MID-SURE

MID-MICHIGAN SYMPOSIUM
FOR UNDERGRADUATE
RESEARCH EXPERIENCES

JULY 26 2023

ACKNOWLEDGEMENTS

The goal of the 13th annual Mid-Michigan Symposium for Undergraduate Research Experiences (Mid- SURE) at Michigan State University (MSU) is to provide a forum for undergraduates in the region to share their research and creative activities with the university community and beyond. Approximately 330 undergraduate students from over 100 different institutions presented their outstanding research and creative endeavors at Mid-SURE on July 26, 2023. These students are mentored by more than 350 faculty, staff, graduate students, and government or industry researchers.

Partnering Programs

Many of the student presenters participated in an MSU-sponsored summer research program. We would like to thank the following MSU programs for encouraging their students to present at Mid-SURE 2023:

- Advanced Computational Research Experience for Students (ACRES)
- BEACON Center for the Study of Evolution in Action
- Biomedical Research for University Students in Health Sciences (BRUSH)
- Bridge to PhD in Neurosciences Program (BPNP Endure)
- Building Bridges
- Communities and Future Earth Scientists (GeoCaFES)
- Cross-Disciplinary Training in Sustainable Chemistry and Chemical Processes (SCCP)
- Developmental Sciences Recruitment and Retention Program (DSRRP)
- Engineering Summer Undergraduate Research Experience (EnSURE)
- Great Lakes Bioenergy Research Center Summer Undergraduate Research Program (GLBRC SURP)
- Internships and Research Experiences at Kellogg Biological Station (KBS)
- Louis Stokes Alliance for Minority Participation Summer Undergraduate Research Academy (MI-LSAMP SURA)
- Michigan Diaries
- National Institute of Environmental Health Science Summer Research Program (NIEHS)
- Physics & Astronomy Research Experience for Undergraduates
- Plant Genomics Research Experience for Undergraduates
- Research Experience for Undergraduates in Structural and Functional Neural Biology (ASPET SURF)
- Sociomobility Research Experience for Undergraduates
- Summer Research Opportunities Program (SROP)
- Summer Undergraduate Research Institute in Experimental Mathematics (SURIEM)

Behind the Scenes

Mid-SURE would not be possible without a team of dedicated individuals in the Undergraduate Research Office who coordinate logistics, respond to inquiries, and support students and mentors. Many thanks to:

- Our undergraduate and part-time staff: Anapaola Almaguer-Morales, Katy Anderson, Maddie Cantrell, Binitha Chandrasena, Samantha Chavez Cortez, Marena Haidar, Luke Kolb, and Martina Yen
- Casie Chunko, Administrative Assistant for Academic Initiatives
- Heather Dover, Coordinator for Undergraduate Research and lead Mid-SURE organizer
- Mordecai Harvey, Assistant Director for Undergraduate Research
- Vanessa McCaffrey, Associate Director for Undergraduate Research
- Korine Wawrzynski, Assistant Dean, Academic Initiatives & Director, Undergraduate Research

We appreciate the work of numerous MSU assistant and associate deans for identifying faculty, staff, post-doctoral fellows, and graduate students to evaluate student presentations.

Finally, we thank the hundreds of dedicated mentors who guided the research projects and creative activities presented in this program book. We encourage you to learn about the impressive work of our next generation of scholars and researchers.

About the Cover

The cover art was designed by Katie White, ‘23 BFA in Graphic Design from the College of Arts & Letters, Department of Art, Art History, and Design.

TABLE OF CONTENTS

Undergraduate Research
MICHIGAN STATE UNIVERSITY

AGRICULTURE & ANIMAL SCIENCE

HONEY BEE (APIS MELLIFERA) POLLEN FORAGING ACTIVITY ON MICHIGAN BLUEBERRY FARMS AFFECTED BY WEATHER CONDITIONS

Presenter(s): Mia Bianchi (Michigan State University)
Agriculture & Animal Science
Mentor(s): Lauren Goldstein (College of Agriculture & Natural Resources), Rufus Isaacs (College of Agriculture & Natural Resources)

Honey bees play a crucial role in Michigan agriculture due to their effectiveness at pollinating fruit crops. A single honey bee hive can contain as many as 65,000 workers that forage for nectar and pollen in crop fields, facilitating pollination. Honey bee foraging activity during blueberry bloom can vary depending on weather conditions, with high heat and severe weather posing a threat to crop pollination. Increasing temperatures due to climate change will trigger blueberry bushes to flower faster and earlier in the season, and this may cause nutrient deficiency in honey bees if they are less likely to collect pollen. This may also lower blueberry crop yields due to insufficient pollination. In this study, we found that pollen foraging by honey bees decreases as temperature and barometric pressure increase. As spring temperatures continue to get warmer during blueberry bloom in Michigan, growers may experience reduced pollination. This investigation was preliminary and the dataset was limited to Michigan, but more research is needed to understand the effects of weather on honey bee foraging and subsequent pollination outcomes on a broader scale.

HOW DOES PLASTIC MULCH IMPACT THE PERFORMANCE OF ONION THRIPS

Presenter(s): Aaron Guggenheimer (Michigan State University)
Agriculture & Animal Science
Mentor(s): Natalie Constancio (College of Agriculture & Natural Resources)

Using plastic mulches provides many benefits, including increased soil moisture retention, plant yield, and weed suppression. Additionally, mulches may also influence insect pest pressure. Previous research suggests that colored mulches may reduce pest pressure on crops. Onion thrips (Thrips tabaci) are an insect pest of onions that feed by puncturing leaf tissues and consuming the cellular contents. This inhibits photosynthesis, which can result in 30 to 50% reductions in onion yield due to decreased bulb size. Preliminary observations suggest mulch color may deter onion thrips from onion plants. Determining if onion thrips mulch preferences align with onion thrips performance can lead to more informed management decisions when choosing mulch for onion fields. The purpose of this experiment is to learn if the mulch an onion grows on influences onion thrips performance. Ninety

onions were individually grown from seeds in cylindrical pots. After 5 weeks, the onions were divided into 5 mulch color treatments, with 18 replicates. The treatments were: black, white, red, silver, or control (no mulch). Three adult thrips were added to each onion and the total number of adult and larval thrips was recorded after 13 days. Generalized linear mixed models were used to determine if mulch had a significant impact on onion thrips. We found that onion thrips performed significantly worse on red mulch when compared to black mulch. However, mulch color did not affect mean plant growth or feeding damage. Further research is needed to understand why these mulches may be affecting onion thrips performance.

