questions, asking students scaled-based questions from 1-10 as well as open-ended questions to provide a platform for suggestion and constructive criticism. The data revealed students recognized that group work was highly beneficial for future workplace preparation, as 66% of respondents agreed that group work

was good for long term success. We also found that students want to possess as much individual control over groupwork as possible, whether that be in the form of selecting group members (78% in favor of selecting their own group, having specified roles, or encouraging peer evaluations (65% in favor of) to hold others responsible. We found that carefully balancing short-term student desires with long-term skill building ideally reconciles group related student experience with the vital skills that group work brings about. To achieve this, providing structures such as peer evaluations is key in the grading process to allow students to best convey group strengths, weaknesses, or problems. This builds necessary communicatory and soft skills within engineering students, while also giving them control over their own experience.
https://youtu.be/BvIcnpqtbog

42
Name: Mary Hyer
Major: Landscape Architecture
Faculty Advisor, Affiliation: Chuo Li, Landscape Architecture
Project Category: Biological Sciences and Engineering

Urban Agriculture in the 21st Century: A Comprehensive Review of Recent Literature
Urban agriculture, or the production of food in an urban area (USDA, 2016), has become regarded over the past several decades as a popular urban design tool. This study aimed to analyze the scholarly perspective on the practice of urban agriculture, focusing on literature published on the subject in major urban design and landscape architecture journals over the past twenty years. Using keywords of “urban agriculture,” “urban farming,” “community gardens,” and other similar variations, articles were identified from several selected urban planning and landscape architecture journals via online databases. These articles were then read, categorized by topic, and analyzed in a comprehensive literature review. Reviewing the literature revealed three major themes studied: planning and land use inventories, community engagement and policy, and design and technology. While these themes have driven the literature over the past two decades, there is much room for expansion on the topic of urban agriculture. This study found a lack of representation of the United States as a study area in the topic of urban agriculture, with major studies limited to larger coastal cities such as New York City. Additionally, the literature studying the design of urban agriculture spaces is limited, leaving an opening for further study on this topic.
https://youtu.be/aM0dX1Ib4Bs

143
Name: Laura Ingouf
Major: Anthropology
Faculty Advisor, Affiliation: Holli Seitz, Communication

Project Category: Social Sciences
REU/ Research Program: Presidential Scholarship Academic Enrichment Fund

Neurodiversity and Online Communities: Why They Matter
A person is neurodivergent when their brain works differently from what is considered the norm by society; neurodiversity is an approach based on embracing and accepting these neurological differences as a natural part of human diversity. This project examines qualitative responses elicited in an online survey to determine what function online communities serve for neurodivergent people and how participation in these communities affects participants. This project is conducted by the researcher as a member of online neurodivergent communities, and findings will be made publicly available to these communities through the creation of a website. For many disabled and neurodivergent people online communities are much more accessible than offline communities and offer more optimal ways of interacting that do not exist offline. Online communities provide a space for neurodivergent people to find each other when offline communities are often dominated by ableist medical professionals and parents and don't provide accepting spaces for neurodivergent people to be themselves. They provide a chance for friendship with people who understand neurodivergence and enable participants to build networks of social support to meet emotional, informational, material, and financial support needs. Respondents also reported that participation in online communities of neurodivergent and disabled people positively affected their self-conception, leading to a decrease in negative thoughts and an increase in self-acceptance. Based on personal experiences in online communities of neurodivergent people, participant observation, and survey responses, I argue that online communities are important sources of social support and social interaction for neurodivergent people and meet needs that are not met or cannot be met offline. Online communities are not simply mirrors of or companions to offline communities but are places of community formation and socialization that should be examined as such.
https://youtu.be/_0xDsynrmXk

129
Name: Chloe Ingram
Major: School of Human Sciences
Faculty Advisor, Affiliation: Juyoung Lee, Fashion Design and Merchandising
Project Category: Social Sciences
REU/ Research Program: College of Agriculture and Life Sciences Undergraduate Research Scholars

The Assessment of U.S. Medical Textiles and Clothing Supply Chain and its Competitiveness in the Time of COVID-19
The coronavirus pandemic in 2019 exposed a noticeable gap in the U.S. textile supply chain. The nation has experienced a widespread shortage of personal protective equipment (PPE), protective clothing such as medical masks, gowns, and other medical personal protective equipment designed to protect the wearer from the spread of infection or illnesses (Commissioner, 2020). Scholars believe that the global dispersion of PPE supply chains

coupled with skyrocketing demand of PPEs might have resulted in a sudden backlog in the supply chains as simple as in treated cotton (*COVID-19 impact assessment and outlook on personal protective equipment* 2020) and the U.S. consumers and retailers' frantic response to the shortage of medical equipment (Cohen, J., Rodgers, Y., 2020). Even though in the current PPE supply chain problems, there has been little discussion about how stakeholders in the PPE supply chains have been overcoming or overcame the problems in the supply chains. Therefore, the purpose of this research was to identify bottlenecks within the domestic supply chain (sourcing → manufacturing → transportation → retail) of PPE and its competitiveness in the time of COVID-19. Through this, tactics to solve bottlenecks in the PPE supply chains were explored based on the theory of constraints. For this research, data will be collected through an industry survey that asked questions pertaining to the PPE supply chain before and during the pandemic and analyzed to categorize where each bottleneck lied within the supply chain using content analysis. It is anticipated that there will be four main bottlenecks identified in the literature: (1) lack of domestic manufacturing, (2) hoarding of PPE, (3) international shipments, and (4) physical labor within production. The study provides implications for all stages across the PPE supply chain to improve the overall domestic PPE supply chain competitiveness in the midst of a global emergency.
https://youtu.be/neA3kCzS5Ro

118
Name: Sarah Isaacs
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Yang Cheng and Jichul Kim, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Investigation of Orbital Trajectories from Earth to Mars
For human feet to walk on the surface of The Red Planet, an interplanetary trajectory from Earth to Mars must be designed that considers human factors and reasonable rocket parameters. This research project will seek to narrow down the many options for an orbital path to one that minimizes the amount of time spent in space and the total change in velocity of the transfer arc. This data will provide an idea for how long a human should expect to be subjected to zero-gravity forces and it should provide engineers with an idea of what their rocket should be designed to achieve in terms of velocity. In the future launch window in the year 2022, the most efficient trajectory that minimizes those two parameters lasts approximately 212 days and has a total change in velocity of 3,270 m/s. When compared to the 2003 mission that sent the Spirit rover to Mars, this 2022 trajectory can be considered efficient.
https://youtu.be/XIo1MnXj9A4

137
Name: Hailey Jamison
Major: Biochemistry
Faculty Advisor, Affiliation: Deborah Eakin, Ph.D., Psychology
Project Category: Social Sciences
Co-Author(s): Ethan Flurry, M.S. and Deborah K. Eakin, Ph.D.

Emotional Memory: Using Individuals' Personal Word Ratings to Finalize Emotional Salience Effects Observed

Previous studies have investigated whether individuals have a predisposition to recall information associated with emotions rather than neutral information. Results have indicated that older adults display a positivity effect; however, some studies did not obtain these results. This discrepancy could be due to only using a normative database's word ratings. The goal of this study was to investigate whether participants' word ratings had a greater impact on free recall than normative database ratings. The second goal was to conclude if older adults display a positivity effect due to the sociocultural emotional selectivity effect which theorizes that individuals remember more positive information as they age. In order to conduct this experiment, 40 young undergraduates enrolled at Mississippi State University as well as 31 older adults within the Starkville community volunteered to participate in the study. The participants first studied a list of 14 neutral and 14 positive words that were rated according to a normative database. Younger adults studied words selected from a normative database of young adults' ratings, and older adults studied words selected from a normative database of older adults' ratings. Next, participants performed a free recall test. After completing the test, participants were asked to individually rate each word as positive or neutral. Memory was compared for the positive and neutral normatively rated words and then when the words were individually rated. No emotional salience effect was observed in either group when normative categorization was used; however, emotional salience effects were observed when words were individually categorized. The positivity bias was observed in older and younger adults. This study exposes a possible reason for inconsistent results in previous emotional memory studies; normative databases may not be enough to accurately categorize a word due to differences in individuals' word ratings.
https://youtu.be/yHVz7O-EjIY

96
Name: Hailey Jamison
Major: Biochemistry
Faculty Advisor, Affiliation: Todd Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Jacinta Alchouron, Chanaka Navarathna, Charles U. Pittman Jr., Todd E. Mlsna
REU/ Research Program: NSF

Sorption of As(III) Using Fe3O4 Nanoparticles Dispersed on Guadua chacoensis Bamboo (Si-char) and Its Redox Transformations

Bamboo (*Guadua chacoensis)* Si-char (BC) and Magnetic Fe_3O_4/Si-char (BC-Fe) were prepared and used to treat arsenite (AsO_3^{3-}) contaminated water. Toxicity of As(III) (inorganic) is significantly greater than As(V) and more difficult to remove from water. Removal efficiency was optimized verses pH (in both de-ionized water and lake water), contact time and initial concentration. Fixed-bed column sorption, sorption from complex matrices and regeneration (KOH and K_3PO_4) were also studied. Pseudo second order model best described the As(III) sorption for BC and BC-Fe, (R^2= 0.99). The Langmuir isotherm showed the best fit at 25 °C with a 15.72 mg/g adsorption capacity which is comparable with other adsorbents, but with faster kinetics (~60 min) at pH 7 and ambient temperature. X-ray photoelectron spectroscopy (XPS) studies and arsenic speciation studies (LC-ICP-MS) showed the presence of As(III) and less toxic As(V) on the of Fe_3O_4 surface indicating oxidation upon contact or drying under oxic conditions and due to Fe(III) to Fe(II) magnetite oxidation of adsorbed (or adsorbing) As(III) under anoxic conditions. BC, BC-Fe and their As-laden analogues were extensively characterized using XPS, XRD, *Mössbauer* and XANES spectroscopy.
https://youtu.be/8Zz-PQjovhw

7

Name: Elijah Johnson
Major: Biochemistry
Faculty Advisor, Affiliation: Jeffery W. Harris**,** Biochemistry, Molecular Biology, Entomology, and Plant Pathology
Project Category: Biological Sciences and Engineering
Co-Author(s): Audrey B. Sheridan, Armelle Jeannine Vallat-Michel, Gaëtan Glauser, Jeffrey W. Harris, Peter Neumann, Lars Straubs

Biological Factors Affecting Small Hive Beetle (*Aethina tumida* Murray) Oviposition and Sublethal Effects of Thiamethoxam on Developing Small Hive Beetles.

One experiment relating to the oviposition of a honeybee pest, the Small Hive Beetle (*Aethina tumida* Murray), is presented here. This experiment observes the biological effects of sublethal exposure to the neonicotinoid insecticide, thiamethoxam. We hypothesize that exposure of pupating Small Hive Beetle to soil contaminated with field-realistic amounts of thiamethoxam will negatively affect the success of adult emergence and reproduction. Laboratory-reared larvae (N=1200) were separated into four treatment groups: Control, TMX-25 ng g^{-1}, TMX-100 ng g^{-1} or TMX-200 ng g^{-1}. Each group consisted of three individual pupation cages, each containing 100 larvae and the soil compound. The containers were then incubated at standard conditions (30 ° C, 60% RH) until adult emergence. From the emerged beetles, 50 males and females were paired and mated over a period of 15 days to observe female oviposition rate. The containers with thiamethoxam contaminated soil revealed lower reproduction, emergence, and oviposition success compared to the control groups.
https://youtu.be/AFb3qC1SUWM

37
Name: Maddie Johnson
Major: Horticulture
Faculty Advisor, Affiliation: Tongyin Li, Plant and Soil Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Jacob Arthur, Geoff Lalk
REU/ Research Program: CALS/ MAFES 2020 Undergraduate Research Program

Shoot Production and Mineral Nutrients of Five Microgreen Species as Affected by Substrate Type and Post-emergence Fertilization

Microgreen is a collective term used for vegetable or herb seedlings consumed at a young growth stage, with expanding cotyledons or the first pair of true leaves, harvested 7 to 21 days after germination. Microgreens are considered to be a functional food and have high concentrations of mineral nutrients and health-beneficial phytochemicals. A number of species from varying families have been grown as microgreens. There lacks research-based recommendations on cultural practices regarding species choice, substrate, and fertilization management. In this current study, we investigated shoot production and mineral nutrients of five microgreen species including broccoli, cabbage, kale, mustard, and radish grown on four types of hydroponic substrates including biostrate, hemp mat, jute mat, and micromat. Results shown that radish produced the highest fresh shoot weight of 153.8 $g \cdot m^{-2}$, with mustard producing the lowest fresh shoot weight of 41.4 $g \cdot m^{-2}$. Hemp mat resulted in the highest fresh shoot weight of 102.6 $g \cdot m^{-2}$, with micromat resulting in the lowest fresh shoot weight of 65.4 $g \cdot m^{-2}$. Microgreen species varied in the macro-nutrient concentrations including nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg), with mustard having the highest P, K, Ca, and Mg concentrations. Hydroponic substrate type altered macronutrient concentrations in microgreen species. Biostrate resulted in the highest N and P concentrations. Hemp mat resulted in the highest concentrations of K, Ca, and Mg.
https://youtu.be/P_oW4eTq0Xs

4
Name: McKenzie Johnson
Major: Architecture
Faculty Advisor, Affiliation: Alexis Gregory, School of Architecture
Project Category: Arts and Humanities

Ethical and Empathetic Research in Architectural Education

The profession of architecture is a field that uses ethical and empathetic ideas to understand and shape society. The basis of this research is to bring attention to the topics of empathy and ethics within architecture schools in the United States and to address the topics in preparing students for the obligations and responsibilities within the architecture profession. The goal is to create a cohesive understanding of these topics, which will allow students to

focus on the shifting culture and driving equity through student organizations, faculty to student relationships, as well as in their architectural education and future careers. Interviews were conducted with a diverse body of students throughout the United States based on the location, program type, curriculum organization, and demographics of the different programs. Over the last year, data was collected in order to better understand the teachings of ethics and empathy in architectural education. Questions regarding the relevance of these topics within the design curricula were asked to create a comparison between the architectural curricula of the various schools represented. The interview responses helped to understand and expose the current lack of empathetic and ethical teachings in architecture schools. The results support the original hypothesis that there is a lack of teaching and understanding of the topics. A proposal to research how ethics and empathy can be implemented into existing courses or programs in the current architectural curriculum could begin to bridge the gap between students and faculty. This course or program could assist students in better understanding ethics and empathy by addressing the studio culture in practice rather than mere exposure through associated organizations or conduct codes, while also making room for changes in policies and practice between administration and faculty; encouraging professors to expand their understanding in empathetic relationships with students and ethical teaching styles.
https://youtu.be/vuuDjD7d5Tg

147
Name: Nishan Karki
Major: Computer Science
Faculty Advisor, Affiliation: Sujan Ranjan Anreddy, Social Science Research Center
Project Category: Social Sciences
REU/ Research Program: NSF

Discovering Topics From Covid-19 Tweets
Topic modeling is a statistical model for discovering the abstract topics that occur in a collection of documents. It helps to organize, summarize, and better understand the major themes embedded within a text-based source. The purpose of this project is to apply the LDA algorithm for topic modeling and extract different topics found within tweets related to COVID-19. The raw tweets contain numerous emojis, hyperlinks, digits, arbitrary spacing, punctuation, and non-ASCII characters, requiring that overall data cleaning and pre-processing occur before attempting to fit the model to the data. After testing the model and supplying it with different values for the parameter dictating the number of topics to be produced, N = 20 topics gave the best and most relevant results when compared to N = 5, 10, 15, or 25.
https://www.youtube.com/watch?v=Vt2e7s1g1zI

119
Name: Sashin Karunarathne
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Yu Lv, Dr. Yang Cheng, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Design, Analysis, and Simulation of a CD Rocket Nozzle
Understanding the concept of isentropic and perfectly expanded nozzle flow is pivotal in rocket nozzle design. The purpose of this research is to investigate how the change in altitude affects the expansion ratio of a CD rocket nozzle, to develop an algorithm that outputs the expansion ratio that minimizes effects of improper nozzle expansion, and investigate how improper nozzle expansion affects nozzle performance.
https://youtu.be/3IQxV-tFp3s

115
Name: Rajan Khadka
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Dr. Ben Xu, Mechanical Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Department of Energy

A Material Study for Solar Absorber Tube with Internal/External Structures for Heat transfer Enhancement and Temperature levelling Using Additive Manufacturing Technology
Solar absorber tube is one of the most important components in a solar thermal power plant, and it is responsible for collecting solar heat through heliostats, but the absorber tube will experience non-uniform heating in the circumferential direction and cause cyclic thermal stress, which may eventually lead to fatigue fracture. The study of materials property of Inconel-718 and Boron was done to utilize a Multi-element Laser Additive Manufacturing technology to 3D print a small piece of solar absorber tube by integrating the internal structures (fins) and the external surface textures. This approach allows for selecting the right materials and structures at the right location to support effective radiation absorption and heat transfer enhancement at a reasonable cost of pressure loss.
https://www.youtube.com/watch?v=zZWQucjKlb8&ab_channel=RazanKhadka