DROUGHT STRESS IMPACTS METABOLITE AND MICROBIOME DYNAMICS IN SOYBEAN ROOTS

Presenter(s): Monica Carey (University of Nevada, Reno)
Agriculture & Animal Science
Mentor(s): Tri Tran (College of Agriculture & Natural Resources)

Water insufficiency is a major contributor to food insecurity globally, accounting for over 9 billion dollars of crop loss in the United States. In the fight against this issue, recent research discovered that soil microorganisms living in association with plant roots hold a promising potential to protect the host against water stress. Harnessing these microbes could provide a sustainable alternative in overcoming water shortages. However, the exact mechanism in which the host initiates the mutualistic relationship with its microbiota remains unknown. In this study, we utilize the soybean root system to elucidate how plants influence their root microbiota. We hypothesize that the modification of metabolic profiles in the host during water limitation impacts the structure and function of its root-associated microbes. We first survey how the host responds to water limiting conditions utilizing two approaches: untargeted metabolomics and quantification of drought-responsive candidates with HPLC. Furthermore, community analysis via NGS sequencing of the 16S rRNA gene will be performed to confirm whether drought stress impacts the root microbiome composition. Since water plays an essential role in plant physiology, we anticipate fluctuations of stress-responding hormones and primary metabolism when plants endure drought stress. Changes in the assembly of the root microbiome might also be observed. Future experiments are needed to establish the relationship between host drought-responsive metabolites and the shift in root microbial community dynamics. Understanding the critical host factors that drive its root microbiome set a foundation for further studies on utilizing soil microbes in the fight against water scarcity.

CHANGES IN OVIPOSITION RATES OF FEMALE GANASPIS BRASILIENSIS DUE TO MALE PRESENCE IN MASS REARING COLONIES

Presenter(s): Taylor Hori (Michigan State University)
Agriculture & Animal Science
Mentor(s): Rufus Isaacs (College of Agriculture & Natural Resources)

Integrated pest management (IPM) is a pest control strategy utilizing mechanical, cultural, and biocontrol methods before or in conjuction with chemical control. As a philosophy, IPM aims to reduce the amount of chemical control used in commercial food production, thus reducing the risk of pesticide resistance in insects and pesticide residue on food. New, non-native or invasive species, challenge traditional IPM practices as chemicals are relied on first to control the pest while mechanical, cultural, and biocontrol options are researched and implemented. Spotted Wing Drosophila (Drosophila suzukii, "SWD"), an invasive species from Asia, was first discovered in Michigan in 2010 and is a major pest of berries, cherries, and grapes. The parasitoid samba wasp (Ganaspis brasiliensis), completes its life cycle by parasitizing SWD larvae, thus killing the larvae. In 2022, the USDA approved releasing samba wasps as a form of biological control for SWD. Rearing sufficient numbers of samba wasps for inundative releases in the summer requires colony maintenance throughout the year. In this study, I aimed to understand how male samba wasps affect female oviposition and the number of offspring produced. Results from this study will improve colony rearing techniques for samba wasps.

THE EFFECTS OF INTRA-ARTICULAR STEROID ADMINISTRATION ON THE METABOLIC PROFILE OF NORMAL HORSES

Presenter(s): Maya Salamey (Michigan State University)
Agriculture & Animal Science
Mentor(s): Jane Manfredi (College of Veterinary Medicine)

Corticosteroids are a commonly used, inexpensive intra-articular treatment for osteoarthritis which may increase the risk of steroid-induced laminitis in horses. Humans with metabolic syndrome experience increases in insulin and glucose post-injection, but responses in horses are not known. The objective of this study was to determine the effect of intra-articular steroids on system insulin and glucose values. We hypothesized corticosteroid injections would result in significant increases in glucose and insulin levels in all observed horses. We injected the middle carpal joint of nine metabolically normal horses with 18 mg of triamcinolone acetonide, a common corticosteroid and serially evaluated insulin and glucose concentrations post-administration. Statistics included repeated measures ANOVAs (significant at $P<0.05$). Peak insulin concentration was 28+/-12.9 uIU/mL at 48 hours with significantly increased concentrations from baseline at 6hr ($p=0.03$), 24hr ($p<0.01$) and 48 hr ($p=0.04$) post steroid administration. Peak glucose concentration was

128+/-11.9 mg/dL at 24 hours with significantly increased concentrations from baseline at 6 hr ($p<0.01$), 8hr ($p<0.01$), 24 hr ($p<0.01$), 48 hr ($p<0.01$) and 72 hr ($p<0.01$) post steroid administration. These values are within the range reported during regularly performed diagnostic endocrine tests in metabolically normal horses. Our clinical take home is that intra-articular steroids do not appear to cause insulin spikes consistent with inducing laminitis in normal horses and therefore can be used safely.