28
Name: Jillian Kurtts
Major: Biochemistry
Faculty Advisor, Affiliation: Carter Wolff, Brandon Barton, Biological Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Carter Wolff, Brandon Barton
REU/ Research Program: USDA

Anthropogenic Sound Alters Grasshopper Diet

Ecosystems are being affected in many ways as human activity encroaches upon natural environments. Sound pollution is a common component of global change, yet little is known about how it can impact ecosystems. Other disturbances, such as predation risk and increased temperatures, cause induced stress responses in herbivores and increase their respiration rates. By increasing the rate at which carbon dioxide is expelled from an organism, stressors can lead to a depletion of stored carbohydrates and induce a shift in diet to replace the carbon lost during respiration. Grasshoppers are important herbivores that feed on a variety of plant species to meet their nutritional needs, and in doing so can alter the abundance of plants within ecosystems. We tested the hypothesis that anthropogenic sound could stress grasshoppers (*Melanoplus sanguinipes*) and alter their diet by conducting two experiments. The first experiment aimed to determine if sound alters grasshopper respiration rate. We used flow-through respirometry to measure grasshopper respiration while exposed to 21 different sound frequencies (range: 0.001 – 60 kHz). We found four frequencies that increased respiration rates and three frequencies that decreased respiration rates. We then asked if these sounds could alter grasshopper diet. We used two artificial diets that differed only in their relative amounts of protein and carbohydrates. Grasshoppers were given both diets and exposed to one of three treatments: sounds that increased respiration rate, decreased respiration rate, or no sound (control). After 48 hours we weighed the food dishes. We found that grasshoppers exposed to the high sound treatment consumed significantly more carbohydrates and grasshoppers exposed to the low sound treatment ate more protein. The results from these experiments demonstrate that anthropogenic sound can stress grasshoppers and alter their diet. Ultimately, this suggests that sound pollution can indirectly impact plant communities by altering herbivore feeding behavior.
https://youtu.be/BFFSjzXn314

104

Name: John Michael Lane
Major: Chemical Engineering
Faculty Advisor, Affiliation: Neeraj Rai, Swalm School of Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Xuan Tran, Woodrow N. Wilson
REU/ Research Program: UG Research Award (365616), DOE Project Code: DE-SC0018211

Binding Modes of Model Beta-O-4 Lignin Dimer on Ni-Supported MWW Zeolite Nanosheet: Preliminary Results

In the search for renewable sources of aromatic compounds and fuels, lignin has shown itself to be a strong contender. Due to its complex structure, resistance to chemical treatment, and variance among different sources of biomass however, lignin depolymerization into value added chemicals and fuels is challenging. Experiments have shown that metal supported zeolites as a catalytic surface can cleave the aryl-ether linkages in lignin via

hydrogenolysis. Unfortunately, a fundamental understanding at the molecular level for how the hydrogenolysis of lignin reaction mechanism proceeds is currently lacking.
In this computational study, we analyze the binding modes and binding energies of four representative Beta-O-4 dimers composed of different monomer units and functional groups upon adsorption onto the (001) surface of a Ni13 nanocluster supported MWW nanosheet catalyst in vacuum. As adsorption is the first step in a heterogeneous catalytic reaction, and catalysts manipulate the geometry of a substrate prior to a reaction, this is the first step in achieving the understanding necessary for how the reaction mechanism proceeds. First principles simulations were carried out with the Vienna Ab initio Simulation Package (VASP5.4.4) at the PBE+D2 level of theory to achieve preliminary results and include dispersion interactions for a nonphenolic lignin dimer over the catalyst. The geometry of the dimer is analyzed to determine how the geometric structure is affected by adsorption, and how the binding energy is impacted by adsorbing different dimers on the surface. Preliminary results indicate that the Ni@MWW-2D catalyst does affect the geometry of the model dimer, but it does not strongly absorb. Future work will be done analyzing the binding modes of the other dimers using a more in-depth level of theory, observing the impact of common solvents for lignin extraction, and analyzing the impact of adsorbed hydrogen.
https://youtu.be/625m3ysLwZ4

19
Name: Caleb LeGrand
Major: Biochemistry
Faculty Advisor, Affiliation: Wen-Hsing Cheng, Food Science, Nutrition, and Health Promotion
Project Category: Biological Sciences and Engineering
Co-Author(s): Samantha Curran
REU/ Research Program: NIH

Oral Gavage of *Akkermencia mucinphilia* Enhances Selenoprotein Expression in the Liver of Mice.
Selenoproteins play an essential role in redox-facilitated signaling pathways as well as function as antioxidants within body systems. Low dietary levels of selenium have been found to contribute to lower concentrations of selenoproteins and reduced signaling cascades, causing propagation of Type II diabetes-like symptoms. Optimal selenium levels to prevent type II diabetes have been previously identified in our lab. We found that Mice fed diets containing ≤0.10 mg Se/kg display impaired glucose tolerance and insulin sensitivity, suggesting increased susceptibility to type 2 diabetes by suboptimal Se status at levels ≤23% of nutritional needs. Preliminary results of our undergoing studies indicated a potential relationship between body selenium status, gut microbiota, and their metabolic influence over type II diabetes. Our current studies explore the relationship between selenium deficiency and its promotion of the increase of the crucial gut microbiota, *Akkermencia mucinphilia* (AM), and its role in the prevention of type II diabetes-like symptoms. To further investigate, 30 2-month-old male mice were fed either a selenium adequate (Se +) or

selenium deficient (Se -) diet for 21 weeks. Then, for a period of 4 weeks, 6 mice with a Se + diet and 7 mice with a Se – diet were given a daily oral AM gavage. Liver and muscle samples were collected from the mice followed by protein extraction. The samples were used to analyze peripheral insulin signaling by western blot analysis of AKT phosphorylation on serine-473 and threonine-308. Western analysis was also used in testing our two hypotheses: (1) the expression of selenoproteins has a positive correlation with the intake of dietary selenium; (2) body selenium status and gut microbiota interact to influence glucose metabolism. Results indicated a slight increase in phosphorylation of AKT at residues S473 and T308 in the liver as well as enhanced selenoprotein concentration in AM exposed mice.
https://youtu.be/W5VpwN_RRVU

107
Name: KyungWon Lee
Major: Mechanical Engineering
Faculty Advisor, Affiliation: JoonSik Hwang, Mechanical Engineering
Project Category: Physical Sciences and Engineering

The Safety System with IOT
Regardless of location, safety should be considered first when conducting research, because the main object of research and invention is making human life better. Innovation with hazard cannot be considered as a contribution to human development. The is due to the fact that sacrificed advancement cannot be seen as the right direction for mankind to move forward. And beyond this philosophical reason, even by eliminating risk factors, every single researcher and worker can perform their best under circumstance that guarantee their safety. For this reasons, the designing safety system is necessary for laboratories and research facilities. I choose single board computer connecting 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, all of permitted people can access this collected information whenever and wherever through internet connection. This sensor mount has display on its surface so; people can check the status visually. In addition, alert speaker is installed at surface as well, so if there is an emergency situation, making alert sound contributes to minimize casualties. Also when dangerous situation is occurred, this safety system sends emails about the what kind of dangerous factor is detected with figure information to people in the group.

3
Name: Madeline Lee
Major: Music (concentration in oboe performance)
Faculty Advisor, Affiliation: Jessica Haislip, Music
Project Category: Arts and Humanities

An Exploration of Ralph Vaughan Williams' Concerto for Oboe and Strings
In the oboe repertoire, few pieces have earned salience comparable to that of Ralph Vaughan Williams' *Concerto for Oboe and Strings*; it is a timeless staple that countless oboists have studied, practiced, and performed. Knowledge of the factors contributing to the composition of the piece are necessary for the most thoughtful and accurate performance of the *Concerto.* Through analysis of Vaughan Williams' life, the form and musical motifs of the *Concerto for Oboe and Strings*, and comparison between the *Concerto* and Vaughan Williams' other compositions, the primary inspirations for the composition of the *Concerto* are revealed: Vaughan Williams' work towards the preservation of traditional English folk songs and studies in ethnomusicology, his English nationalism and military service, and the rebirth of the Romanticism movement in English literature and art coinciding with the *Concerto*'s composition. Armed with this information, any oboist can achieve the highest level of performance of the *Concerto for Oboe and Strings* maintaining the composer's intent behind each carefully selected and practiced note.
https://youtu.be/6n7Mvz3tsJw

90
Name: Daniel Littlejohn
Major: Agricultural Engineering Technology & Business
Faculty Advisor, Affiliation: Joel Paz, John Wes Lowe, Mary Love Tagert, Agricultural & Biological Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Office of Research and Economic Development, ORED Undergraduate Research Grant

3D Visualization of the Impacts of BMPs in a Watershed using Augmented Reality Sandbox
Augmented Reality (AR) is a subclass of virtual reality (VR) technologies, and takes digital or computer-generated information and overlays them in a real-time environment. The AR Sandbox was developed by the W.M. Keck Center for Active Visualization in the Earth Sciences (KeckCAVES) at the University of California-Davis. The goal of this project is to create an augmented reality sandbox that can be used to highlight the impacts of human activities in a watershed. This project combines a hands-on sandbox and 3D visualization applications to examine how best management practices (BMPs) can impact water flow and reduce erosion in a watershed. An AR sandbox is currently being constructed in the Agricultural and Biological Engineering department. The system consists of: a) wooden sandbox, b) welded metal tube frame with casters (for mobility), c) sand, d) Linux-based desktop computer, e) Microsoft Kinect camera, and f) video projector. The sandbox can mimic a watershed or multiple watersheds. Changing the landscape by decreasing or increasing the gradient within a watershed can be achieved by sweeping or moving the sand in the box. Using the Kinect camera and projector, the interactive system can simulate and visually project how water flow changes inside a watershed by altering the landscape. In addition, critical source areas of erosion in the watershed can be identified and targeted placement of BMPs can be

implemented. Lego blocks and other materials, representing specific BMPs such as terraces and gully breaks, can be placed in the sandbox. The application of augmented reality and 3D visualization can be used to examine how BMPs can reduce the impacts of human activities in a watershed by changing the rate of water movement and erosion.
https://youtu.be/yC9-aWFGjR0

32
Name: Kim Lowery
Major: Wildlife, Fisheries, and Aquaculture
Faculty Advisor, Affiliation: Kristine Evans, Wildlife, Fisheries, and Aquaculture
Project Category: Biological Sciences and Engineering
Co-Author(s): Will Pigot, Isabella Durham, Kristine Evans, L. Wes Burger, Jr., and Leslie Burger
REU/ Research Program: College of Forest Resources Undergraduate Research Scholars

Evaluating Pollinator Plant Establishment and Response to Management in Black Belt Prairie Region of Mississippi

Pollinators provide a critical function in the ecosystem for plant and agricultural systems. Increases in urbanization and improvements in agricultural production have caused many native pollinator habitats to be eliminated resulting in a steep decline of pollinator populations. In the Southeast's Black Belt Prairie region, less than 1% of native prairie habitat remain. Conservation Reserve Program CP42—Pollinator Habitat incentivize landowners to establish native prairie habitat on lands previously under row-crop production. Despite incentives, labor and seed mixes are costly and vary widely in establishment success. Thus, to be successful it is imperative to recommend seed mixes that are regionally appropriate in establishing efficient and effective pollinator habitat. Our project evaluated establishment rates and response to prescribed fire management of 30 recommended pollinator-friendly plant species within the Black Belt Prairie region in Clay County, MS from 2018-2020. We created 30 experimental 10m^2 species plots, replicated over four blocks, and used mixed regression models to examine stem densities of each species over time. Plains Coreopsis, Butterfly Milkweed, White Prairie Clover, Blackeyed Susan, and Illinois Bundleflower exhibited greatest stem densities in the first growing season after planting in 2018. Half of the 30 species had significant declines in log count of stems across the 11 survey weeks, and only two species exhibited positive trends. In the second growing season, Narrowleaf Sunflower and Evening Primrose exhibiting some of the greatest stem densities but a decrease in Plains Coreopsis and Blackeyed Susan. Information from our research will help develop and target regionally effective seed mixes, increasing effectiveness, efficiency, and landowner buy in to CP42 specifically in the Black Belt Prairie region of Mississippi.
https://youtu.be/xL-eDaiR9zo

117
Name: Samuel Lusby
Major: Physics
Faculty Advisor, Affiliation: Dr. Ben Crider, Physics & Astronomy
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Ben Crider, Ben Henkel, Ronal Unz
REU/ Research Program: Co-operative Agreement W912HZ- 16-2-0015 with the U.S Army Corp of Engineers, Engineering Research and Development Center in Vicksburg, MS

LabView Control System for an Automated Gantry System for Radiation Detector Characterization

Originating from both military use and as a by-product of nuclear decay, depleted uranium (DU) presents a health & pollution risk in many locations worldwide. DU mainly consists of uranium-234, uranium-235, and uranium-238 which all undergo radioactive decay releasing gamma radiation as one of the decay products. The identification and clean-up of areas with large amounts of DU is necessary to prevent environmental damage to the soil and water of affected areas. With the aid of a sandbox test bed filled with general purpose aggregate, different radioactive sources such as DU can be simulated in a desert environment. The gantry itself is developed with several electric motors integrated into a LabView system-design platform. Utilizing a Germanium Gamma-ray Imager (GeGI) integrated in LabView and mounted on the gantry system above the sandbox, the gamma radiation from a source within the test bed can detected and imaged. This effectively creates an efficient test bed to characterize and determine the limits of the detector in the controlled environment of a lab using known detector-source geometries. Monte Carlo simulations reproducing detector behavior can be then validated with this in-lab data to determine how the GeGI characteristics can be extrapolated to environments beyond the in-lab tests. The progress of integrating the GeGI and gantry system into the Labview program will be presented.
https://youtu.be/ctE2cQm3a4E

91
Name: Daniel Majors
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Manav Bhatia, Mr. Calvin Walker, Mr. Rob Wolz, Aerospace Engineering Department
Project Category: Physical Sciences and Engineering

Stress Simulation and Research on the Topology Optimization of a 3D Structure

This is a work-in-progress research of topology optimization of 3D parts and is headed by Dr. Bhatia of the Department of Aerospace Engineering. The overall goal is to optimize 3D structures using Dr. Bhatia's algorithmic solvers so that a model can be physically created to test its fidelity and discover its loading characteristics in comparison to a computational model. In this pursuit, plans had to change course, so the focus of the presented research will

cover a stress simulation of a bridge structure that is similar in design and dimension to one created by Dr. Bhatia. This method was chosen due to an absence of available data and resources to conduct physical tests. The process was carried out with Solid Works software and will demonstrate a simple cantilever beam under load as well as a more complex bridge structure under its max load before yielding. The data from the cantilever beam analysis is checked by hand calculations to verify the software's values. Then, a simulation is run on the bridge structure to obtain results that are reliable for a comparison to future physical test numbers once those facilities are available. It was found that the beam data had less than 1% error to the hand calculations, which gives credibility to the data. A trial-and-error approach then was used to find the max load of the bridge structure made from 7075-O aluminum. The exact model could not be used for the simulation, but this approximate data will help future research and testing by giving an idea of how the optimized structure will behave.
https://youtu.be/Bf8QSh1Sl3A

58
Name: Ashton Martin
Major: Geoscience
Faculty Advisor, Affiliation: Varun Paul, Geoscience
Project Category: Physical Sciences and Engineering

Biochar: Alternative Filtration
With the growing prevalence of news about unsafe water or droughts water security has become a large concern. Many individuals are forced to drink water polluted by heavy metals and bacteria. This research hopes to establish the viability of producing a substance called biochar and its ability to filter pollutants from the water. The methods used to produce the biochar have been limited to rudimentary (easily performable) methods, with a goal to ensure easy adoption and recreation in poor and rural communities. The rudimentary methods mentioned hold true for both the biochar furnace as well as the filter setup. Furnace materials were constructed from a metal container and metal piping commonly found in places around the world. The filter uses PVC and plastic in order to create a filtration device. The specific biochar is derived from *Zea mays* (Corn) and is referred to as c-biochar. Specific measurements on the filtration include flow rate, breakthrough curve, and water quality. The flow rate through the filtration setup was measured to be 0.3 liters/hour. The breakthrough curve will give a representation of the adsorption rate of the metals to the biochar filter. The breakthrough curve allows more accurate insight when observing the amount of times water can be filtered. A solution containing arsenic, cadmium, copper, and lead is currently being tested for its removal using the biochar. Metal concentration will be analyzed using inductively coupled plasma-optical emission spectrometer (ICP-OES). The results from this project will help provide a more easily adoptable method to filter metal-contaminated water in rural and poor communities.
https://youtu.be/dLDbC3cbBsA

106
Name: Joseph May
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Zhenhua Tian, Dr. Rani Sullivan, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Acoustic Separation
With the rise of 3d printing, relatively cheap ultrasonic transducers, and open-source projects, a new take on winnowing is being tested. Instead of using wind to separate the grain from the chaff, this test aims to use ultrasonic waves. With a 4x15 array of 40 kHz ultrasonic transducers, sunflower seed shells and seeds are separated. From a height of around 325mm, the seeds average horizontal displacement was about 8 mm while the shells average displacement was around 20mm. The seeds and shells could only be separated if the particles were limited to one at a time, but this shows that particle separation using ultrasonic transducers can work on particles . With the current monetary limits this design is limited, but if more powerful transducers were acquired this design could be scaled up to allow for a higher flow rate of particles.
https://youtu.be/0eM2MOvxppc

43
Name: Meg McNerny
Major: Biochemistry
Faculty Advisor, Affiliation: Dr. Seung-Joon Ahn, Biochemistry, Molecular Biology, Entomology and Plant Pathology
Project Category: Biological Sciences and Engineering
REU/ Research Program: Undergraduate Research Program

Genomic architecture of a gene duplication hot spot in *H. zea*
Gene duplication is the process by which a region of DNA coding for a gene is copied. It can occur as the result of an error in recombination or through a retrotransposition event. These duplicate genes are often immune to the selective pressure under which genes normally exist. This can result in an accumulation of many mutations in the duplicate gene code, which may render the gene nonfunctional or confer some benefit to the organism. Recently, a gene was identified that is composed of over 45 homologous genes in the corn earworm moth. A subfamily, called UGT33, is made up of 20 genes that are closely related sequentially. All 20 genes in the subfamily are located in proximity of a genomic location, suggesting that they multiplied in tandem. This is called a gene duplication “hot spot” probably undergone by recent duplication events in a lineage-specific manner. The UGT33 hot spot was investigated by performing molecular cloning of UGT33 genes and creating a genome map of the duplication hot spot. Further study includes comparative analysis of the genomic architecture among loosely related moth species.