EXPLORING POOR PLANT GROWTH BY REPLANTED BLUEBERRY CROPS IN MICHIGAN

Presenter(s): Sarah Shoaff (University of Illinois Urbana-Champaign)
Agriculture & Animal Science
Mentor(s): Josh Vanderweide (College of Agriculture & Natural Resources)

Michigan is in the process of removing and replanting approximately 40% of its blueberry crops in favor of better-tasting cultivars. Farmers have indicated that their replanted blueberry crops are prone to poor growth. The goal of this study was to observe and research healthy replanted and symptomatic replanted blueberry plants on Michigan farms. Next, we hoped to identify specific variables that may be influenced by plant condition (healthy or symptomatic). This study involved four farms in Michigan, and each farm had both healthy and symptomatic plants of the same cultivar. For a plant to be labeled "symptomatic," it had to have stunted growth and poor foliage development. Plant and soil measurements were taken. Our findings indicate that there is a difference in plant height growth (in/yr) ($p < 0.001$) and plant width growth (in/yr) ($p < 0.001$) between healthy and symptomatic plants. This demonstrates that farmers may have an underlying issue causing some plants to display lessened annual growth than the rest of their plants. Symptomatic plants are associated with a higher soil pH than healthy plants ($p = 0.042$). Our finding indicates that the median pH (5.0) from our study is equal to the maximum optimal soil pH for growing blueberries (5.0). This data suggests too high of a soil pH may be the underlying cause for a decrease in annual crop growth. This study presents preliminary data on the matter.

EXPLORING THE UNIFORMITY OF BLUEBERRY FLAVOR

Presenter(s): Cassandra Austin (Michigan State University)
Agriculture & Animal Science
Mentor(s): Josh Vanderweide (College of Agriculture & Natural Resources)

Blueberry flavor is inconsistent between berries. The lack of uniformity in blueberry flavor negatively impacts consumer repeat purchasing. Flavor and consumer liking are influenced by the ratio of Total Soluble Solids (TSS) to Titratable Acidity (TA), with the new quality standard set between 15 and 30. Current efforts in blueberry breeding emphasizes flavor, which has resulted in improvements in flavor quality standards. A uniformity analysis was conducted on three blueberry cultivars, Duke (1987), Draper (2004) and Calypso (2015) harvested at 10%, 30%, 50% and 70% blue color. Samples were obtained by tagging individual branches and waiting for berries to ripen to desired blue color percentage. Our uniformity analysis included size measurements by scale and caliper, firmness measurements by BioWorks Firmtech, texture analysis with the TA.XT Texture Analyzer, and destructive pH, TSS, and TA measurements with the Atago Pocket pH and Brix-Acidity Meters. It was observed that Duke berries have more variation in TSS/TA distribution, while Draper berries demonstrated a more uniform TSS/TA distribution. In addition, it was determined TSS/TA deviates from the acceptable range due to significant decreases in acidity during extended ripening. Moving forward, this data will be integrated with additional quality metrics and an analysis of flavor volatiles will be conducted using SPME-GCMS. These findings will help narrow the industry harvesting time frame, leading to a more uniform flavor profile and saving farmers time and money. Overall, we expect our efforts to positively impact consumer repeat purchasing.

EVALUATING COMMON EASTERN BUMBLE BEE (BOMBUS IMPATIENS) BODY SIZE ALONG AN URBAN GRADIENT

Presenter(s): Olivia Franklin (Michigan State University)
Agriculture & Animal Science
Mentor(s): Jen Roedel (College of Agriculture & Natural Resources)

Land use change (urban, agricultural, etc.) affects several species, especially pollinators. We looked at how the body size of Bombus impatiens changed with land use. Bee size coincides with their survival, reproduction, and dispersal. I measured 400 Bombus impatiens under a microscopic camera to get the intertegular distance. We expect body size to be smaller in urban areas and larger in rural areas. Bees play an important role in food production, so it is worth investigating body size to understand if conservation efforts need to be made.

ARE POLLINATOR PATCHES RESERVOIRS OF BLUEBERRY PESTS?

Presenter(s): Winter Krajci (Michigan State University)
Agriculture & Animal Science
Mentor(s): Lauren Goldstein (College of Agriculture & Natural Resources), Rufus Isaacs (College of Agriculture & Natural Resources)

Many blueberry farmers in Michigan have created pollinator patches on their farms near crops for beneficial insects, but crop pests may also be inhabiting them. It is important for farmers and researchers to know if these areas are acting as pest reservoirs and if pest pressure can be predicted by vegetation type. To study this, three blueberry pests of interest, cranberry fruitworm (CBFW), blueberry maggot (BBM), and spotted wing drosophila (SWD) were chosen to be sampled across two Michigan blueberry farms. Data showed that

BBM was significantly more abundant in the crop than the pollinator patches, but SWD and CBFW did not have a preference. Areas of vegetation around traps were used to determine the three most abundant species of flora to see if there was any significant relationship between vegetation type and pest abundance. It was determined that BBM and CBFW did not have a significant relationship with any of the most abundant species of vegetation. As the percent cover of bee balm around the trap sets increased, the number of SWD decreased. This was only seen post-emergence of SWD and only when considering percent ground cover of bee balm. SWD also had a marginally significant and negative relationship with red clover. It can be determined that certain species of vegetation are negatively correlated with pest pressure of SWD, but not BBM or CBFW. More data is needed as the growing season continues and pests keep emerging to have stronger evidence of these relationships.

CATEGORIZING HEAT STRESS IN BLUEBERRY PROTOCOLS

Presenter(s): Jd McClanahan (Michigan State University)
Agriculture & Animal Science
Mentor(s): Josh Vanderweide (College of Agriculture & Natural Resources), Stephanie Rett-Cadman (College of Agriculture & Natural Resources)

Developing a protocol that uses leaves to predict thermotolerance in blueberry cultivars. The benefits of a water bath protocol will allow scientists to compare many cultivars at once. This protocol will be compared with greenhouse measurements to determine the efficacy. Developing a sound method will allow farmers to make informed decisions on what cultivars fit best given their worst-case heat wave.