145
Name: Maya McWilliams
Major: Biology
Faculty Advisor, Affiliation: Dr. Bizu Gelaye; Department of Epidemiology, Harvard T. H. Chan School of Public Health
Project Category: Social Sciences
Co-Author(s): Dr. Mary Wesley, Dr. Bizu Gelaye
REU/ Research Program: Delta Scholars Program

Exploring the Relationship between Food Insecurity and Asthma in Mississippi
Food insecurity is defined as inadequate access to nutritional foods for a household's healthy lifestyle. In America, nearly 50 million people experience food insecurity. Food insecurity has been found to be associated with asthma in some studies but this relationship has not been explored in Mississippi. The research question was: What is the association between food insecurity and asthma in Mississippi? Our study used the Mississippi 2015 Behavioral Risk Factor Surveillance System (BRFSS) data with the Social Context Module addressing food insecurity in the past year. Current asthma status was self-reported and socio-demographic factors were examined. Data was analyzed utilizing the BRFSS Prevalence & Trends Tool and SAS 9.4 with complex sample procedures. The results showed that the population was 59% White and 37% Black, with almost one fifth being 65 years and older and a majority (43%) graduated from high school (H.S.) and most were employed. Seven percent of MS adults reported having asthma and a third of the population reported being food insecure. Females, Blacks, individuals with low income, individuals without H.S. education, unemployed, separated individuals, and individuals 45-54 yrs of age reporting the highest prevalence of asthma or food insecurity. These differences were statistically significant at $P<0.05$. Initial bivariate analysis shows that there was a statistically significant association between food insecurity and asthma ($P<0.05$). In conclusion, individuals in Mississippi experiencing food insecurity have limited access to healthy foods, limited economic opportunities, and bear health disparities. Additional study is needed, noting limitations of data that is self-reported, cross sectional, susceptible to recall bias, and limited to adult respondents. However, our results reveal adverse outcomes for vulnerable populations. Targeted public health and policy solutions are necessary to improve health and economic well-being for all.
https://youtu.be/eFOO9FNMVZE

146
Name: Nicole Mejia
Major: Psychology
Faculty Advisor, Affiliation: Dr. Mary E Dozier; Psychology
Project Category: Social Sciences
Co-Author(s): Karly Pyles & Rachel Kalchbrenner

Do You Care about Clutter? Hoarding and Apathy

Hoarding disorder is characterized by significant acquisition of items, urges to save, and difficulty discarding and sorting (American Psychiatric Association, 2013). Hoarding symptoms often have an early onset and worsen with age (Dozier, Porter, & Ayers, 2016). Participants in a previous study endorsing a relationship with hoarded items saw them as sources of comfort, security, and extensions of the self (Frost et al., 2015). The purpose of this study is to assess the associations between item attachment, apathy, emotional support, and hoarding behaviors among college students (N = 686). Participants were undergraduate students enrolled in psychology courses at a large southeastern university whose ages ranged from 18-51 (mean age = 19.71) and were mostly female (70%). All study procedures were conducted online. Pearson correlations were conducted using participant reported levels on the Saving Inventory-Revised (SI-R; Frost et al., 2005), the Clutter Image Rating (CIR; Frost et al., 2008), Apathy Evaluation Scale (AES; Marin et al., 1991), and the Patient Reported Outcomes Measurement Information System (PROMIS) Short Form instrument for Emotional Support (v2.0 8a) (Cella et al., 2010). Participants with higher levels of hoarding reported higher levels of object attachment on the RSI (r = .33, p < .05), apathy on the AES (r = -.20, p < .05), clutter on the CIR (r = .23, p < .05), and lower levels of emotional support on the PROMIS (r = -.16, p < .05). Overall, hoarding symptoms are significantly associated with higher levels of apathy and lower levels of emotional support among college students. Interventions that target motivation and interpersonal connections may be beneficial for the treatment of hoarding. Future research should be conducted on whether apathy is a strong predictor of hoarding in other age groups and how this impacts treatment.
https://www.youtube.com/watch?v=HIH1mv4vqfk

30

Name: Joshua Mitchell
Major: Biochemistry
Faculty Advisor, Affiliation: Sorina C. Popescu, Biochemistry, Molecular Biology, Entomology and Plant Pathology
Project Category: Biological Sciences and Engineering

Common Soil Bacteria as Possible Antifungal Biological Control Agents Against Xylaria sp. and Taproot Decline

In 2017 a new plant disease for soybeans was identified. Taproot decline (TRP) has quickly become a growing concern for its effectiveness at killing the soybean plants. Xylaria sp. has been identified as the fungus that causes this disease in soybeans. The common characteristics of TRP is the interveinal chlorosis on the leaves and a black stroma on a darkened taproot. TRP has been identified to exist within southern states including Alabama, Arkansas, Louisiana, Mississippi, and Missouri, and remains a great threat throughout the soybean growing season (Allen et al 2017). Xylaria, the fungus that causes TRP, is part of the ascomycetous fungi division, and often grows on decaying wood (Sharma et al 2018). A library of bacteria has been collected from samples of soil. These bacterial strains belong to the class

Alphaproteobacterim, Bacillus, Proteobacterium, and Pseudomonas. Bacterial strains are assigned then tested through an in vitro phase of testing using in vitro assays. The bacteria strains that show the most fungal inhibition are then moved to an in vivo phase of testing using biocontrol assays. Bacterial strains that show promising results in the in vivo phase will be identified to be potential biocontrol agents (BCAs) against TRP in soybean plants. This is an ongoing research project. There are still several strains to be tested in vitro as well as in vivo.
https://www.youtube.com/watch?v=R3_2-A82yHA

44
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Major: Biochemistry
Faculty Advisor, Affiliation: George Popescu, Institute for Genomics, Biocomputing & Biotechnology (IGBB)
Project Category: Biological Sciences and Engineering
Co-Author(s): Philip Berg, Marilyn L. Warburton, and George Popescu
REU/ Research Program: Institute for Genomics, Biocomputing & Biotechnology (IGBB)

Using liftover tools on SNPs for future combined analysis
Aflatoxin is produced by *Aspergillus flavus*, a fungus that infects *Zea mays*. Aflatoxin accumulation can lead to ear rot in maize and result in major crop losses each year and can harm humans if ingested. Genome-wide association studies (GWAS) have identified thousands of single nucleotide polymorphisms (SNPs) that are significantly associated with reduced aflatoxin levels, but many SNPs are aligned to various versions of the B73 reference genome and can't be directly compared. Lift over tools could be used to uplift SNP coordinates from older genome versions to the current version so that a GWAS meta-analysis can be performed. To determine the robustness of current liftover tools, SNPs from a past GWAS were uplifted using EnsemblPlants Assembly Converter, and the association tool, TASSEL, was used to run a General Linear Model (GLM) and a Mixed Linear Model (MLM). A comparative analysis of the uplifted and non-uplifted GWAS was used to determine if uplifting SNPs can preserve their information and yield similar significant SNP results after GWAS. Lifting over of SNPs from older genome annotations did not seem to affect the overall information associated with these SNPs, so this is a viable method that can be used to combine datasets for a GWAS meta-analysis.
https://youtu.be/KU49A8U4Dn0

68
Name: Seth Morrison
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Dr. Shane Brauer, Mechanical Engineering Department
Project Category: Physical Sciences and Engineering
REU/ Research Program: Bagley College of Engineering

Quantifying the Strength of Additively Manufactured High Density Polyethylene (HDPE) in a Vacuum

Since April 12, 1961, with the launch of Yuri Gagarin, mankind has sought to extend its reach into the unknowns of space. One of the ongoing challenges since this time is understanding what and how certain materials will hold up in the vacuum of space. Starting January 2021, I will be conducting research on quantifying the strength of 3D printed High Density Polyethylene (HDPE) in a vacuum. With the addition of additive manufacturing capabilities to the International Space Station, NASA's Artemis missions, and the abundant availability of HDPE, the goals for this research are to provide information that can be used for both scientific and economic purposes in the space industry. HDPE is the most widely used type of plastic to date and makes up everything from plastic bottles to corrosive resistant pipe making it both an economic and recyclable resource. HDPE test structures will be modeled and subjected to finite element analysis to determine any preliminary stress locations of specimens printed at atmospheric conditions and then placed in a vacuum. Knowing the preliminary stress locations will allow specimens to be printed at certain infill rates and patterns to decrease any preliminary stresses before being load tested in vacuum. Therefore, all obtained results will be applicable to both the space industry's government entities and privateers, in everything from rocket production, satellites, and personal life support systems for astronauts.

https://youtu.be/n4fIEQ60Y7A

73

Name: Abigail Musser
Major: Civil Engineering
Faculty Advisor, Affiliation: Todd Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Chanaka M. Navarathna, Xuefeng Zhang, Prashan M. Rodrigo, Todd E. Mlsna
REU/ Research Program: Provost Scholars

Removal of Arsenic(V) from Water using Zero Valent Iron Douglas Fir Biochar

Zero valent iron modified Dougals fir biochar (ZVI BC) was used to treat Arsenic (V)-contaminated water. The goal is to provide a material for rural households to use to treat drinking water. The removal efficiency was tested over a range of pH, concentrations, contact times, and temperatures. The optimal pH was 3, so pH 3 and 7 solutions were tested to find the industrial (optimal) and household removal efficiencies. The adsorption kinetics data best fit the pseudo second order model (R^2 = 0.99) and revealed the adsorption capacity at 2 hours. The isotherm study was conducted with ten different concentrations at pH 7 for 2 hours at three different temperatures (10℃ , 25℃ , 40℃). The isotherms study revealed the highest adsorption capacity at 40℃ but had the best fit with the Langmuir model at 25℃ .

https://youtu.be/7mCbx3RAG9o

53
Name: Shanika Musser
Major: Civil Engineering
Faculty Advisor, Affiliation: Benjamin Magbanua, Rula School of Civil and Environmental Engineering
Project Category: Biological Sciences and Engineering
REU/ Research Program: Bagley College of Engineering

Potential of biochar for the removal of waterborne microbial contaminants.
A *Guadua chacoensis* bamboo biochar was tested for its capacity to remove *Escherichia coli* and total coliform bacteria for drinking water applications. An environmental water sample taken from Chadwick Lake at the Mississippi State University campus was treated with varying amounts of biochar, and the survival of *E. coli* and total coliform bacteria was evaluated. Results indicated a numerical trend in which coliform density decreased as biochar amount increased. This trend was not statistically significant. However, the difference between no biochar or the least amount of biochar (0.1 g) and the two highest amounts of biochar (0.2 g and 0.3 g) was statistically significant, with a p-value of 0.013. No *E. coli* was detected in any of the samples. There is a need for more replications and for testing higher rates of biochar to determine if this could be a viable water purification method.
https://youtu.be/u9mCNi5IqUM

78
Name: Andie Nanney
Major: Chemistry
Faculty Advisor, Affiliation: Todd Mlsna, Debra Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Chanaka Navarathna
REU/ Research Program: Mississippi State University, National Science Foundation

Removal of oil spills using enhanced hydrophobic biochar--Illustrating adsorption isotherms for undergraduate students using an Analytical Balance
The application of chemistry for ecological purposes gets often overlooked during an undergraduate chemistry student's education. Oil spills are an extremely high-profile problem investigated by environmental chemists and are easily recognizable to even those without an extensive background in chemistry. We have devised an experiment teaching through the context of oil spills that may be used in an undergraduate chemistry teaching lab exploring environmental chemistry and the topics of isotherms and intermolecular forces. This experiment is favorable as most labs exploring the topic of isotherms specifically require access to sophisticated equipment, which may be inconvenient or impossible for some teaching institutions. Instead, the only equipment which this lab requires is an analytical balance. In this lab, the adsorption of oil onto lauric-acid magnetized biochar (MLBC) is explored. Biochar is a byproduct of bio-oil and syn-gas production. It is modified with lauric

acid and iron oxide to give it magnetic and hydrophobic properties. Using spent machine oil is recommended to reduce waste, but crude, engine, and transmission oil may be used as well. Students measure samples of plastic cups with varying amounts of oil and add those to a constant quantity of simulated seawater, add MLBC which adsorbs the oil, remove the MLBC using a magnet, and then measure the cups again to determine the mass of oil removed. The data is then fitted to a linear Freundlich plot. This lab is easily replicated, explores complex topics in an approachable manner, and exposes students to environmental chemistry topics.
https://youtu.be/ydLdQ4DJkOY

1
Name: Joseph Newell
Major: English
Faculty Advisor, Affiliation: Lara Dodds, Dhanashree Thorat, English
Project Category: Arts and Humanities

Dickinson, Displacement, and her use of Defense Mechanisms to Cope with Psychological Trauma.

Emily Dickinson, the famous 19th century American Romanticist poet, often wrote about her disdain for God through expressions of abandonment and anguish in her poetry. Research from Eberwein, Archer, and Zapedowska surrounding Dickinson's early childhood suggests that she endured her father's strict religious upbringing and studies Dickinson's diagnosis of mental illness caused by childhood trauma. In this paper, I analyze religious upbringing, childhood trauma, and mental illness in Dickinson's poem "Of Course–I Prayed" through the lens of Freudian displacement. While prior scholarship has addressed these ideas in isolation, my research shows that these ideas must be studied together to understand how they inform Dickinson's work. By studying scholarly work, Dickinson's letters and writing, and documentation of Dickinson's medical history, I show that Dickinson's poetry uses displacement as a defense mechanism to cope with her feelings of being abandoned by her father and not by God. Drawing on Freud's idea that displacement is a substitution by allusion that produces utterances with deeper meanings by revisiting trauma and memories of childhood, I argue that Dickinson's recurring notion of anger towards God must have derived from trauma experienced by an authoritative figure in her childhood. Since the research concluded that Dickinson left the church at an early age, her father remained the only authoritative figure around her who represented Dickinson's displaced image of God.
On this rationale, the concept of displacement not only explains Dickinson's anger towards God but insinuates that one's true feelings and psychological anguish can be assessed through things they cherish. My research highlights how assessing linguistic and literary devices such as figurative language and symbolism can help us learn more about the psychic conditions of the writer.
https://youtu.be/188hYZi81dQ

16
Name: Ashleigh Nicaise
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Barbara Kaplan, Comparative Biomedical Sciences, CVM
Project Category: Biological Sciences and Engineering
REU/ Research Program: NIH

TCDD Inhibits IgG1 Antibody Production in EAE and In Vitro
Experimental autoimmune encephalomyelitis (EAE) is an autoimmune disease model of multiple sclerosis that can be induced in mice using the myelin oligodendrocyte glycoprotein (MOG) peptide. Part of the pathophysiology of EAE involves production of pathogenic antibodies that can recruit cytolytic cells to destroy MOG-expressing cells that comprise myelin. Previously we showed that TCDD inhibited MOG-specific IgG and decreased disease at 18 days. In an in vitro model, we also showed that TCDD preferentially inhibited IgG1 cell surface expression. Thus, the purpose of this study was to characterize the effects of TCDD on the IgG1 subclass of IgG to further investigate the mechanism behind TCDD's known immune suppression. We hypothesized that TCDD would suppress IgG1 production in vivo and in vitro. In a recent EAE study, TCDD significantly suppressed MOG-specific IgG1 in the serum at end-stage disease. ELISA analyses showed that TCDD modestly inhibited total IgG in mouse splenocytes or purified B cells stimulated with LPS or LPS plus IL-4 for 4 days. Additional ELISA analyses showed that TCDD inhibited IgG1 production in splenocytes or purified B cells stimulated with LPS plus IL-4 at various times over the 4-day culture, but there was no significant effect on IgG1 production in bone marrow at 2 days post stimulation. Together these data show that a sensitive target of suppression by TCDD is the IgG1 subclass of IgG, which was inhibited in vivo in the EAE model and in vitro. While TCDD could not be developed as a therapy for autoimmune disease, these studies provide insights for the mechanisms by which AhR ligands are immune suppressive.
(Support: NIH R15 ES027650)
https://youtu.be/WdYM8kxxlLw

35
Name: Luke Nichols
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Dr. Lauren Priddy, Dr. Steven Elder, Department of Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Sophie Jones, Kamryn Clymer, Emily McCabe
REU/ Research Program: BioHorizons Implant Systems, Inc., Bagley College of Engineering Undergraduate Research Program

Cell growth and morphology on surface-modified titanium alloy for dental implants
Titanium is considered one of the most biocompatible materials used for orthopedic implants due to its favorable properties: high strength, low density, and high corrosion resistance.