COMMUNITY COMPOSITION OF DIPTERA IN AGROECOSYSTEMS

Presenter(s): Amelia McGinnis (Michigan State University)
Agriculture & Animal Science
Mentor(s): Deshae Dillard (College of Agriculture & Natural Resources)

Flies (Order: Diptera) are understudied in comparison to other insect taxa despite the broad range of ecological niches they occupy, and vital contributions to ecological services such as pollination, decomposition, nutrient recycling, and biological control. Our objective is to determine the community composition of Diptera amongst annual row crops. Eight treatments (Aspirational- Corn, Soybean, Wheat, Canola, Forage, and Restored Prairie; Business As Usual- Corn and Soybean), each with four replicates, from the Long-Term Agroecosystem Research Aspirational Cropping Systems Experiment Main site at the Kellogg Biological Station in Hickory Corners, MI have been sampled using malaise and soil emergence traps. The sampling will occur from May to August 2023 during two-week sampling intervals. At the center of each plot (28m x 85m), a trap was placed and remained in the plot for 48 hours. Samples were collected every 24 hours and traps were rotated among replicates at the end of the 48 hours. Each Dipteran specimen was identified by the family. The data collected in May and June 2023 shows that in the Business As Usual plots, Statiomyidae (soldier flies) are nearly absent, and soil-dwelling Diptera like Chironomidae (non-biting midges), Sciaridae (dark-winged fungus gnats), and Cecidomyiidae (gall midges) are being found in low quantities likely due to a difference in management practices (i.e. cultivation).

COMPARING ZEBRAFISH AND SPOTTED GAR BRAIN GENE EXPRESSIONS TO UNDERSTAND THE IMPACT OF THE TELEOST GENOME DUPLICATION ON FISH EVOLUTION

Presenter(s): Emalee Swisshelm (University of New Orleans)
Agriculture & Animal Science
Mentor(s): Ingo Braasch (College of Natural Science), Jamily Ramos De Lima (College of Natural Science)

The Teleost Genome Duplication (TGD) is a major evolutionary event within the ray-finned fish lineage when the entire genome was duplicated in the ancestor of the teleost fishes. Teleosts represent about half of all living vertebratespecies and the TGD is a hypothesized reason for their rapid speciation and evolution. The zebrafish (Danio rerio), a typical teleost and important biomedical model organism, has retained ~20% of the TGD duplicated genes. While many of the duplicated genes were lost (non-functionalization), retained genes often have neuronal functions and may be examples of sub-functionalization (i.e., duplicate copies share ancestral expression patterns), or neo-functionalization (i.e., emergence of new expression domains). The spotted gar (Lepisosteus oculatus) serves as a proxy for the ancestral form, as its lineage branched off from teleosts prior to the TGD. Comparative analysis of neuronal genes expressed in the brain of zebrafish and spotted gar will allow us to examine the implication of the TGD on gene expression and function through piscine evolutionary history. In this study, we examine the expression of metabotropic glutamate receptors (grm) in these two fish species using immunofluorescence for annotation of gar brain regions and Hybridization Chain Reaction (HCR). HCR allows us to visualize expression of pairs of duplicated grm genes within the same sample. Our results will lay the foundation to further study the mode of functional evolution of grm duplicate expression across teleost lineages.

ARTS & HUMANITIES

AFTER HURRICANE MARÍA: IDENTITY, LITERATURE & LIVED EXPERIENCE OF AFRO-PUERTO RICAN WOMEN

Presenter(s): Jeremy Santiago-Rojas (University of Puerto Rico, Rio Piedras Campus)
Arts & Humanities
Mentor(s): Maria Burgos Carradero (College of Arts and Letters), Yomaira Figueroa (College of Arts and Letters)

On September 20, 2017, Hurricane Maria hit Puerto Rico leaving over 4,645 deaths, uncovering racial, environmental, and gender inequalities on the archipelago. The 32 cities directly affected by the hurricane accounted for 33% of Puerto Rico's population, with 51.3% female, 14.2% female-headed households, and 52% of them living below the poverty level. The number of studies on this event from a gender and race perspective has been limited. This research seeks to better understand how Afro-Puerto Rican women navigate, experience, and act during this atmospheric event through short stories, novels, and interviews. The story selection was based on the context of the text (Hurricane Maria) and the characters (Afro-Puerto Rican women). The books used for the study are "Antes que llegue la luz" by Mayra Santos-Febres, "Voices from Puerto Rico Post Hurricane Maria" by Iris Morales, and "Aftershocks of Disaster: Puerto Rico before and after the storm" by Yarimar Bonilla and Marisol Lebrón. Also, the research incorporates the analysis of The Diaspora Solidarities Lab "After the Storm" interviews to Afro-Puerto Rican Women after the hurricane to see how fiction reflects into reality. Both, the books and interviews, were analyzed trough literary analysis. The study was guided by Zaira Rivera-Casellas "Poetics of Enslavement", Xhercis Méndez "Decolonial Feminist Theory" and Kimberlé Crenshaw "Intersectionality" to recognize the different factors that frame the oppression of women of color. In this research, I argue that gender roles are reinforced in the midst of atmospheric events and that identities shaped the experiences of Afro-Puerto Rican women during Hurricane Maria.

"OH, I'M QUOTING SOMETHING I DON'T LIKE": USAGE OF "OH" TO SIGNAL NEGATIVE STANCE

Presenter(s): Janice Peng (Pomona College)
Arts & Humanities
Mentor(s): Adam Barnhardt (College of Arts and Letters), Betsy Sneller (College of Arts and Letters), Jack Rechsteiner (College of Arts and Letters), Suzanne Wagner (College of Arts and Letters)

There has been much sociolinguistic research on quotations, as well as on discourse markers, which are words like "um" or "oh" which contribute pragmatic meaning to a sentence. However, there has been less work on the role of discourse markers in quotation. Trester (2009) examines "Oh" as a preface to quotations, arguing that it (1) signals a shift from narration to quotation, and (2) indicates a negative speaker stance towards the quotations. These functions are shown in the following example: "like people are just like

'Oh our theater is better than your theater'" (Trester, 2009: 149, Example 2). In this study, I build on Trester's findings by examining the usage of quotation-prefacing "Oh" through a quantitative lens. Using self-recorded "audio diaries" collected by the Michigan Diaries project, I analyze one participant's use of quotation-prefacing "Oh" through 155 instances of quotation. I find that when this participant has a negative stance towards their quotation, they are more likely to begin their quotation with "Oh" compared to when they have a positive or neutral stance towards their quotation. I also analyzed the verb used to introduce each quotation. I find that when a quotation do not begin with a clear verb of quotation, it was more likely to begin with "Oh" than quotations that begin with "be like" or another verb of quotation. These findings support Trester's (2009) argument that (1) "Oh" can signal a shift between narration and quotation, and (2) it signals negative speaker stance.

DECODING DISCOURSE: WHO IS THE "YOU" IN "YOU KNOW"?

Presenter(s): Lena Abed (Pomona College)
Arts & Humanities
Mentor(s): Suzanne Wagner (College of Arts and Letters)

This research investigates whether directly addressing an imagined interlocutor is a predictor for using the discourse marker you know appearing in their speech. Discourse markers are linguistic elements like 'well', 'right', 'you know', and 'so' which bracket "units of talk." Previous research shows discourse markers serve numerous functions in conversation including signaling a relationship between the segment they introduce and the prior segment. Discourse markers can be speaker-oriented or addressee-oriented. "I mean" is a speaker-oriented marker that modifies an utterance, while 'you know' is an addressee-oriented marker that primarily facilitates interaction and signals shared knowledge. But when there is no direct addressee, what is 'you know' doing? I investigate this question using twelve self-recorded audio-diaries from the MI Diaries corpus, wherein the speaker cannot see their audience nor ascertain who will be listening. Even though no one is listening, some diarists still address an imagined audience (e.g., "Hello, MI Diaries"). I analyze the frequency and utterance position of you know in speakers' diary entries to determine whether addressing an imagined audience increases speakers' use of 'you know'. I found that diarists employed 'you know' more frequently when they were addressing an audience. Furthermore, utterance-final 'you know' was more frequent in diaries that addressed an audience directly. This research may have implications for future studies in discourse analysis and oral history projects, providing insights into how individuals behave in self-recorded personal narratives. Specifically, it suggests that 'you know' performs a similar pragmatic function whether a direct addressee is present or not.

PET INTER- HEY DONT EAT THAT! INTERRUPTED SPEECH

Presenter(s): Paul Ganago (Eastern Michigan University)
Arts & Humanities
Mentor(s): Adam Barnhardt (College of Arts and Letters), Betsy Sneller (College of Arts and Letters), Jack Rechsteiner (College of Arts and Letters), Suzanne Wagner (College of Arts and Letters)

Most previous research on animal-directed speech has been from the perspective of how the animal reacts, but what has not been previously addressed is the effect of pet-directed speech on the person speaking. This study aims to explore what happens when a pet interrupts a speaker who then addresses the pet, and whether/how their speech changes after the interruption and they get back to what they were saying. Specifically, I investigate whether a speaker's pitch changes when they are talking to their pet, compared with before they have been interrupted by their pet. I also investigate whether any pitch changes persist after they are done speaking to their pet. The data I use is from self-recordings submitted to the Michigan Diaries Project, where participants submit audio recordings. I find a very clear pitch pattern when speakers switch to pet-directed speech: pitch increases while talking to their pets, and goes back to baseline after talking to their pets. I do not find a similar pattern for speech about pets: speakers do not have a clear pitch pattern when talking about their pets. This implies that (1) pitch changes during PDS because of a new addressee, and (2) this new addressee does not remain after pet-directed speech. Future work could expand this research to see whether pet behavior (good vs. bad) differently impacts pitch, both for pet-directed speech and for speech about pets.

I'M, UM, NONBINARY: USAGE OF UM/UH AMONG NONBINARY SPEAKERS

Presenter(s): Sam Scroggins (Grand Valley State University)
Arts & Humanities
Mentor(s): Adam Barnhardt (College of Arts and Letters), Betsy Sneller (College of Arts and Letters), Jack Rechsteiner (College of Arts and Letters), Suzanne Wagner (College of Arts and Letters)

Conversational speech is distinct from pre-planned speech in part due to the presence of breaks, irregularities, and fillers, such as "um", "uh", "like", "er". Past research has demonstrated a significant distribution across binary genders in usage of the filler words "um" and "uh", with males more frequently using "uh" and females more frequently using "um". However, to my knowledge there has been no research examining the usage of "um" vs. "uh" among speakers who fall outside of the male/female gender binary. Building on previous work on gender differences in UM/UH usage as a sociolinguistic indicator as well as work on sociolinguistic indexing by nonbinary speakers, this study investigates usage of UM/UH among nonbinary speakeres to determine whether significant patterns arise. Using speech recordings from

7 nonbinary speakers in the MI Diaries corpus, I extracted all instances of UM and UH by each speaker to identify each speaker's overall ratio of UM to UH. I find that usage of UM and UH aligns relatively closely with assumed childhood socialization. This suggests that UM/UM may be below the level of awareness as a gendered feature and therefore not available to adjust as a conscious marker of gender identity. As the topic of nonbinary linguistics is still fairly new, there has been much less study devoted to nonbinary speakers than to speakers that fall within the traditional male/female binary. With this research, I aim to shed some light on the linguistic practices of a community that has previously been underrepresented in research.

TERRORISM AND COUNTERTERRORISM

Presenter(s): Kaila Frank (Chaminade University of Honolulu)
Arts & Humanities
Mentor(s): Steven Chermak (College of Social Science)

I want to research terrorism across different regions. I will review 9 countries where terrorism has the strongest presence and look at their overall terrorism situation and the counterterrorism approaches used there. I will be comparing countries across three regions. In the Middle East I will look at Afghanistan, Syria, and Yemen. For South East Asia I'll do The Philippines, Indonesia, and Singapore. In Sub-Saharan Africa, The Democratic Republic of the Congo, Nigeria, and Somalia. I am interested in studying the challenges/outcomes that arise because of terrorism, to better understand the situations that people are affected by or involved with. I want to eventually be able to help people suffering from terrorism, and also be able to de-escalate/prevent situations like these from happening.