Dental implants are a popular use of titanium due to its high fracture resistance, wettability, and osseointegration (ability to bind well with the underlying bone/tissue). Specifically, the most commonly used titanium alloy is Ti-6Al-4V-ELI (Ti64), which contains ~90% titanium, ~6% aluminum, ~4% vanadium, and extra low interstitials (ELI). BioHorizons®, a company specializing in osseointegrative dental implants, modifies the smooth surface of a dental implant using two techniques: Laser-Lok® (LL) and Resorbable Blast Texturing (RBT). The LL technique produces adjacent long channels, and the RBT technique produces a more randomly rough surface, both of which allow for high bone cell and soft tissue attachment. BioHorizons fabricated two batches of each of these surface types: LL-1 and LL-2, and RBT and RBT-Plasma (RBT-P). The goal of this research was to compare the biological properties of the versions within each pair by conducting cell culture studies on 10-mm diameter disks. Our hypothesis was that the properties would be similar between LL-1 and LL-2 disks, as well as between RBT and RBT-P disks. *In vitro* tests were conducted with pre-osteoblast cells to evaluate cell behavior on all surface types, including two control groups: tissue culture plastic coverslips and a smooth, machined Ti64 surface. Cell attachment and proliferation was observed using Cell Counting Kit-8 assays, qualitative cytotoxicity using live/dead staining and imaging, and cell spreading and cytoskeletal alignment using SEM imaging and DAPI/Phalloidin staining with confocal imaging. All surfaces facilitated cell attachment, proliferation, and viability, while the LL-1 and LL-2 surfaces showed the most highly aligned cells. As expected, no significant differences were observed between LL-1 and LL-2 surfaces, or between RBT and RBT-P surfaces.
https://youtu.be/cJx4oMMQWI4

123
Name: Abigail Nichols
Major: Fashion Design and Merchandising
Faculty Advisor, Affiliation: Catherine Black; Department of Human Sciences
Project Category: Social Sciences

Speech Mask Development: The Speakeasy
Since Covid-19, people all over the world have been forced to wear face mask. For those who are deaf or hard of hearing, surrounding people wearing mask can quickly become an issue if you heavily rely on lip reading. Dr. Black originally created the windowed mask for a friend's deaf husband. She then proceeded to create and donate these mask to speech therapist around the Starkville Community. My mother teaches special education and often interacts with children who cannot hear properly. Through our new Speakeasy mask, we hope consumers can stay protected as well as communicate with facial gestures and lip reading.
https://www.youtube.com/watch?v=KEpVt0o1Ztc

108
Name: Madeline Nichols
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Mark Janus; Redha Wahidi, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Effects of Drag Force on the Trailing Car in Drafting Configurations
NASCAR has been around since the early 1950's, and before that people were modifying their own cars and racing each other. The spirit of competition and the desire to outperform one another is ingrained in human beings. Today in NASCAR since the implementation of guidelines for the generation [#] cars, that advantage has all but become dependent on how well a driver can control the manipulation of the aerodynamics of his vehicle. One of the most important aspects of this is the use of drafting – using drag to one's advantage. Using the wind tunnel in the testing of model cars will show how the lateral separation and longitudinal separation will influence aerodynamic drag. The testing will be performed with two cars, the trailing car free to move and the leading car fixed. Attached to the trailing car will be a load cell that will measure the drag force acting on the car. The testing points will vary by wind speed, longitudinal spacing, and lateral spacing. These results will then be plotted, analyzed, and compared to show the benefits of each configuration and what is the best configuration to reduce overall drag.
https://youtu.be/4xU0tTsfnAE

48
Name: Rachel Nobles
Major: Landscape Architecture
Faculty Advisor, Affiliation: Te-Ming Tseng, Plant and Soil Science
Project Category: Biological Sciences and Engineering
Co-Author(s): Mary Gracen Fuller, Brien W. Henry,

Using weed-suppressive corn and cover crops for weed management and increased profitability of corn
Corn plays a major role in crop production in the state of Mississippi. Weeds prove to be the primary threat to corn production. Morningglory is a weed that winds around plants, eventually suffocating the corn crop. Traditional pesticides have proved to be ineffective in controlling the weed throughout the duration of the corn growing season. Additionally, the heavy usage of chemicals for weed control may result in herbicide-resistant weeds, which tends to complicate crop management. Among the tools in integrated weed management are the use of weed-suppressive/competitive cultivars to minimize weed competition. The natural consequence of this is the reduced need for herbicide application and increased herbicide efficacy because of the reduced weed population. Maximum herbicide rates or multiple herbicide applications may no longer be needed, which is good for the environment.

The selection of weed suppressive corn varieties in a modified stair-step assay was utilized in this research. Three repetitions of ten corn varieties were tested in the stair-step system. The height, chlorophyll concentration, as well as biomass, was measured and recorded for every plant. Three weed-suppressive corn varieties, DKC, Slow Food #2, and Long #2, were identified that reduced morningglory height by 30-53%. DKC70-27 was the best performing variety that resulted in a 53% reduction in morningglory plant height. We hope to screen additional varieties against additional weed species and confirm the results in a field study.
https://youtu.be/JMLHAFfTW5Q

128
Name: Breana Norton
Major: Kinesiology
Faculty Advisor, Affiliation: Dallas Breen, Political Science
Project Category: Social Sciences

Title IX and NIL: Predicting the Effects of Player Compensation
Title IX's purpose in 1972 was to bar discrimination on the basis of sex in educational programs or activities that receive federal funding. This statute still attempts to bridge the gap in the inequality and inequity of gender, especially in the sphere of collegiate athletics. While the gap has decreased since 1972, Title IX issues are still prevalent in NCAA institutions today. The NCAA has begun discussions on allowing student-athletes to benefit off their name, image, and likeness. Student-athletes could soon be able to market themselves for advertisements and merchandise, or to profit off individual winnings or salaries. Should this become legal, the gap Title IX is attempting to close would widen further. This research uses data from the United States Department of Education that gives the gender participation for each sport in four different NCAA conferences and divisions from 2003-2017. This data will be used to compare the number of male student-athletes to female student-athletes to evaluate if Title IX is effective in narrowing the gap. Also, the revenue from advertisement for professional athletes will be examined to see if there is a difference in pay for similar advertisements between male and female professional athletes. Based on the data, most schools do not have relative equal number of male student-athletes to female student-athletes; therefore, Title IX is not effectively doing the job it was put into place for. The payment for male professional athletes is much higher than female professional athletes based on the data. This pattern suggests the same may be true of payment for likeness at the collegiate level. Scholarships in the legislative budgets for universities may also be impacted. This research will examine the levels of which the NIL may negatively affect female's participation in sport, as well as economic opportunities for female student-athletes.
https://youtu.be/0Pk0b7QQEoQ

77
Name: Alyssa Pace
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker and Robert Wolz, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Study of the SB-1 and V-280
An analysis of the Sikorsky-Boeing SB-1 Defiant and the Bell V-280 Valor and the determination of which of these aircrafts is superior. To study the different design chooses chosen by each manufacturer and the advantages and disadvantages of both. Determining the different capabilities of the tilt rotor design on the V-280 and the compound coaxial helicopter design for the SB-1 and the advantages that they each possess compared to the capabilities of the Sikorsky H-60 Black Hawk which is in current use by the United States Army. Analyzing the different performance capabilities of each aircraft through the use of MATLAB and using knowledge to determine the range, endurance, lift to drag ratio, and rate of climb. Then using this information to be able to determine which aircraft is superior to the other and how they compare to the Black Hawk in current use.
https://youtu.be/BmEB_iQE5m4

131
Name: David Parker
Major: Educational Psychology
Faculty Advisor, Affiliation: Kasia Gallo, Counseling, Educational Psychology, and Foundations
Project Category: Social Sciences

The Effectiveness of Art Therapy in the School Setting: Diverse Applications for Special Populations
Schools have a much greater responsibility than just providing students with academic knowledge, they must also do their best to equip students with the skills to face adversity. This is especially important when, according to NAMI, 1 in 5 children ages 13-18 have or will have a serious mental illness. To address this crisis, school professionals need effective approaches to serve the social and emotional needs of their students. This literature review investigated the social-emotional barriers of special populations and the effectiveness of art therapy in the school setting. The term “special populations” is used to identify students who may be disadvantaged due to any factor that may significantly affect their ability to learn. Findings from 14 recent, peer-reviewed empirical studies were synthesized and sorted in to three groups: students with neurological and psychological disorders, students who are considered “at-risk”, and students with disruptive behavior. The number of participants varied across the studies from 1 to 50 individuals. Participants were all students whose age ranged from 4 to 20 years old. Each study involved an arts-based intervention delivered either individually or within a group setting. Data for analyses were collected through a combination of self-reports, psychometric scales, observations from teachers and parents, and from the school itself. Improvements were noted in the students’ resilience, self-concept, and

emotional empathy. Teachers and parents observed improvements in behavior and academic performance. Research is needed, however, to determine whether an art therapy program can be administered broadly for groups of students with varying needs. Art therapy is adaptable to the student it serves. As a more approachable form of therapy, it may be part of the solution to help the social and emotional needs of our students, address the rising mental health crisis in young people, and close the achievement gap for disadvantaged students.
https://youtu.be/gUX5ccJVDFs

138
Name: Haley Parnel
Major: Psychology
Faculty Advisor, Affiliation: Dr. Colleen Sinclair, Psychology
Project Category: Social Sciences
Co-Author(s): Matthew Dean
REU/ Research Program: Social Science Research Center

Not All Threats are Created Equal: Higher levels of perceiving threats predicts receiving threats

It has been identified through our research that the Libertarian leaning terrorist group, the Boogaloo Movement, pose a clear threat to anything opposing the right to bear arms, anything pro police, or pro establishment. Through the Boogaloo data set, five Threat Types were identified- Physical Health Threat, Resource Threat, Moral Threat, Social Threat and Self Threat. Our goal for this study was to predict if that higher levels of perceived threats will help predict threats as well as the prediction that Moral and Physical Threat will be the strongest predictors of intended violence. With this in mind, we ran a regression to identify previously identified threat types, and the concurrent construction of those threats to take action upon the outgroup. Using this knowledge, we identified whether the content of their posts fit into any of the aforementioned categories. We hypothesize The data proved that the main effect of threat construction was a significant predictor, $F(5, 352) = 56.046$, p = <.001, $R^2(358) = .443$, $p = <.001$. There was a significant main effect of Physical Threat construction ($b = 1.273$, $SE = .084$, $\beta = .610$, $p = <.000$), Resource Threat construction ($b = .683$, $SE = .139$, $\beta = .196$, $p = <.000$), and Moral Threat construction ($b = .765$, $SE = .157$, $\beta = .195$, $p = <.000$) on making a threat. There was also a negative main effect of Social Threat on threat level ($b = -.471$, $SE = .143$, $\beta = -.133$, $p = <.05$). Only Self Threat showed no significance. Therefore, we were able to confirm both of our hypotheses- our research showed that higher levels of perceived threats will help predict threats, and that Moral and Physical threats were the strongest predictors of intended violence on an outgroup.
https://youtu.be/yAN9VkOIZ2k

155
Name: Amy Pham
Major: Food Science, Nutrition, and Health Promotion
Faculty Advisor, Affiliation: Terezie Tolar-Peterson, Nicole Reeder;
Project Category: Social Sciences
REU/ Research Program: Mississippi Agricultural and Forestry Experiment Station; National Institute of Food and Agriculture, U.S. Department of Agriculture, Hatch project under accession number 1011322, project number MIS-609200.

The Relationship between Obesity and Sleep Quality in College Women
Obesity is a prominent health concern in the United States. The leading causes of mortality in the United States, such as coronary artery disease, cancer, type 2 diabetes, and stroke are all linked to obesity. One factor that may affect the risk of weight gain and overweight/obesity is sleep quality. The objective of this study was to examine the correlation between obesity, as measured by BMI and body fat percentage, and sleep quality among female college students. Thus, a sample of 40 women college students (80% White/Caucasian; 7.5% Black/African American; 12.5% Other) completed the Pittsburgh Sleep Quality Index (PSQI) survey and had body composition measurements taken using bioelectrical impedance analysis (MC-780U, Tanita Corp.). Self-reported subjective sleep quality was significantly associated with BMI, with students who reported the poorest quality sleep having a significantly higher mean BMI than students who reported moderate-quality sleep (27.92±10.07 vs 21.38±3.48, p=0.022). BMI was also significantly associated with sleep duration. Students who reported the shortest average duration of sleep each night had the highest mean BMI of 31.90±10.77 (p=0.003). BMI was not significantly associated with total (global) PSQI scores, nor other PSQI component scores, and there were no significant associations with body fat percentage. These results add evidence to suggest that sleep quality and weight status may be related for young women, though these findings need to be confirmed in a larger study. Based on these findings, Registered Dietitians may wish to consider discussing sleep hygiene with patients/clients as part of an overall healthy lifestyle.
https://youtu.be/kBfDmKuiONI

72
Name: Walker Phillips
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Rani Sullivan, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Mississippi State University Space Grant Program

SolidWorks Modeling of a T-38 Strut Door
The Northrop T-38 Talon has been one of the most popular military aircraft trainers over the past few decades. Currently, almost one-third of the fleet is undergoing structural upgrades in order to extend their service life to 2029. In conjunction with the Airforce Research Laboratory, the Mississippi State Department of Aerospace Engineering has been tasked with

creating a composite main landing gear strut door for the T-38. This project seeks to supplement those efforts with a 3D CAD model of the strut door done in SolidWorks. By following original drawing files for the titanium door, the model was done in the following three stages: exterior skin, orthogonal core, and interior skin. These were done by creating sketches of certain points along the drawing, extruding the pieces, and then chamfering edges to ensure smooth transitions. The next step as a part of this research is to execute finite-element-analysis in ABAQUS to assure that the model meets the given load requirements. A composite model is also to be generated from this model for subsequent FEA in ABAQUS.
https://youtu.be/n5k6Pg3-_mQ

22
Name: Dana Poore
Major: Agricultural Science
Faculty Advisor, Affiliation: Dr. Guihong Bi, Plant and Soil Sciences
Project Category: Biological Sciences and Engineering
Co-Author(s): Dr. Tongyin Li
REU/ Research Program: MDAC Specialty Crop Block Grant and USDA-NIFA Hatch project

Extending Blueberry Harvest Season Using Southern Highbush Cultivars and High Tunnels
Blueberry production in Mississippi is typically limited to rabbiteye cultivars whose harvest season is from late May to late July. While southern highbush cultivars have an earlier harvest season so they offer Mississippi the opportunity to bring fresh fruit to market earlier. High tunnels can be used to reduce weather risk associated with growing southern highbush cultivars and extend the growing season. The objective of this study was to investigate the feasibility of extending blueberry harvest season using southern highbush cultivars and high tunnels in MS. This study uses five southern highbush cultivars 'Patrecia', 'Meadowlark', 'Rebel', 'Camella', and 'Star'. One year-old blueberry plants were transplanted into 15-gallon plastic containers in March 2019 and grown in a high tunnel. Data was collected for the 2020 growing season from first harvest date, date and yield of peak harvest, single berry weight, total berry weight, to the soluble solids content. Preliminary data from this study showed that using southern highbush blueberry cultivars in combination with high tunnels can extend blueberry harvest season into early spring. However, there is still risk of frost damage on blooms and berries in late winter and early spring even with high tunnel protection.
https://youtu.be/DOmAa-bR74U

126
Name: Ashton Porter
Major: Political Science
Faculty Advisor, Affiliation: Dr. Carolyn Holmes; Political Science
Project Category: Social Sciences

Measuring Immigrant Integration in the United States South

This study examines the integration success of immigrants in the U.S. South. The design of this study establishes six indicators of integration: employment, education, political engagement, health, housing, and language. In the discussion, each section establishes the indicator's measurement technique, its relevance to integration, and its relationship with other indicators. The proposed measure is a point-based survey which correlates to a hexagonal spider graph as an overall index of integration success. The survey is recommended for individual administration to compare cases and determine change across time of immigrants as they integrate into the U.S. South**.** Integration is viewed as the extent to which immigrants are able to function and contribute as members of their community. This is relevant for the quality of life of both immigrant populations and the populations in which immigrants settle. There is limited research on measuring immigrant integration, as well as the dynamics of integration specifically in the U.S. South. There is a need to expand this area of research because of increasing immigrant populations in the U.S. South, a lack of pathways to reduce barriers for immigrants, and an increasing generational gap between first-generation immigrants and their children.
https://www.youtube.com/watch?v=eR2CQ1KEyUM

82

Name: Arissa Ramirez
Major: Biochemistry, Chemistry
Faculty Advisor, Affiliation: Dr. Todd Mlsna, Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Charles U. Pittman Jr.
REU/ Research Program: National Science Foundation REU