BIOCHEMISTRY & MOLECULAR BIOLOGY

EFFICIENT MOLECULE MATCHING FOR DYNAMICS-BASED MOLECULAR SIMULATION

Presenter(s): Xavier Santiago (University of Portland)
Biochemistry & Molecular Biology
Mentor(s): Alexander Dickson (College of Natural Science)

Molecular similarity is an important concept in many areas of chemistry, with applications in fields such as chemoinformatics and drug design. We propose a method using the Behler-Parinello symmetry functions to describe a molecule's atoms in translation, rotation, and index-invariant terms. From there, a comparison between two groups of atoms can be set up as an instance of the assignment problem with costs determined by the L2 norm of the differences between the attributes of any two given atoms. Additionally, we are able to compare molecules with different numbers of atoms by introducing a penalty term that determines the cost of assigning an atom in one molecule to a null value in the other. The generalized algorithm for solving the assignment problem is the Hungarian algorithm. However, with a cubic time complexity, larger molecules can cause issues for the speed of simulation. We investigate the Sinkhorn-Knopp Algorithm as an alternative, which approximates the total of the minimum cost assignment. In addition, it is easily differentiable, an important trait for machine learning based approaches.

NATURAL VARIATION OF ROOT EXUDATE METABOLITES IN SWITCHGRASS

Presenter(s): Stephanie Qu (Carnegie Mellon University)
Biochemistry & Molecular Biology
Mentor(s): Xingxing Li (College of Natural Science)

Switchgrass (Panicum virgatum L.) is a C4, perennial, prairie grass native to North America. Its resilience and ability to thrive on marginal land, characterized by the poor soil structure unsuitable for growing food crops, has contributed to its role as a major biofuel crop. In this study, we have analyzed the root exudates using mass spectrometry based metabolomics and documented the variation in metabolites across the different genotypes of switchgrass that represent different ecotypes and polyploidies. The seeds were sterilized, germinated, and grown in an axenic hydroponic systems. After four weeks of growth, the switchgrass seedlings and their root exudates are harvested and extracted for metabolites. Each sample is then analyzed using gas chromatography (GC)-MS and liquid chromatography (LC)-MS. We have detected both primary metabolites, including sugars and amino acids, and specialized metabolites, including diterpenoids and saponins from the exudates. Moving forward, we can study the correlations between the specific metabolite profiles and microbe interactions, gaining more information on the switchgrass microbiome assembly. This effort will help continue optimizing switchgrass as a low input biofuel crop.

OPTIMIZATION OF MALDI-TOF MASS SPECTROMETRY IMAGING OF C. ELEGANS FOR SMALL MOLECULE ANALYSIS

Presenter(s): Elizabeth Smith (Allegheny College)
Biochemistry & Molecular Biology
Mentor(s): Tian Qiu (College of Natural Science)

Understanding the molecular mechanism underlying the communication among microbiome, gut and brain (the microbiome-gut-brain axis) is critical for the development of future microbiome-based disease interventions. The Caenorhabditis elegans (C. elegans) is a promising model organism for studying the microbiome-gut-brain axis due to shared molecular mechanisms in the function and responses of the nervous systems. While many genetics and optical tools have been developed for C. elegans, the chemical topology of C. elegans has not been resolved in situ. Matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS) provides chemical analysis with spatial resolution. However, the small size of C. elegans proves to be an obstacle for MALDI-MS imaging. We propose a method of MALDI-MS imaging of C. elegans by exploring choices of embedding mediums, MALDI matrices, and orientation of C. elegans to enable MALDI-MS imaging analysis of C. elegans. Embedded samples were cryosectioned, thaw-mounted, and dried under a Schlenk line before being imaged using a compound microscope. Matrix layers were deposited on the sample's surface using an automatic sprayer before slides were analyzed through our Bruker timsToF fleX, a MALDI-TOF instrument with trapped ion mobility spectrometry (TIMS). Several embedding mediums and matrices were explored to determine those with the least background and most crystal homogeneity. In order to reliably orient the C. elegans, we sandwiched the nematode between porcine gelatin before cryosectioning. Results show that gelatin embedded C. elegans can reliably be imaged with MALDI chemical matrices and that nematodes can be situated between porcine gelatin to obtain longitudinal sections.

ROLE OF IRE1 ACTIVITY AND DNA DAMAGE CAUSED BY OBESITY OR PERFLUROOCTANOIC ACID AND PERFLUROOCTANE SULFONATE IN DEVELOPMENT OF CHEMOTOLERANT CANCER CELLS

Presenter(s): Elaina Gouin (Michigan State University)
Biochemistry & Molecular Biology
Mentor(s): Christina Chan (College of Engineering), Kevin Chen (College of Engineering)

Environmental stressors on the body can increase risk for diseases like cancer. Obesity has been shown to cause poor cancer treatment outcomes. Additionally, per- and polyfluoroalkyl substances (PFAS), man-made chemicals found in household cleaning products, water, and the environemt are linked to various diseases. Two PFAS chemicals, perfluorooctanoic acid (PFOA) and perfluoroctane sulfonate (PFOS), have been found to be accumulating in the body at concentrations of 3.4 nM and 8.5 nM respectively. Both obesity and PFAS have shown to induce endoplasmic reticulum (ER) stress in cancer cells. In response to this stress, cancer cells utilize cellular survival mechanisms including the unfolded protein response (UPR) and DNA damage repair (DDR) to survive, metastasize, and resist treatment. One signal protein of the UPR, inositol-requiring enzyme 1 alpha (IRE1α), mediates ER stress via X-box binding protein-1 (XBP1) mRNA splicing and regulated IRE1-dependent decay (RIDD). The DDR mediates genotoxic stress by repairing DNA damage like double stranded breaks (DSBs). An early marker of damage is the phosphorylation of histone H2A.x to γH2A.x. Previously, our group showed that the activation of the IRE1α pathway promotes cancer metastasis and chemoresistance, especially in the context of obesity. Preliminary results suggest that PFAS may have similar effects on cancer cells.

ROLE OF ACT-LIKE DOMAIN IN THE FUNCTION OF ARABIDOPSIS TT8 BHLH TRANSCRIPTION FACTOR

Presenter(s): Avery Hickcox (Drake University)
Biochemistry & Molecular Biology
Mentor(s): Erich Grotewold (College of Natural Science), Yun Sun Lee (College of Natural Science)

The basic-helix-loop-helix (bHLH) transcription factor (TF) belongs to one of the largest regulatory protein families in eukaryotes. The first bHLH TF described in maize was the R protein, which has many regulatory functions including flavonoid biosynthesis and anthocyanin pigmentation. Both the bHLH domain and ACT-like domain are located in the C-terminus of R. The ACT-like domain mediates the formation of homodimers and negatively affects DNA binding in bHLH domains. These domains are highly structurally conserved in other plant species with bHLH TFs such as Arabidopsis thaliana. Transparent Testa 8 (TT8) is an ortholog of the maize R protein that functions in proanthocyanidin accumulation in the seed coat of Arabidopsis. Preliminary results show that the ACT-like domain of TT8 homodimerizes similar to R. The objective of this project is to identify and quantify homodimerization activity in the ACT-like domain of TT8, and assess the effect on DNA-binding in the bHLH domain due to ACT-like domain homodimerization. From this data, the role of the ACT-like domain in anthocyanin biosynthesis and dimeric regulatory mechanisms can more accurately be described in protein-protein interactions.

INCREASING TERPENE PRODUCTION THROUGH THE ARTIFICIAL TARGETING OF TERPENE METABOLIC PATHWAYS TO PLASTOGLOBULES

Presenter(s): Charles Swiggett (King University)
Biochemistry & Molecular Biology
Mentor(s): Bjoern Hamberger (College of Natural Science), Lucas Reist (College of Natural Science)

Terpenes are the oldest and most diverse group of specialized metabolites. They are used for many different purposes within plants. Many terpenes are hormones for communication within and between plants, attract pollinators, and assist in defense mechanisms. A large number of terpenes are also useful to humans as well for purposes such as fragrances, pharmaceuticals, and as a biofuel source. In order to provide a more sustainable source of terpenes and terpene derivatives for human use, the engineering of crops to effectively produce and store these compounds is crucial. A solution for this storage is in plastoglobules, a lipid body found within plastids as an extension of the thylakoid. Recent discoveries in structural proteins associated with plastoglobules, called fibrillins, have allowed us to utilize a plastoglobuli targeting motif. To try and shuttle terpene products to plastoglobules, we synthetically fused this motif with enzymes from two different terpene pathways: a 15 carbon sesquiterpene and a 20 carbon diterpene pathway. Within these pathways we have chosen to express particular enzymes, prenyltransferases and terpene synthases, to create our products. We have also chosen Nicotiana benthamiana as our model organism as it is readily transformed by Agrobacterium tumefaciens to express our synthetic enzymes. Leaf tissue infiltrated will be collected and analyzed using gas chromatography with flame ionization detection to quantify our terpenes for analysis. If successful, this will be a beginning in an effective new way to store and produce biochemicals in a sustainable manner.

ACOUSTIC TWEEZING CYTOMETRY ENHANCES THROUGH STEM CELL DIFFERENTIATION INTO ENDOTHELIAL CELL

Presenter(s): Brandy Lee (Bennett College)
Biochemistry & Molecular Biology
Mentor(s): Ping Wang (College of Human Medicine)

Type 1 Diabetes (T1D) is an organ-specific autoimmune disease. Meaning the immune systems is attacking the body instead of protecting it. In the case of T1D, the attack on the immune system destroys the insulin producing beta cells within the islets of the pancreas. A possible method for creating cells that produce insulin is to differentiate stem cells into pancreatic beta cells. A recently developed approach, despite the success of other newly created differentiation procedures that create islet organoids from induced pluripotent stem cells (iPSCs) in vitro and transplant them in animal models and for clinical trials. In this, there is a problem with the viability and functionality of the differentiated cell products at its final formation. A study published in August 2022 focuses on an "In depth functional characterization of human induced pluripotent stem cells (hiPSCs) derived from beta cells". In this examination many of the islet aggregates were transplanted smoothly. However, a group of small size islet-like aggregates clumped during a rotating suspension protocol. Endothelial cells (ECs) are an essential cell for vasculature structure in native islets of humans. This cannot be found in islet organoids differentiated from iPSCs. The reason islet organoid transplantation in vivo is defective comes from the shortage of ECs and vasculature. Without those, the microenvironment is difficult for foreign cells to understand. In this current study, we use a selection of advanced acoustic technologies among them acoustic tweezing cytometry (ATC) for targeted cellular and molecular stimulation. Our results show that functional endothelial cells can be created through facilitated stimulation and controlled differentiation of human iPSCs on account of ATC.