Sorption of As(V) using Fe3O4 nanoparticles dispersed on Douglas Fir. Biochar

Arsenic is a toxic contaminant commonly found in drinking water, which could lead to deleterious health effects including cancer, cardiovascular disease, kidney diseases etc. In this study Fe_3O_4 (magnetite) was chemically co-precipitated on commercial high surface area (700 m^2/g) Douglas fir biochar (MBC) (syn gas by product) using $FeCl_3$ and $FeSO_4$ followed by NaOH base treatment. MBC was tested for it's As(V) removal in both batch and column sorption under different initial solution pH, equilibrium time, initial concentrations, in the presence of competitive contaminants (phosphate, selenate, molybdate, chromate, nitrate, chloride, fluoride, copper and methylene blue). Also, ionic strength, dose, dose volume, performance in real water matrices, cyclic sorption, fixed-bed column sorption were assed with a special attention to scaled-up applications. MBC was able to reduce the As(V) concentrations down to WHO drinking water standard limits (<10 ppb). The MBC redox transformation studies on As(III) has shown the MBC has a potential to convert As(III) to less toxic As(V). Primary sorption mechanism is sought to be chemisorption onto surface iron hydroxyl groups. In addition, stoichiometric Fe-As compound formation was considered with a comprehensive iron leaching study. These preliminary experiments suggest that MBC has a great potential to

provide As(V) free drinking water. Future experiments will be focused on engineering the MBC in large scale for commercialization.
https://youtu.be/pG3V7HfVuVI

122
Name: Vishveshvar Ramkumar
Major: Biochemistry
Faculty Advisor, Affiliation: Dr. Virginia Montiel-Palma, Niroshani S. Abeynayake; Chemistry
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Virginia Montiel-Palma, Niroshani S. Abeynayake;

Conversion of arylalkenes to alkenysilanes using Rh2(OAc)4/ PPh3 catalyzed dehydrogenative silylation
In organometallic chemistry, understanding the regiospecific and catalytic function of alkenes is a major challenge. Alkenylsilanes are versatile and serve as intermediate in organic transformation. Direct, selective dehydrogenative silylation of alkenes gains more interest to access valuable alkenylsilanes. Here, we present the direct synthesis of dehydrogenative silylation of styrene derivates catalyzed by $Rh_2(OAc)_4$/ PPh_3 in the presence of norbornene, in reflux conditions. Norbornene and PPh_3 play a key role in specificity favoring the dehydrogenative silylated product. Moreover, excellent conversion, and selectivity were achieved.
https://www.youtube.com/watch?v=TLpVYU5fyh8

8
Name: Luke Ramsey
Major: Kinesiology - Neuromechanics
Faculty Advisor, Affiliation: Sachini Kodithuwakku Arachchige, Harish Chander, Alana Turner, Adam Knight, Kinesiology
Project Category: Biological Sciences and Engineering
Co-Author(s): Sachini Kodithuwakku Arachchige, Harish Chander, Alana Turner, Adam Knight

Using Virtual Reality to Recreate the Classical "Moving Room" Experiment to Assess Postural Control
The “moving room” paradigm was developed by Lee and Aronson in 1974 to analyze the impact of visual and proprioceptive input in the control of posture. Postural perturbations can be provided to the visual system, using a modified “moving room/wall” paradigm, using virtual reality (VR). **Purpose:** To analyze the impact of an unexpected and expected moving wall in a virtual environment on postural stability. **Methods:** Nineteen participants (age: 25 ± 6 years; height: 166.13 ± 11 cm; mass: 67.86 ± 12 kg) were tested for static postural stability using a force platform under three conditions: baseline (BL) with no perturbation and no VE, unexpected visual perturbations (UP) and expected visual perturbation (EP) in a custom built

VE through a head mounted display (HMD). A one-way repeated measures ANOVA was used to analyze postural sway variables derived from center of pressure (COP) excursions at alpha level of 0.05. COP length (COP-L), COP radial displacement (COP-RD), maximum anterior-posterior (COP AP-Max) and medial-lateral (COP ML-Max) COP excursion are reported in this paper. **Results:** Significant differences between testing conditions existed for COP ML-Max [$F(2,36) = 5.093$, $p = 0.011$, $\eta p2 = 0.221$] and for COP-RD [$F(2,36) = 7.506$, $p = 0.002$, $\eta p2 = 0.294$]. Post-hoc pairwise comparisons for both variables revealed that baseline exhibited significantly lower postural sway compared to UP, with no significant differences between baseline and EP. **Discussion & Conclusions:** UP demonstrated significantly higher postural sway parameters compared to BL, suggesting decreased postural stability when exposed to unexpected moving of the virtual wall. With visual perturbations experienced without anticipation, participants were relying on compensatory postural responses (CPRs) to make postural adjustments. However, no significant difference existed between EP and BL, suggesting no change in postural stability, even with visual perturbations in a VE, as long as those are anticipated; thus, the anticipatory postural responses (APRs) can make proactive responses to maintain postural stability. Based on the current findings, there is evidence of both CPRs and APRs during visual perturbations in the "virtual moving wall" paradigm could potentially serve as a low-cost and feasible fall prevention-training program.

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Name: Mackenzie Ripper
Major: Poultry Science
Faculty Advisor, Affiliation: Li Zhang
Project Category: Biological Sciences and Engineering
Co-Author(s): Sabin Poudel, Aaron Kiess, and Li Zhang, Agricultural and Biological Engineering
REU/ Research Program: College of Agriculture and Life Sciences Undergraduate Research Scholars Program

Evaluating the loop-mediated isothermal amplification (LAMP) assay for the rapid detection of Campylobacter jejuni in poultry

Loop-mediated isothermal amplification (LAMP) is a nucleic acid-based amplification method, which can be utilized to identify pathogens. Advantages of using the LAMP method include high sensitivity and specificity, low cost, and it does not require any specialized equipment. The objective of this project was to establish a methodology to rapidly detect *Campylobacter jejuni* (*C. jejuni)* on the farm using the LAMP method. If an on-site LAMP assay method could be developed, remediation of disease outbreaks caused by *C. jejuni* could be accelerated on the farm. For this experiment, pooled fecal and litter samples were first randomly collected from a commercial broiler farm. Samples were then washed with PBS, filtered, and centrifuged to remove inhibitory debris and concentrate the DNA. To extract DNA, three different extraction techniques were evaluated; the silica membrane method (Qiagen), the salt precipitation method (Wizard), and the magnetic beads method (MagMax). Once DNA extraction was complete the LAMP method was then performed using 6 different sets of primers that were specific to a *Campylobacter jejuni* gene. This method was performed under

isothermal conditions, between fifty-nine and sixty-five degrees Celsius for an hour. Our results demonstrated that after 40 minutes of incubation using the LAMP method, the MagMax technique was capable of amplifying DNA from both fecal and litter samples. After 60 minutes, the DNA from the litter using the Qiagen kit was also capable of amplifying DNA. Reference strains were also used to assess the specificity and sensitivity of not only the LAMP assays but also the DNA extraction technique was used. From our results, the data suggests that the Magnetic kit provided the most sensitivity when using the LAMP method, for both the fecal and litter samples. The other aspect of this experiment that was of interest, was the fact that our negative control, containing only water, began to demonstrate DNA amplification after 60-minutes. This may have been due to cross-contamination between the positive and negative control sample because they were next to each other on the laboratory bench. By changing pipette filters more frequently or changing the order of the samples may resolve this problem in the future. Continuing research will address the negative control issue, along with testing the new LAMP assay method on the farm, for the rapid detection of *C. jejuni* in the field. This publication is a contribution of the Mississippi Agricultural and Forestry Experiment Station
https://www.youtube.com/watch?v=22aNxl1su2s

109
Name: Miguel Rivera
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Prashant Singh, Mechanical Engineering
Project Category: Physical Sciences and Engineering

Design and development of experimental facility for thermal conductance measurement of composites

This project's goal was to develop an experimental setup for evaluating the performance of various Thermal Interface Materials (TIMs). TIMs are commonly employed to facilitate efficient heat transfer between the chip and the heat sink, and hence their accurate thermal conductance knowledge determination is critical. This experimental setup includes a cold plate on which the two Aluminum blocks with TIM sandwiched will be mounted where the goal is to obtain a unidirectional flow of heat. The cold plate includes four through holes drilled and tapped into its thickness through which water will flow. This water loop contains a water pump, a reservoir, and the water will be routed through a coiled copper tube immersed in an ice-water slurry. This experimental setup will facilitate long duration experiments where a constant temperature gradient can be observed between the two Aluminum blocks with a discontinuity at their interface. The thermal conductance will hence be determined through the knowledge of the temperature discontinuity between the two Aluminum blocks and the net flow of heat from top to bottom.
https://youtu.be/SfpxBkww898

29
Name: Jordan Roberts
Major: Forestry
Faculty Advisor, Affiliation: Thu Ya Kyaw, and Courtney Siegert, College of Forest Resources
Project Category: Biological Sciences and Engineering
Co-Author(s): Thu Ya Kyaw, Courtney Siegert, and Heidi Renninger
REU/ Research Program: USDA

Water quality improvement in the Lower Mississippi Alluvial Valley using short-rotation woody crops in riparian buffer areas
Agriculture is prevalent throughout the Lower Mississippi Alluvial Valley and the runoff from agriculture practices can lead to the degradation of water quality locally and downstream in the Gulf of Mexico. Vegetated riparian areas play a critical role in capturing runoff and preventing water quality degradation. These areas experience frequent flooding in LMAV, limiting their capacity to be farmed annually but could be planted with short rotation woody crops (SRWC) to provide additional income for landowners. SRWCs can create a riparian buffer that can filter out the excess nutrients from agriculture runoff before the excess nutrients reach a larger water body. In addition to the ecological benefits of SRWCs, the biomass can be sold as a feedstock for bioenergy production. This study evaluated the ability of SRWC to remove nutrients (nitrate, ammonia, and total phosphorus) from shallow groundwater located between agriculture fields and the Yazoo River in Sidon, MS. The riparian species studied were black willow (Salix nigra), eastern cottonwood (Populus deltoides), and American sycamore (Platanus occidenalis)... Based on this study's results, the SRWC plantation was successful in removing over 69% of nitrate from shallow groundwater. No mitigation was observed in shallow groundwater for total phosphorous or ammonia. Based on the analysis, 2.6 kg/ha/year of nitrate is being removed from the groundwater because of the water and nutrient uptake from the SRWC plantation. In conclusion, SRWC plantations can be used as a riparian buffer that can improve the water quality by reducing the number of nutrients, particularly nitrate, from agricultural runoff.
https://youtu.be/cLC-_C1C6qc

34
Name: Lindsey Robinson
Major: Microbiology
Faculty Advisor, Affiliation: Seth O'Connor and Dr. Ling Li, Biological Sciences
Project Category: Biological Sciences and Engineering
REU/ Research Program: Department of Biological Sciences

Methylation Context Regulates QQS expression in Arabidopsis Thaliana¬†
Cytosine DNA methylation is an important form of epigenetic regulation in eukaryotes. While cytosine methylation in animals is mostly restricted to symmetrical methylation in the CG context, plants have unique methylation pathways capable of managing cytosine methylation in all three methylation contexts (CG, CHG, and CHH: where H can be anything other than G).

To better understand how different states of methylation affect gene expression, we studied *QQS* (*Qua Quine Starch*), a species-specific orphan gene in *Arabidopsis thaliana,* involved in regulation of starch and protein accumulation. Expression level of *QQS* was known to increase with complete loss of methylation in its promoter (all three contexts). We used the *jumonji 14* (*jmj14*) mutant, a mutant with inhibited CHG and CHH methylation, to determine how *QQS* is affected when CG methylation is unaltered. Bisulfite sequencing showed less methylation at the QQS promoter region in *jmj14* plants when compared to wild-type plants. *Starch* staining revealed an increase in leaf starch in *jmj14* plants, a phenotype similar to *qqs* knockout mutant plants, suggesting a lower expression of the *QQS* gene. In addition, qPCR revealed a decreased expression level of *QQS* in *jmj14* mutant. Our results indicate that different methylation contexts may confer different biological effects and multiple epigenetic pathways can control the activity of the orphan gene *QQS*.
https://youtu.be/7Q3Fk5gkpMo

130
Name: Claire Roscoe
Major: Psychology
Faculty Advisor, Affiliation: Dr. Colleen Sinclair, Psychology
Project Category: Social Sciences
Co-Author(s): Matthew Dean

Getting emotional: How moral outrage predicts making threats in the online posts of domestic extremists
Through the AnCoDi hypothesis (Matsumoto, et al, 2015) and the Theory of Hate (Sternberg 2003) we examined extremist posts on social media for prediction of threat within social media posts. The social media posts were coded for the emotions Anger, Contempt, and Disgust and specificity of threat. Overall, our analysis showed support for the AnCoDi hypothesis and demonstrated that the emotional content of speech can sometimes be a reliable predictor for levels of threat. Anger was found to be a main effect for predicting threat. Contempt was insignificant for predicting threat.
https://youtu.be/f4pTYxmHqhM

144
Name: Madison Ryburn
Major: Fashion Design & Merchandising
Faculty Advisor, Affiliation: Dr. JuYoung Lee; Fashion Design and Merchandising
Project Category: Social Sciences
REU/ Research Program: College of Agriculture and Life Sciences Undergraduate Research Scholars Program

Resilience and Competitiveness of Cotton Industry Clusters

The cotton industry clusters include businesses from fiber production, yarn and textile production, apparel and textile product manufacturing and clothing and home furnishing retailers (Textile manufacturing, 2018). As the U.S. economy evolved, the structure and characteristics of the cotton industry cluster changed as well. However, the details of resilience and competitiveness in cotton industry clusters and the relationships in various industry cluster stakeholders remain largely unknown. Based on this current understanding, the purpose of this study is to investigate the relationship between resilience and competitiveness of cotton industry clusters. The objective of this paper is to identify how the formation of cotton industry clusters has a positive relationship to resilience and competitiveness of the cotton product manufacturing businesses. The study is planning to use surveys with open ended questions and multiple choices to identify the resilience and competitiveness levels in an industry cluster. The questions about resilience are modified open-ended questions from the scale of Organizational Resilience (Kantur & Iseri-Say, 2015) based on path dependency theory (Simmie & Martin, 2010). and the questions about competitiveness are modified open-ended questions from the scale of Porter's Competitive Strategy Scale (Porter, 1985) based on path dependency theory (Simmie & Martin, 2010). The industry cluster is measured by Location Quotient (LQ) for NAICS 313 (textile manufacturing), 314 (textile product manufacturing), and 315 (apparel manufacturing) that are considered a typical cotton industry cluster (Delgado et al., 2016). The survey created by Qualtrics will be sent out to participants that are currently working in fiber production, textile manufacturing, textile product manufacturing, apparel manufacturing, or home furnishing and clothing retail. Once the surveys are collected, the author will analyze the responses using content analysis to extract the meanings of the responses in relation to competitiveness, resilience and industry cluster in the fashion textile supply chains.

https://youtu.be/eEa1F_LemBc

40

Name: Makenzie Sanabria
Major: Wildlife, Fisheries, and Aquaculture Science
Faculty Advisor, Affiliation: Dr. Ray Iglay, Wildlife, Fisheries, and Aquaculture Science
Project Category: Biological Sciences and Engineering
Co-Author(s): Samantha L. Rushing, Jonas A. Hudnall, Nikita Q. Hinson, Trevon D. Strange, Jessica L. Tegt, and Raymond B. Iglay
REU/ Research Program: National Wildlife Research Center and the National Feral Swine Management Program

Stomach extraction and content analysis of wild pigs (*Sus scrofa*) for mitigating agricultural damage

Wild pigs cause over one and a half-billion dollars in damage per year to crops and property. However, extensive research on their diets in the places where they cause the most damage is lacking. In this study, we attempted to efficiently acquire, remove, and analyze the

stomachs of wild pigs. We acquired 147 suitable sp ecimens from trapping, aerial gunning, and night shooting efforts. Pigs were weighed, sexed, aged, and given a corresponding identification number. Stomachs were removed in the field by severing the stomach's connections to the esophagus and duodenum. Zip ties were used to secure stomach openings and retain stomach contents. Frozen stomachs were transported to a wet lab and thawed. Contents were removed and washed to eliminate any dirt and unwanted debris. Then, stomach co ntents were dried until constant weight. Dried specimens were sorted and placed into s torage bags. Preliminary data from five wild pig stomachs have demonstrated a preponderance of vegetation and small amounts of animal matter such as in sects, mussels, and the occasional bird and mammal.
https://youtu.be/_5ociPRSnhU

62
Name: Erin Sanders
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Adrian Sescu, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Mississippi Space Grant Consortium

Parachute Deployment Conditions and Performance
Motivated by the complex deployment process of a dome parachute a study was performed to analyze the effect of the suspension line ratio on the parachute performance. Experiments were conducted in a wind tunnel to observe how this parameter affects the drag produced by the parachute during deployment, how it impacts the deployment process, and what effects the drogue parachute might induce. Suspension line ratios of 1, 1.5, and 2 were tested across three subsonic speeds in the wind tunnel. Because the initial motivation of this study targeted the atmospheric reentry for space vehicles, models were deployed from a capsule designed to resemble reentry vessels but not designed to match any specific capsule. This was attached to a support beam that also served as the tunnel balance. The small tunnel size required that ribbon parachutes be used for the drogue parachutes. Evaluation was completed using video captured during the process, and strain gauge data obtained from the balance. Video footage was used to study the time for deployment and the dynamics of the deployment process. Review of the time values showed that shorter suspension line ratios allows the parachute to deploy in less time. All three runs for the suspension line ratio of 2 showed some extent of tangling. The suspension line ratio of 1 was more likely to move up and down in the tunnel right after deployment, but this was less noticeable at higher speeds. An effect of the suspension lines was seen in the force exerted at a sufficiently high speed. Higher suspension line ratios exhibited a higher peak in force. Effects of the drogue parachute were negligible for this study. Combining this information indicated that the ideal suspension line ratio for the deployment process is 1.
https://youtu.be/gdcbU4ct7fI

9
Name: Luke Sauls
Major: Biochemistry
Faculty Advisor, Affiliation: George Popescu, IGBB
Project Category: Biological Sciences and Engineering
Co-Author(s): George Popescu
REU/ Research Program: College of Agriculture and Life Sciences / MS Agricultural & Forestry Experiment Station's (MAFES) Undergraduate Research Scholars Program (URSP) and the Institute for Genomics, Biocomputing & Biotechnology

Potential for New Methods in Polyploid Plant CNV Analysis
Genetic variation is the key to adaptation and the driving force of evolution. Root of both disease and fitness alike, a greater understanding of genomes is a key focus of the life sciences. Yet one form of genetic variation, Copy Number Variants (CNVs) are far less understood than other forms of variation such as SNPs, yet are likely to contribute an equal or greater amount to genetic diversity. Hence the need to create improved methods of discovering and analyzing CNVs, especially as large sets of NGS data are becoming available. One particular area of interest is polyploid plants; crops in particular due to their importance to humanity. Unique difficulties arise when it comes to determining CNVs of polyploid plants; hence the need for innovation and new methods to overcome these obstacles. We have already designed algorithms for CNV detection and breakpoint location; the current task is to produce a similar method tailored for polyploid plants so as to increase precision and recall. Firstly, we acquired and formatted the necessary data from public genome databases. Next, we obtained pre-existing CNV detection programs and tested their efficacy at discovering CNVs in general and polyploid plant CNVs in particular, in order to determine which current methods were most effective. Further work to be done is the finalization our own method for CNV detection, and testing of said method versus preexisting programs. Lastly, we intend to implement machine learning in order to analyze the resulting genomics information.