TRIOSE PHOSPHATE UTILIZATION CHARACTERIZED THROUGH DEVELOPMENT

Presenter(s): Malinali Sanchez Carmona (Iowa State University)
Biochemistry & Molecular Biology
Mentor(s): Maxwell Harman (College of Natural Science)

One of the factors limiting plants' total photosynthetic output is TPU (Triose Phosphate Utilization). The Calvin Cycle generates three-carbon sugar units with a phosphate group called triose phosphates, also known as the G3P molecule, which releases a phosphate group to the cytosol as the triose phosphates are combined to make sugars. When the cytosol lacks free phosphates, there is insufficient substrate to convert ADP into ATP and continue the photosynthetic process. This project seeks to identify genetic factors regulating this limitation, which is unknown during plant development. Using an LI-6800, we quantified chlorophyll fluorescence response to identify TPU carbon assimilation and photosynthesis efficiency levels in different developmental stages of tobacco plants when presented with saturated carbon dioxide levels. A plant's age can affect the levels of photochemical quenching (the efficiency of photochemistry and photons being used in photosystem II to drive electron transport) and non-photochemical quenching (when there is an excess of absorbed light not used for photochemistry and is dissipated as heat). This rate can affect chlorophyll fluorescence and carbon dioxide assimilation as the leaf ages. Decreasing the rate of photochemistry would ultimately decrease the rate of ATP synthesis. Even though this would lower the rate of photosynthesis, a decline in ATP synthesis rate would require less phosphate use, potentially stabilizing triose phosphate limitations. Measuring chlorophyll fluorescence and carbon assimilation throughout different developmental stages of tobacco could help us further understand triose phosphate utilization and may provide insights to maintain higher photosynthetic rates in future climates.

SCREENING FOR PLIP3 SUPPRESSOR MUTANTS IN ARABIDOPSIS

Presenter(s): Abigail Proksch (Ferris State University)
Biochemistry & Molecular Biology
Mentor(s): Christoph Benning (College of Natural Science), Jinjie Liu (College of Natural Science)

Land plants produce defensive hormones as a response to environmental stresses that alter their use of resources and affect their growth. In particular, chloroplasts respond to stress by remodeling their membrane lipids, which creates signaling molecules that stimulate defensive changes. Jasmonic acid (JA) is an oxylipin that is synthesized in response to biotic stress and becomes active when conjugated with isoleucine (JA-Ile). Recently, PLASTID LIPASE3 (PLIP3), the enzyme that initiates this pathway, was characterized in Arabidopsis thaliana. When A. thaliana was mutated to overexpress PLIP3

(PLIP3-OX), JA-Ile accumulated and affected the phenotypic appearance to a smaller size, altered leaf morphology, and visible accumulation of anthocyanin. Investigation of enzymes and transporters involved in the JA and other oxylipin pathways is of current interest. Lines with random point mutations were created by treating PLIP3-OX mutants with ethyl methanesulfonate (EMS). Presumed suppressor mutants (SM) will phenotypically resemble (or partially) the wild type but have the same genetic background and lipid profile of PLIP3-OX due to the EMS induced mutation affecting the JA pathway but not the activity of PLIP3. The M1 generation of the mutants was selected based on their phenotypes and their genetic backgrounds and lipid profiles were confirmed before crossing them with PLIP3-OX for the F2 generations. This forward genetics approach to mutant screening makes it possible to efficiently produce and identify promising mutations for further downstream investigation.

INTRODUCING ACETATE AND FORMATE UTILIZATION TO ZYMOMONAS MOBILIS

Presenter(s): Sydney Buchsbaum (North Carolina State University)
Biochemistry & Molecular Biology
Mentor(s): Magdalena Felczak (College of Natural Science), Michaela TerAvest (College of Natural Science)

Bioethanol produced from lignocellulosic biomass presents a promising and sustainable solution to meet the increasing global energy demand without sacrificing food-crop land. Among potential ethanol-producing microorganisms, Zymomonas Mobilis, a facultative anaerobe, stands out due to a few useful features, such as low biomass accumulation and high tolerance to conditions found in lignocellulosic hydrolysate. However, the commercial viability of Z. mobilis is hindered by a very limited range of consumable substrates. This research works to address this limitation by investigating two genetically engineered strains of Z. mobilis. The first strain incorporates a formate dehydrogenase enzyme, while the second strain incorporates the pta-ackA pathway to facilitate acetate consumption. Through these genetic modifications, the aim is to expand the substrate range of Z. mobilis, thereby enhancing its potential for efficient bioethanol production.

FITNESS COST ASSOCIATED WITH PHAGE DEFENSE SYSTEMS

Presenter(s): Hilary Roberts (University of the Virgin Islands)
Biochemistry & Molecular Biology
Mentor(s): Christopher Waters (College of Osteopathic Medicine), Jasper Gomez (College of Natural Science)

Vibrio Cholera belongs to the Vibrio bacteria family, where certain strains of this bacterium can lead to a severe diarrheal condition known as cholera, while other strains typically result in less severe illnesses. Cholera is a widespread problem in countries with poor sanitation and limited access to safe drinking water. This significant global public health threat affects the treatment of various microbial infections, highlighting the necessity for alternative treatment strategies against antibiotic resistance. One potential approach is the use of bacteriophages, which are viruses that infect and kill bacteria. Phages offer distinct advantages over antibiotics specifically Vibrio cholerae and other bacterial illnesses, as they target only the bacteria causing the infection and do not cause harmful side effects. However, we must determine if phage defense systems have a fitness Cost. A fitness cost is a biological disadvantage or reduction in the overall survival of a microorganism. The experiment This research study will evaluate if the absence of a phage defense systems affects Vibrio cholera Fitness. he experiments involved cultivating growth curves for four cultures (C6706, C6706 Δ lacZ, CR03, CR03 Δ lacZ), followed by competition experiments in mixtures (CR03+C6706 Δ lacZ, C6706+CR03 Δ lacZ, CR03+CR03 Δ lacZ, C6706+C6706 Δ lacZ), and colony counting. We hypothesize that in the absents of phage, bacteria strain lacking phage defense systems (-) will outcompete bacteria strains with phage defense systems (+) when phages are absent due to fitness cost. If a fitness cost is discovered through this process, additional research and experimentation will determine why there is a cost.

PHAGE DISPLAY SCREENING FOR GADOLINIUM BINDING PEPTIDES

Presenter(s): Mimi Tarter (Michigan State University)
Biochemistry & Molecular Biology
Mentor(s): Assaf Gilad (College of Engineering)

Lanthanides have been a recent topic of interest due to their unique properties in technical applications such as magnets, computer systems, and medical devices. Gadolinium (Gd), also a lanthanide, is an effective intravenous MRI