25
Name: Hannah Scheaffer
Major: Biochemistry, Concentration: Science
Faculty Advisor, Affiliation: Dr. 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): Dr. Abdolsamad Borazjani

The Interference of PGD2 in the IL4 Anti-Inflammatory Pathway in THP1 Macrophages
When stimulated with the Th2 cell-derived anti-inflammatory cytokine IL-4, THP1 macrophage-like cells undergo alternative macrophage activation (M2 polarization). This activation sets off an intracellular signaling cascade resulting in the expression of the M2

marker gene *arachidonate lipoxygenase-15* (*ALOX15*). The *ALOX15* gene codes for the ALOX15 protein responsible for the breakdown of arachidonic acid into 15-(S)-HETE (hydroxyeicosatetraenoic acid). In the traditional IL4 signaling cascade, IL4 binds to its receptor causing it to dimerize. This dimerization leads to the phosphorylation the Jak1 protein and the phosphorylation of the STAT6 protein. Phosphorylated STAT6 dimerizes and moves into the nucleus activating the transcription factors that cause ALOX15 production. Prostaglandins (PGs) are endogenous immunomodulatory lipids produced by macrophages activated by inflammatory stimuli. They are formed from arachidonic acid by the action of cyclooxygenase (COX) enzymes. In this study, we found that when THP1 macrophages were stimulated with IL4 in the presence of prostaglandin D_2 (PGD_2), the IL4 induced expression of *ALOX15* was greatly attenuated. This effect was seen in *ALOX15* gene expression levels and in Western blot analyses of ALOX15 protein production. This substantial reduction was also noted in Western blot studies of phosphorylated STAT6 production, leading us to conclude that PGD_2 must interfere in the STAT6 phosphorylation process. This interference then leads to reduced levels of phosphorylated STAT6 moving into the nucleus, ultimately resulting in a significant drop in ALOX15 production. This finding is consistent with the suggestion made in previous studies that lipid mediators such as PGD_2 can modulate the responses of macrophages toward cytokines such as IL4.
https://youtu.be/fN-538B6I1s

113
Name: Philippe Schicker
Major: Mechanical Engineering
Faculty Advisor, Affiliation: Dr. Heejin Cho, Department of Mechanical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): Dr. Heejin Cho & Mr. Dustin Spayde
REU/ Research Program: Bioenergy Feedstock Logistics Program [grant no. 2020-67019-30772 / project accession no. 1022075] from the USDA National Institute of Food and Agriculture.

Design and Feasibility Study of Biomass-Driven Combined Heat and Power Systems for Rural Communities

Meeting energy demands at crucial times can often be jeopardized by unreliable power supply from the grid. Local, on-site power generation, such as combined heat and power (CHP) systems, may safeguard against grid fluctuations and outages. CHP systems can provide more reliable and resilient energy supply to buildings and communities while it can also provide energy-efficient, cost-effective, and environmentally sustainable solutions compared to centralized power systems. With a recent increased focus on biomass as an alternative fuel source, biomass-driven CHP systems have been recognized as a potential technology to bring increased efficiency of fuel utilization and environmentally sustainable solutions. Biomass as an energy source is already created through agricultural and forestry by-products and may thus be efficient and convenient to be transported to remote rural communities. This paper presents a design and feasibility analysis of biomass (primarily wood pellets)-driven CHP

systems for a rural community in the United States. A particular focus was set on rural Mississippi to investigate possible grid-independent applications; however, this analysis can be scaled to rural communities across America. The viability of wood pellets (WP) as a suitable fuel source is explored by comparing it to a conventional grid-connected system. To measure viability, three performance parameters – operational cost (OC), primary energy consumption (PEC), and carbon dioxide emission (CDE) – are considered in the analysis. The results demonstrate that under the right conditions wood pellet-fueled CHP systems create economic and environmental advantages over traditional systems. The main factors in increasing the viability of bCHP systems are the appropriate sizing and operational strategies of system and the purchase price of biomass with respect to the price traditional fuels.
https://youtu.be/B9-Plr2amjg

11
Name: Regan Sellers
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Sara Adibi, CAVS
Project Category: Biological Sciences and Engineering

Properties of Elastin-Like Polypeptides for Tissue Engineering
Elastin-like peptides (ELPs) are key to biomedical material design. They present numerous applications within bioengineering including but not limited to tissue engineering, scaffolds, and drug delivery. ELP has the ability to be molded and built-in many different forms which is why the use of ELP is so attractive in the biomedical research community. ELP can be tailored depending on the type of mechanical properties one needs it to present. ELP not only proves to be an ideal aid because of its inherent biocompatibility, non-immunogenicity, and biodegradability, but its stout ability to self-assemble. Remaining extremely adaptable, ELP poses quick responses to environmental changes including temperature and pH. A key focus point in this study is the aggregation of ELP at various temperatures in search of transition temperature. ELP is known to display inverse phase transition behavior. Within the range of temperatures below the transition temperature, ELP increases in solubility and entropy; while temperatures above present coacervation or disordered aggregation. Both of these processes are completely reversible. This inverse transition behavior is key to peak performance/stability of ELP in tissue engineering. ELPs display a strong resemblance to the ECM chemically and mechanically which makes it a strong contestant for biomedical applications. Long-term objectives for the use of ELP in tissue engineering include but are not limited to drug delivery, tissue regeneration and differentiation, cell sheet engineering.
https://youtu.be/9arh2cb3Ez8

89
Name: Christopher Shackelford
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Tim Moore, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Modeling the Terminal Ballistic Performance of 30 Caliber Armor- Piercing Ammunition
This project details the formation of an explicit dynamic simulation for the terminal ballistic performance of a 30 caliber armor-piercing round in Ansys™. Then, a ballistics test was performed to determine the accuracy of the model. Observations were recorded and compared from each method to determine that the model is accurate and would be viable if used for future programs. Furthermore, potential simulation enhancements are included which could increase the precision of the simulation.
https://youtu.be/dbjAl-BuAI4

83
Name: Blake Shelton
Major: Petroleum Engineering
Faculty Advisor, Affiliation: Maryam Mirabolghasemi, Petroleum Engineering
Project Category: Physical Sciences and Engineering

Investigation of the Potential of Geothermal Energy Production from Abandoned Oil and Gas Wells in Mississippi
Geothermal energy is a renewable energy source that can be produced from abandoned oil and gas wells. In this method of energy production, fluid is circulated in the well and is heated by the earth, resulting in a fluid exiting at a higher temperature than it entered. The heated fluid is able to be used by a turbine-driven generator to produce electricity. For these generators, the fluid has to reach a minimum temperature in order to function properly. In this study, we conduct heat transfer calculations to predict the extent of fluid temperature rise as a function of properties such as well depth and circulation rate. Furthermore, we use these results to estimate the amount of the net power produced by the generator. We provide these estimates for a number of abandoned oil and gas wells in Mississippi that are located in regions with high geothermal gradients. Findings of this study are helpful in the assessment of the feasibility of this mode of energy production in the state of Mississippi and other regions with similar geothermal potential and accessibility to abandoned deep wells.
https://youtu.be/ebfMJBq9AgI

92
Name: David Simpson
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker, Aerospace Engineering
Project Category: Physical Sciences and Engineering

REU/ Research Program: Raspet Flight Research Laboratory

Agricultural Aircraft Characterization and Statistical Analysis

Unmanned Aircraft Systems (UAS) trying to integrate into the current National Airspace (NAS) face many problems technically. Outside of the technical issues, the Federal Aviation Administration (FAA) is trying to pave a roadmap for commercial and private UAS operators to safely join the current airspace. One of the few remaining holes in aircraft modelling is due to agricultural aircraft flying too low to be picked up by major radar. This senior seminar seeks to assist Raspet Flight Research Laboratory in characterizing the agricultural aircraft population as well as performing statistical analysis to help other universities model more accurately this type of airspace. This project used a dataset of over 28000 flight logs that spanned over 49000 hours to characterize and develop a flight model for agricultural aircraft. While the current iteration of this model has limitations, it will prove useful for further aircraft modelling and encounter simulations.
https://youtu.be/S4Q2t7ll1FA

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Name: Brandon Sorrell
Major: Wildlife, Fisheries, and Aquaculture
Faculty Advisor, Affiliation: Peter Allen, FWRC- Wildlife, Fisheries & Aquaculture
Project Category: Biological Sciences and Engineering
Co-Author(s): Orion Rivers

The plasticity of the alligator gar gills

The alligator gar, *Atractosteus spatula,* is a bimodal breather, absorbing dissolved oxygen through its gills and atmospheric air through an air-breathing organ called the swim bladder. These adaptations allow them to inhabit low dissolved oxygen environments. They are also a euryhaline species; their gill physiology allows them to live in a wide variety of environments ranging from freshwater to saltwater. The gill is a multifunctional organ, with primary functions of gas exchange, ionic regulation, acid-base regulation, and osmoregulation. Although the alligator gar can occupy a wide range of habitats, there is little understanding of the role of environmental adaptation by the gills. The main goal of this study was to evaluate the gill anatomical structures that facilitate its environmental plasticity. To gain this understanding, alligator gar were acclimated to fresh water (0 ppt) or saline water (20 ppt) for over 4 weeks. Fish from both groups were euthanized and gills were extracted via dissection. Multiple filament and lamellae samples were placed in aldehyde-based fixatives and washed in a series of chemical buffers in preparation for scanning or transmission electron microscopy (SEM or TEM, respectively). Using SEM, the external surfaces of the gill filament and lamellae were examined. Using TEM, internal cellular structures of epithelial cells were examined. Images were taken to characterize the diversity of structures and to understand their function. In freshwater gar, there were chloride cells with numerous microvilli extending outwards, generally located on the gill filaments near the insertion of the

lamellae. In saltwater gar, chloride cells were recessed, with chloride channels and button cells present over the filament surface. In both cases, these cells are important for maintaining internal osmotic, ionic, and acid-base levels. These findings elucidate the plasticity of cellular gill responses to external salinity change in alligator gar, and provide adaptive comparisons with ancestral, teleost, and bimodal breathing fishes.
https://youtu.be/mDtky9VrOCA

132
Name: DistaniD Standifer
Major: Educational Psychology
Faculty Advisor, Affiliation: Kasia Gallo, Counseling, Educational Psychology, and Foundations
Project Category: Social Sciences

Influences that Affect One's Moral Development
Moral development is the emergence and change over the lifetime of an individual's attitudes and actions towards others in society. It is influenced by people's interactions with others and the consequences of their actions. This literature review synthesizes 15 recent, peer-reviewed empirical studies investigating the influences of culture, religion, and parenting on one's moral development. The moral beliefs of participants of the reviewed studies have been investigated both through analyses of their beliefs and their behaviors. The number of participants varied across the studies between 200 and 264,617. Participants' age ranged from 7 to 50; male and female participants provided data for analyzes. Most literature focused on children and young adults, but some studies included parents' perspectives as well. Most participants were white, but studies were conducted all over the world.
Each study used similar approaches including surveys that measured participants' personalities and evaluated how moral development occurs in each culture, or across cultures. Findings suggested that individuals in different cultures may display dissimilar moral perspectives and reasoning. Culture and religion explained socio-cognitive skills differences in cultural groups with high levels of moral reasoning. The guidance of parents and mentors helps shape children's perspectives on the world. In one study, Spanish adolescents scored higher on self-interest while Turkish adolescents scored higher on empathy. Research suggests that children learn from their parents while coexisting with separate cultures of their peers; two additional influential forces are culture and religion. Further research should focus on the influences of teachers. This information would illuminate the effects of the environment outside of parental guidance. Additionally, since parental guidance affects the child's moral development, research is lacking on multigenerational influences including grandparents. Lastly, many studies would have benefitted from more diverse samples.
https://youtu.be/wdu1BCBcnIs

54
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Project Category: Biological Sciences and Engineering
Co-Author(s): Isabel Schlegel Werle, Shandrea Stallworth, Carolina Pucci de Moraes, Xin Ye, Brenton Breland, Shaun R. Broderick, Te-Ming Tseng
REU/ Research Program: Undergraduate Research Scholars Program

Using soil steaming for weed management and increased profitability of organic tomato production.

Weed suppression is a growing problem in the tomato production industry. Weeds such as yellow and purple nutsedge, large crabgrass, and Palmer amaranth contribute to the largest yield losses in tomato. This study aimed to explore the effectiveness of soil steaming as a method of weed management in organic tomato production. These experiments were conducted at the Mississippi Agricultural and Forestry Experiment Station's Truck Crops Branch (MAFES Truck Crops Branch) in Crystal Springs, MS. A randomized split-plot experimental design was used, consisting of six treatments and three high-tunnel replications. A mixture of yellow nutsedge, large crabgrass, and Palmer amaranth was sown into each plot at 20 plants m^{-2}. Two days later, each plot was steamed at a temperature of approximately 82ºC for treatments of either 0, 5, or 20 minutes. Weed cover, plant height, and fruit yield were monitored. The highest percent of weed coverage was found in treatments with 0 minutes of soil steaming, recording 55% weed coverage consisting mostly of yellow nutsedge. The difference in plant heights of mulched treatments versus non-mulched was 8 cm on average and about 5 cm in steamed (5 or 20 minutes) versus non-steamed treatments. Mulching and soil steaming treatments (5 and 20 minutes) resulted in a 46 and 57% increase, respectively, in total crop yield. This study primarily shows that soil steaming-- even as little as five minutes-- is an effective method for weed suppression in commercial tomato production, successfully providing a more sustainable and environmentally safe method of weed control.
https://youtu.be/jtMrM8yM0Tw

135
Name: Georgiana Swan
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Project Category: Social Sciences
Co-Author(s): Taylor Ray, Megan Stubbs-Richardson, Ben Porter, Shelby Gilbreath, Mary Margaret Mitchell, Sujan Anreddy, J. Edward Swan II
REU/ Research Program: National Science Foundation Rapid Grant

An Examination of COVID-19 scams and misinformation on social media and forums

Misinformation and scams are a huge problem on social media platforms which erodes trust in our democracy and professionals in every field. The purpose of our team's study is to analyze the prevalence of scams, misinformation, and counter misinformation related to the COVID-19 pandemic and the COVID-19 vaccine rollout across 6 social media and forums platforms. Our team aimed to examine the vaccine rollout because of the increased amount of misinformation surrounding this topic. Also, many earlier scams and misinformation related to COVID-19 have either been removed by the platform or have a warning label. In order to study these phenomena, the computer science team collected posts from YouTube, Twitter, Parler, Tumblr, Reddit, and 4 Chan from December 1st through January 31st. Five coders on our team each coded 700 randomly selected posts. Our team created a codebook that has 8 categories: relevance, news, general misinformation on COVID-19, countering general misinformation on COVID-19, misinformation on the COVID-19 vaccine, countering COVID-19 vaccine misinformation, general cybercrime related to COVID-19, and cybercrime related to the COVID-19 vaccine. Based on our coding, the team's graduate research assistant ran a Multinominal Naïve Bayes on the remaining data. This type of Machine Learning answers the question, "what is the probability that the selected post fits into each category?" Our findings show that our coders agreed the most on relevance and disagreed the least on countering vaccine misinformation. However, due to using the Machine Learning software the coders were not able to follow website links. Our team suggests that future researchers should follow links for more context. Our coding team also has more posts to code, so our inter-rater reliability should increase. This study contributes to the misinformation literature because it combines qualitative and quantitative data and examines multiple platforms at once.
https://youtu.be/fUV7SNkJOYM

38
Name: Madison Taylor
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Dr. Steve Elder, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
REU/ Research Program: Bagley College of Engineering Undergraduate Research Program

Fibrin Gels Containing Decellularized Extracellular Matrix Microparticles for Cartilage Regeneration

Decellularization of tissue removes cells and immunogenic materials, leaving the components that reside outside of the cell, collectively called the extracellular matrix (ECM). The ECM provides signals for cell behavior, and each tissue type has a unique composition. These signals can direct cell proliferation and differentiation. Previously, meniscus microparticles were mixed with cells to determine the efficiency of tissue growth. Microparticles are used due to an increased ability to fill in between cells and an easily moldable construct to implant in cartilage defects within joints. Histology results showed that new ECM secretion occurred with combination of decellularized ECM (dECM) and murine osteoblast precursor cells

(MC3T3). This serves as reasoning to pursue further studies incorporating dECM in biomaterials. dECM is being incorporated into fibrin gel scaffolds. Combining two components of plasma, fibrinogen and thrombin, results in gelation of fibrin. Fibrin gels were constructed based on published protocol by Murphy and Leach and mixed with dECM to compare to control fibrin gels without any dECM. Incorporation of dECM in the fibrin gels was found to decrease gelation time and improve mechanical properties. Also, this study demonstrated the efficiency of a process to create microparticles from decellularized tissue, and the amount of DNA after decellularization was determined. Moreover, a novel protocol for creating fibrin gels containing dECM with a double barrel syringe was established. The double barrel syringe is anticipated to be useful in filling in cartilage defects, particularly during a microfracture procedure in which stem cells are allowed into the injury site to encourage new tissue formation.
https://youtu.be/-EjJt8vHHbE

33
Name: Landon Teer
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Lauren B. Priddy, Agricultural and Biological Engineering, Wenmeng Tian, Industrial and Systems Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Weitong Chen, Mahathir Bappy, Kailey Clinton
REU/ Research Program: MSU Office of Research and Development, National Science Foundation

Geometric Accuracy Characterization of 3D Printed Composite Scaffolds in Bone Tissue Engineering

3D printing has shown significant potential in fabricating patient-specific organs and tissues with great flexibility in geometry, mechanical, and biological properties. In bone tissue engineering, 3D printing can be used in treating large bone defects due to injury or illness. Composite materials made of polymer and ceramic have been shown to be especially effective in mimicking bone mechanical properties and accelerating osteogenesis. By varying material components, concentration, morphology/molecular structure, etc., the composite material demonstrates significant variability in material viscosity, mechanical, and biological properties. Therefore, there is an urgent need in integrating experimental investigation and mathematical modeling to describe the complex relationship between scaffold geometric accuracy and input variables and process setup variables. Poly (lactic-co-glycolic acid) (PLGA) and nano hydroxyapatite (nHA) were chosen as materials due to their well-known biocompatibilities and superior ability to be mixed in solution. The PLGA and nHA were mixed in 1,4 dioxane, freeze dried, and ground up before being printed. In this study, the parameters of interest included printing temperature, pressure, and speed, and three levels were determined based on preliminary experiments. A full factorial design was used, and 27 experiments were conducted. In each

experiment, three struts were printed using the BIO X 3D printer and layer-wise images were captured. The images were analyzed and the thickness of the struts over length extracted as curves. Subsequently, Principal Component Analysis (PCA) was applied to reduce the dimensionality of the curves. Low dimensional functional features were used as response variables in the regression model where temperature, pressure, and print speed were used as predictors. The results serve as a significant step for design and optimization for 3D printed composite scaffold geometric accuracy optimization.
https://youtu.be/r0u_ODaRRDU

67
Name: Langston Thompson
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Calvin Walker, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Designing an Effective Recon Quadcopter for Special Missions

This project is to design a recon drone for reconnaissance for military and police powers. A quadcopter is a four-rotor helicopter that produces thrust to lift the automaton up. It is usually utilized for observation for some law implementations. It is great for reconnaissance and stealth. During this project, funding is very limited so the design of the drone will not happen. However, the planning process will be shown. Also, a cheaper attainable drone with the necessary requirements will be used to determine performance and understand endurance in a quadcopter. A quadcopter has been known to have poor endurance and that is a roadblock that must be overcome in order to meet requirements.
https://youtu.be/hPr2Ml1cEAc

114
Name: Quyen Tran
Major: Chemical Engineering
Faculty Advisor, Affiliation: Neeraj Rai, Chemical Engineering
Project Category: Physical Sciences and Engineering
Co-Author(s): John Michael Lane, Woodrow Wilson
REU/ Research Program: Department of Energy project code: DE-SC0018211

Bader Charge Analysis of Model b-O-4 Lignin Dimers: Preliminary Calculations for Hydrogenolysis on Ni@MWW-2D

Lignin has gained great attention as a possible renewable source of aromatic compounds and fuels. However, due to its complex structure, resistance to chemical treatment, and variance among different sources of biomass, lignin depolymerization into value added chemicals and fuels is challenging. Metal nanocluster supported zeolites have shown success experimentally as a possible catalytic surface to cleave the aryl-ether linkages in lignin via hydrogenolysis.

However, there remains a lack of fundamental, molecular level understanding for how the hydrogenolysis of lignin reaction mechanism proceeds. In this computational study, we perform use Bader charge analysis to calculate the charge distribution of four representative b-O-4 lignin dimers. These are preliminary calculations for using the charge density to explain the hydrogenolysis reaction mechanism of the dimer upon adsorption onto the surface of a Ni13 nanocluster supported MWW nanosheet catalyst. As adsorption is the first step in a heterogeneous catalytic reaction, and catalysts manipulate the charge density of a substrate prior to a reaction, understanding the charge distribution prior to adsorption this is the first step to explain how the reaction mechanism proceeds. First principles simulations were carried out with the Vienna Ab initio Simulation Package (VASP5.4.4) at the PBE+D2 level of theory to achieve preliminary results and include dispersion interactions. As seen from the Bader analysis, dimers consisting of two guiacyl monomer units have more negative charge on the hydroxy oxygen atom on the a Carbon. This indicates that the hydroxy oxygen will become protonated upon adsorption onto the catalyst and will lead to cleavage of the b-O-4 bond, and the GG dimer will have the lowest activation energy barrier. Future work will be done analyzing the charge distribution by using a more in-depth level of theory, observing the impact of common solvents for lignin extraction, and analyzing the impact of adsorbed hydrogen."
https://youtu.be/D38ryy7hJR8

127
Name: Bailey Tullos
Major: Psychology
Faculty Advisor, Affiliation: Dr. Danielle Nadorff; Department of Psychology
Project Category: Social Sciences
Co-Author(s): Acacia Lopez

Household Chaos and its Connection to Anxiety and Depression in Children Raised by Grandparents

In the United States, 4.4 million children aged 3-17 have been diagnosed with anxiety and 1.9 million have been diagnosed with depression. Previous literature links household chaos to negative outcomes in children, including anxiety and depression. Additionally, kincare households have been found to be more susceptible to chaos than non-kincare households. Kincare refers to children who are taken care of by a family member other than their biological parent, typically a grandparent. As of 2019, 6.2 million children in the U.S. are under the primary care of their grandparents, or in kincare. This project examines the relation of household environments and children's anxiety and depression between kincare households and non-kincare households. Participants included grandparents (*N* = 88) and biological parents (*N* = 3,403) from Wave 15 of the Fragile Families & Child Well-Being Study who completed self-report measures on household environment and mental health outcomes for their dependent children. Moderation analyses were conducted using Model 1 of SPSS' PROCESSv3.5 Module, with household chaos as the independent variable, anxiety and depression as dependent variables, and caregiver status as the moderator variable. Caregiver

status moderated the relation between household chaos and depression in children (F(3, 3032) = 5.064, p = .002), with grandparent-headed households showing a positive correlation between the variables (t = 3.34, p <.001), but no relation biological parent-headed households (t = 3.34, p = .511). Caregiver status also moderated the relation between household chaos and anxiety in children (F(3, 3032) = 3.925, p = .008), with a positive correlation for both grandparent-headed households (t = 2.74, p <.01) and parent-headed households (t = 2.03, p <.05). Results suggest that household chaos impacts children in many contexts, including non-traditional families. Implications include the need for targeted interventions using psychoeducation aimed at minimizing household chaos.
https://youtu.be/2W-BSMpnBmw

84
Name: Britt Wade
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Rani Sullivan, Aerospace Engineering
Project Category: Physical Sciences and Engineering

Permeability Study of Stitched Composites with 3D Printed Liner
The purpose of this study is to remedy the issue of stitched carbon fiber composites permeation degradation with repeated thermal cryogenic cycles. The method used is 3d printing a PET-G liner and attaching it to the carbon fiber specimen and testing the difference in permeation. Many attempts were made to have the liner printed directly onto the carbon fiber specimens, but the adhesion was imperfect, and would have failed immediately in testing. Therefore, the focus of the experiment shifted to investigating the characteristics of different adhesives partnered with permeation testing the best specimens. The experiment was overall successful in improving the permeation characteristics of the specimen. The change in adhesion technique, however, makes it difficult to tell which component, the epoxy or the liner, is more responsible for the improvement in permeation.
https://youtu.be/-bd2Mnc7fJk

140
Name: Katelin Waldrep
Major: School of Human Sciences
Faculty Advisor, Affiliation: Dr. Carley Morrison, Dr. Kirk Swortzel; School of Human Sciences
Project Category: Social Sciences
Co-Author(s): Leah Gann

What Do We Know? An Ag Literacy Study
Although technology and education techniques concerning agriculture literacy have improved drastically over the last 35 years, research indicates that the disconnect between the agriculture industry and consumers is a growing concern. In an effort to bridge this gap

between producer and consumer, there must be an increase of agricultural education efforts throughout communities, specifically, with college students. This demographic is steadily overlooked throughout agriculture education research efforts. It is vital for the future of the agriculture industry that the next generation of consumers are well educated and informed citizens. In this pilot study, we surveyed the undergraduate students enrolled in the College of Forest Resources (CFR) at Mississippi State University to determine if prior exposure to agriculture impacts their food purchasing perceptions. Of the 63 voluntary responses (n = 63) received, we found that community of origin, news sources, prior involvement in agriculture, the impact of agriculture on their daily life, and knowledge of agriculture had statistically significant (p < .05) impact on CFR undergraduate students purchasing perceptions. These perceptions included health benefits, Genetically Modified Organisms, cage-free production, antibiotic use, pasture-raised, appearance, grass-fed, labeling, animal welfare, country of origin, plant-based and organically produced products. However, price, quality, naturally produced, vegan, appearance, and taste were not significantly influenced based on prior exposure to agriculture. These findings coincide with previous research suggesting that previous experience, subjective knowledge, and objective knowledge are the factors that influence consumer decisions. This study should be replicated with a larger sample size. Additionally, these variables should be narrowed into a more concise list to further examine specific impacts on college students purchasing decisions such as financial wellness.
https://youtu.be/ASYqHROf_-s

27
Name: James Warren
Major: Biomedical Engineering
Faculty Advisor, Affiliation: Steve Elder, Agricultural and Biological Engineering
Project Category: Biological Sciences and Engineering
Co-Author(s): Daniel Young, Matthew Ross, Steve Elder

Bioprinting and evaluation of PLGA-KGN scaffolds as an augmentation to microfracture

Microfracture is a commonly performed surgical procedure that aims to regenerate damaged cartilage in patients with focal cartilage lesions. Microfracture is fairly successful in lesions <2 cm^2, but the procedure is not practical for larger lesions due to the fibrocartilage generated, which is mechanically inferior and less durable than normal hyaline cartilage. The proposed augmentation to microfracture aims to improve its clinical outcomes by introducing a bio-printed poly(lactic-co-glycolic acid) (PLGA) scaffold functionalized with kartogenin (KGN), a small bioactive molecule known to induce mesenchymal stem cell differentiation into hyaline cartilage. The PLGA-KGN scaffold would be suitable for attachment to the defect site following microfracture. As PLGA naturally degrades in the body, the entrapped KGN would release and presumably influence mesenchymal stem cell differentiation. Functionalized scaffolds were created by mixing dissolved PLGA and KGN together, evaporating the solvent, and then grinding to form a powder that was then used in bioprinting. 10x10x1 mm scaffolds

were printed for KGN release experiments and dumbbell-shaped scaffolds for tensile testing. The scaffold's release characteristics were evaluated over 30 days by high performance liquid chromatography, which indicated the presence of KGN degradation products at each time interval and confirmed a sustained release of KGN from the scaffold. Tensile testing results indicate that the functionalization of PLGA with KGN has no significant impact on PLGA's elastic modulus or tensile strength, but it does significantly increase the polymer's overall toughness. Further research will aim to confirm the chondrogenic activity of released kartogenin in vitro using primary marrow-derived human mesenchymal stem cells. Chondrogenic influence of the proposed augmentation will also be evaluated in vivo using a rat model of knee microfracture.
https://www.youtube.com/watch?v=vk4ikXSOzL8

150
Name: Thad Webb
Major: Environmental Economics and Management
Faculty Advisor, Affiliation: Dr. Shaun Tanger, Coastal Research and Extension Center; Dr. T. Eric McConnell, Forestry; Dr. Alan Barefield, Agricultural Economics
Project Category: Social Sciences

Analyzing the Contribution of Consulting Foresters to Mississippi Economies
We used three comprehensive databases to innovatively assess economic activities at as granular a level as possible in the *Foresters Consulting* component of *Support Activities for Forestry* in Mississippi. Emsi provided estimates by 6-digit NAICS codes and a geographic listing of businesses by NAICS codes that contained employment, earnings, and sales data. Esri further categorized the 6-digit NAICS codes into 8-digit codes, thus providing a more detailed view of this sub-sector's businesses. However, since this listing does not comprehensively tabulate all businesses of each classification within a geographic area, we developed an innovative weighting method to estimate output, jobs, and earnings for *Foresters Consulting* (ESRI-NAICS classification 11531004) using Emsi data. USDA Forest Service Forest Inventory and Analysis (FIA) sub-regional IMPLAN models were then shocked with these results to determine economic contributions. The North possessed larger estimates for employment, labor income, and value-added, while the South's output was greatest. The Delta's low levels of activity were expected given the region's dedication to row crop production. Central Mississippi also produced lower activity levels, as its more urban and suburban geography contains less commercial forestland. *Foresters Consulting* employed 535 direct jobs with earnings of $29,981,000 in Mississippi. These businesses provided $25,409,000 in value added on output of $53,274,000. When added to the economic "spillover" benefits (the indirect and induced effects) total employment was 703 jobs that earned $36,460,000. The contribution to state Gross Domestic product was $37,756,000 on sales of $76,642,000. Federal and state tax contributions collectively exceeded $13,000,000.
https://youtu.be/DoTFqfD_Mg4

17
Name: Benjamin Wheeler
Major: Microbiology
Faculty Advisor, Affiliation: Dr. Shecoya White, Food Science, Nutrition, and Health Promotion
Project Category: Biological Sciences and Engineering
Co-Author(s): Kyla Asher, Dr. Shecoya White
REU/ Research Program: Mississippi Agricultural and Forestry Experiment Station Special Research Initiative, Mississippi State University Undergraduate Research Scholars Program

Efficacy of Lemon Essential Oil Added to Marinade on Spoilage Microbiota of Chicken Tenders
Every year in America $218 billion, or 1.3% of the nation's Gross Domestic Product, is spent on the transport and production of food that is never eaten. This is a huge waste of time, money, and nutrition contributing to global food waste. Due to Covid-19 there was a shift from consumers ability to eat out at restaurants to transitioning to cooking at home and increased purchasing of pre-marinated products. Marination has the potential to enhance flavor, quality, extend shelf-life and limit both spoilage and pathogenic microorganisms, reducing food waste. Lemon oil, a natural antimicrobial, has been used to extend shelf-life of various food products. In the present study, lemon oil was incorporated into a marinade for chicken tenders that were stored refrigerated (4℃). Ten-gram samples of chicken tenders stored in sterile bags. Samples were treated in a few different ways: marination for either half an hour or 2 hours with a marinade containing 0, 1, or 2% lemon essential oil, or no marination. Samples were then stored at 4℃ for nine days. On days 1, 3, 5, and 9, samples were plated onto Aerobic Plate Count (APC) Petrifilm™, to determine total plate count. After incubating for 48 hours at 34℃, colonies were counted and CFUs (colony forming units) were determined. Results showed that all of the marinade treatments were effective at inhibiting the growth of the background microbiota of the chicken tenders compared to the control. All marinades extended the date of spoilage by at least 5 days. The pH and microbial growth on the unmarinated chicken were appreciably different from those of the various marinated samples, but the marinated samples were not different among themselves. All the marinades kept microbiota populations close to constant while the unmarinated chicken's microbiota grew by over 5 log. All the marinades extended extended the date of spoilage by at least 5 days. This study shows that even though neither the lemon essential oil didn't provide a synergistic or additive effect to the base marinade, our specific combination of ingredients in the marinade inhibited growth of spoilage microorganisms.
https://www.youtube.com/watch?v=MSHzlzP0ggQ

94
Name: Grace Williams
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Dr. Rani Sullivan, Mr. Robert Wolz, Aerospace Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: NASA Space Grant

Determination of Mechanical Properties of Sandwich Composite Components

Determining the mechanical properties of sandwich composite components is necessary to produce a reliable finite element model. Materials that are commonly used in the aerospace industry will be tested and their mechanical properties will be experimentally obtained by using a digital imaging correlation system. The mechanical properties that are determined from the testing can then be compared to the provided manufacturers properties. Tensile tests are performed on the carbon fiber/epoxy specimen, and compression tests are performed on the polymethacrylimide foam core specimen. The results for the tensile tests are consistent and they show very little standard deviation between the calculated mechanical properties of the three carbon fiber/epoxy specimen. The results for the compression tests are also consistent and they show very little standard deviation between the calculated mechanical properties of the five polymethacrylimide foam specimens. The mechanical properties that are obtained for both of the specimen are also similar to the mechanical properties provided by the manufacturers. The experimentally obtained mechanical properties are consistent and can be used to create a reliable finite element model.

https://youtu.be/jnNIJg46-4w

97

Name: Harrison Williams
Major: Aerospace Engineering
Faculty Advisor, Affiliation: Matthew Priddy, Department of Mechanical Engineering
Project Category: Physical Sciences and Engineering
REU/ Research Program: Center for Advanced Vehicular Systems

Cellular Automata Simulation for Microstructural Estimation during Wire-Arc Additive Manufacturing

Computationally efficient microstructure estimation endows a deep understanding of mechanical properties, enabling the development of next-generation materials. Microstructures are generated by repetitive heterogeneous thermal cycling in the additive manufacturing (AM) process, so mesoscale modeling efforts are necessary for microstructure prediction and control. In this study, the cellular automata (CA) method is used to model and simulate metallurgical processes at the mesoscale level. The simulation of metallurgical phenomena such as recrystallization is determined upon but not limited to grain size/shape, morphology, and phase volume fraction. The CA state transition is proven to predict the nucleation process with separate states for each of the properties mentioned above while remaining stochastic. CA has an intrinsic advantage of the calibration to time and length scale making the method more practical than the alternative Vertex, Monte Carlo, and Phase Field methods. However, CA's most significant characteristic is its ability to remain computationally inexpensive as simulation sizes grow. This ability makes it essential to have a scalable CA library that can couple with macroscale methods to create a multi-scale framework. The CA library for supercomputers and high-performance computing systems, CASUP, is built with Fortran coarrays and MPI. The three-dimensional integer array coarray fits the intended

three-dimensional CA cubic cells, making the Fortran coarray decision inherent to the project. In this study, the coupling of the CA finite element method (CAFE) and CA crystal plasticity finite element method (CACPFEM) will be applied to create a three-dimensional multi-scale framework to estimate the hot deformation of the AM process.
https://youtu.be/igJScQs6Zj0

142
Name: Kristin Williford
Major: Food Science, Nutrition, and Health Promotion
Faculty Advisor, Affiliation: Rahel Mathews; Food Science, Nutrition, and Health Promotion
Project Category: Social Sciences
REU/ Research Program: USRP

Food Insecurity and Anxiety Among Mothers During COVID-19
Introduction: Food insecurity is one of the top nutrition issues in the country. When COVID-19 spread across the United States in March 2020, food banks, schools, and many food assistance programs became restricted and many closed down. Grocery store food and supplies also became limited, leading to increased rates in food insecurity and anxiety.
Purpose: To describe the food insecurity and anxiety that mothers experienced during the COVID-19 pandemic in Mississippi when grocery shopping.
Methods: A Qualtrics survey was sent out to teachers, staff and parents/guardians of children enrolled in Head Start centers on the Mississippi Gulf coast. For this study, participants had children under the age of 18 in their household. Questions measuring worries about food insecurity were asked on a Likert scale.
Results: Findings show that of the 43 mothers who responded to the survey, 9.4%(n= 4) reported that before March 2020, they often worried if their food would run out before they could afford to buy more, as compared to 25.6%(n= 11) after March 2020. Additionally, 34.9%(n=15) of the participants stated that they were worried about grocery stores running out of food, while 48.9%(n=21) were worried that grocery stores would close down altogether.
Discussion: Mothers responded with increased worries regarding food insecurity during the COVID-19 pandemic, which has also been cited in previous research. There are potential limitations to these results due to the small sample size.
Conclusion: Food insecurity and anxiety reportedly increased among families during the COVID-19 pandemic. Continuing to provide food assistance programs can be beneficial.
https://youtu.be/X4CS3N1sVi8

141
Name: Khirsten Wilson
Major: Psychology
Faculty Advisor, Affiliation: Dr. H. Colleen Sinclair, Psychology
Project Category: Social Sciences

Co-Author(s): Jessica Utley

Bystanders to Bullying: Coping Mechanisms Involved in Challenging Hostile Workplace Dynamics

A wide variety of research is dedicated to examining the long-term effects of peer-to-peer bullying and social-emotional development in victims of bullying later in life. This study is intended to analyze conditions in which individuals would be more likely to intervene or employ coping mechanisms in workplace bullying. Two conditions will be analyzed in which a response to peer-to-peer bullying is recorded and when a power differential, such as boss-coworker, is present and when it is absent. It is hypothesized that individuals will be more likely to intervene when the bully and the victim are equals in comparison to the presence of a power differential. Approach Coping and Avoidance coping are two general types of coping mechanisms that will be used to measure when participants choose not to intervene or avoiding contact with the bully. Essentially, this research and further research studies can contribute to awareness of workplace bullying and provide a basis for the encouraging positive intervention in work environments.
https://youtu.be/3mv-Ju2BLuo

120
Name: Timothy Wunrow
Major: Industrial Engineering
Faculty Advisor, Affiliation: Haifeng Wang, Industrial and Systems Engineering
Project Category: Physical Sciences and Engineering

Unsupervised Abnormal Event Detection from Multidimensional Time Series Data

This research project is to study unsupervised learning models for abnormal event detection in time series data. This anomaly detection method can be used on vehicle sensor data to help operators identify potential failures and start maintenance before they occur. Moving average and autoregressive integrated moving average (ARIMA) models can be used to predict time series data and therefore determine when anomalies occur. In this research, moving average and ARIMA models were used on synthetically generated data to determine whether they could accurately predict anomalies. Multiple methods of identifying anomalies were tested and the results were compared to previous research. The ARIMA model using RMSE to find anomalies was found to be accurate, while the moving average model and ME technique for identifying anomalies were very inaccurate.
https://youtu.be/RLZLuGWtMY4

46
Name: Peyton York
Major: Biochemistry
Faculty Advisor, Affiliation: Dr. Andrew Lawton, Biological Sciences

Project Category: Biological Sciences and Engineering
Co-Author(s): Dr. Andrew Lawton

Differential-Expansion and Cerebellar Brain Folding

During development, the brain expands and folds creating beautiful gyri that compartmentalize the functional circuitry. In the cerebellum, the hindbrain element, folding arises during development due to differences between the expansion rates of the outside, the external granule layer, and the inside core of the cerebellum. This type of growth is called differential-expansion. Folding reaches completion after the first postnatal week, yet growth continues without any new folds. We hypothesize that in the second postnatal week the cerebellum starts a period of balanced expansion. We predict this is achieved by decreasing the rate of outer growth as it is known that the external granule layer depletes in this time. The rate of inner core expansion may also increase with the onset of myelination. Additional experiments will be performed to research other factors contributing to the regulation of folding termination. This work will provide insight into human disorders hat present with folding malformations.
https://youtu.be/ZRd65qlNee8

Thank you to the Judges for their help with the Spring 2021 Undergraduate Research Symposium

Seung-Joon	Ahn	Biochemistry, Molecular Bio, Entomology, & Plant Pathology
Amin	Amirlatifi	Chemical Engineering
Sujan Ranjan	Anreddy	Social Science Research Center
John	Ball	Electrical & Computer Engineering
Raju	Bheemanahalli Rangappa	Plant & Soil Sciences
Becky	Bickford	Library
Devon	Brenner	Office of Research and Economic Development
Harish	Chander	Kinesiology
Keith	Chenier	Wildlife, Fisheries, & Aquaculture
Whitney	Crow	Biochemistry, Molecular Bio, Entomology, & Plant Pathology
Maleesha	De Silva	Chemistry
Marina	Denny	Human Sciences
Mary	Dozier	Psychology
Deborah	Eakin	Psychology
Katie	Echols	Research Initiatives & Innovations
Saman	Fatemi	Poultry Science
Shankar	Ganapathi Shanmugam	Institute for Genomics, Biocomputing & Biotechnology
Vicki S.	Gier	Psychology, Meridian
Zachary	Gillen	Kinesiology
Lynn	Holt	Philosophy & Religion
Joonsik	Hwang	Mechanical Engineering
Godfred	Inkoom	Physics & Astronomy
Jenna	Johnson	Industrial & Systems Engineering
William	Kingery	Plant & Soil Sciences
Caroline	Kobia	Human Sciences
Nisarga	Kodadinne Narayana	Institute for Genomics, Biocomputing & Biotechnology
Rabina	Kumpakha	Biological Science
Deborah	Lee	Library
Shien	Lu	Biochemistry, Molecular Bio, Entomology, & Plant Pathology

Erdogan	Memili	Animal and Dairy Sciences
Maryam	Mirabolghasemi	Chemical Engineering
Raheleh	Miralami	Center for Advanced Vehicular Systems
Deb	Mlsna	Chemistry
Ayoub	Mousstaaid	Poultry Science
Anna	Osterholtz	Anthropology & Middle Eastern Cultures
Chanyeop	Park	Electrical and Computer Engineering
Amanda	Patrick	Chemistry
Harun	Pirim	Industrial & Systems Engineering
Sorina	Popescu	Biochemistry, Molecular Bio, Entomology, & Plant Pathology
Ben	Porter	Social Science Research Center
Prabhakar	Pradhan	Physics & Astronomy
Neeraj	Rai	Chemical Engineering
Kari	Reeves	Industrial & Systems Engineering
Binod	Regmi	Physics & Astronomy
Hailey	Ripple	Counseling, Educational Psychology, & Foundations
Sathish	Samiappan	Geosystems Research Institute
Lashan	Simpson	Agricultural and Biological Engineering
Hallie	Smith	Counseling, Educational Psychology, & Foundations
Christopher	Snyder	Shackouls Honors College
Bob	Swanson	Physics and Astronomy
Bradley	Thornton	Wildlife, Fisheries & Aquaculture
Zhenhua	Tian	Aerospace Engineering
Wenmeng	Tian	Industrial & Systems Engineering
Hossein	Toghiani	Chemical Engineering
Haifeng	Wang	Industrial & Systems Engineering
Yibin	Wang	Industrial & Systems Engineering
Elaine	Wei	Counseling, Educational Psychology, & Foundations
Shecoya	White	Food Science, Nutrition & Health Promotion
Yizhi	Xiang	Chemical Engineering

congratulations

MISSISSIPPI STATE UNIVERSITY

TO OUR SPRING 2021 UNDERGRADUATE RESEARCH SYMPOSIUM WINNERS!

Arts and Humanities

1st Place - Joseph Newell: Dickinson, Displacement, and her use of Defense Mechanisms to Cope with Psychological Trauma (Mentors: Dr. Lara Dodds and Dr. Dhanashree Thorat, English)

2nd Place - Lindsey Downs: Loss, Reckless Behavior, and Jane Austen's Realism in *Sense and Sensibility* and *Persuasion* (Mentor: Dr. Kelly Marsh, English)

Biological Sciences and Engineering

1st Place - Reese Dunne: Development and Implementation of a Magnesium-Based Finite Element Degradation Model for Orthopedic Implants (Mentor: Dr. Matthew Priddy, Mechanical Engineering)

2nd Place - Hannah Scheaffer: The Interference of PGD2 in the IL4 Anti-Inflammatory Pathway in THP1 Macrophages (Mentor: Dr. Matthew Ross, Comparative Biomedical Sciences, Center for Environmental Health Sciences, College of Veterinary Medicine)

3rd Place - James Warren: Bioprinting and evaluation of PLGA-KGN scaffolds as an augmentation to microfracture (Mentor: Dr. Steve Elder, Agricultural and Biological Engineering)

3rd Place - Sarah Hobbs: Characterization of Antifungal Activity of Strain A against aflatoxin producer *Aspergillus flavus* (Mentor: Dr. Shien Lu, Biochemistry, Molecular Biology, Entomology, and Plant Pathology)

3rd Place - Anna Gamblin: Annual Coastal Bird Community Response to Natural Vegetation Succession on Dredge-Spoil New Round Island (Mentor: Dr. Raymond Iglay, Wildlife, Fisheries, and Aquaculture)

Physical Sciences and Engineering

1st Place - Hailey Jamison: Sorption of As(III) Using Fe3O4 Nanoparticles Dispersed on *Guadua chacoensis* Bamboo (Si-char) and Its Redox Transformations (Mentor: Dr. Todd Mlsna, Chemistry)

2nd Place - Nirmal Bhatt: Thermo-Mechanical Modeling of Tubular Receivers for Solar Energy Storage (Mentor: Dr. Like Li, Mechanical Engineering)

3rd Place - Grace Williams: Determination of Mechanical Properties of Sandwich Composite Components (Mentors: Dr. Rani Sullivan and Mr. Robert Wolz, Aerospace Engineering)

3rd Place - Nathan Frey: Computational analysis of benzene-fused and extremely twisted pyrene-fused N-heterocyclic germylenes and boranes (Mentor: Dr. Edwin Webster, Chemistry)

3rd Place - James Dye: Acoustic Levitator in Motion (Mentors: Dr. Zhenhua Tian and Dr. Jichul Kim, Aerospace Engineering)

Social Sciences

1st Place - Emily Davis: Implementing Empathy in Future Healthcare Workers: Injury and Illness (I2) Simulation (Mentors: Dr. David Buys, Mrs. Ann Sansing, and Ms. Jasmine Harris-Speight, Food Science, Nutrition, and Health Promotion)

2nd Place - Nicole Mejia: Do You Care about Clutter?: Hoarding and Apathy (Mentor: Dr. Mary E Dozier, Psychology)

3rd Place - Khirsten Wilson: Bystanders to Bullying: Coping Mechanisms Involved in Challenging Hostile Workplace Dynamics (Mentor: Dr. H. Colleen Sinclair, Psychology)

3rd Place - Maya McWilliams: Exploring the Relationship between Food Insecurity and Asthma in Mississippi (Mentors: Dr. Bizu Gelaye and Dr. Mary M. Wesley, Epidemiology, Harvard T. H. Chan School of Public Health, Delta Scholars Program)

Community Engagement Research Track

**Sponsored by the Center for Community-Engaged Learning

1st Place in Arts and Humanities - McKenzie Johnson: Ethical and Empathetic Research in Architectural Education (Mentor: Alexis Gregory, School of Architecture)

1st Place in Biological Sciences and Engineering - Cristina Griffith: Precision Agriculture Technologies for Small Farmer Adoption (Mentors: Dr. Jeff Johnson and Dr. John Wes Lowe, Agricultural Economics and Agricultural & Biological Engineering)

1st Place in Social Sciences - Kristin Williford: Food Insecurity and Anxiety Among Mothers During COVID-19 (Mentor: Dr. Rahel Mathews, Food Science, Nutrition, and Health Promotion)

Public Health Research Competition

**Sponsored by the Department of Food Science, Nutrition and Health Promotion

1st Place - Nicole Mejia: Do You Care about Clutter?: Hoarding and Apathy (Mentor: Dr. Mary E Dozier, Psychology)

2nd Place - Amy Pham: The Relationship between Obesity and Sleep Quality in College Women (Mentors: Dr. Terezie Tolar-Peterson and Nicole Reeder, Food Science, Nutrition, and Health Promotion)

3rd Place - Emily Davis: Implementing Empathy in Future Healthcare Workers: Injury and Illness (I2) Simulation (Mentors: Dr. David Buys, Mrs. Ann Sansing, and Ms. Jasmine Harris-Speight, Food Science, Nutrition, and Health Promotion)

3rd Place - Katie Evans: Efficacy of Plant-Based Antimicrobial against Foodborne *Salmonella* spp. in Hummus Stored at Refrigerated and Abusive Temperatures (Mentor: Dr. Shecoya White, Food Science, Nutrition and Health Promotion)

Theta Tau Tomorrow Builder Award

**Sponsored by Theta Tau Professional Engineering Fraternity

Shanika Musser: Potential of biochar for the removal of waterborne microbial contaminants (Mentor: Dr. Benjamin Magbanua, Rula School of Civil and Environmental Engineering)

"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: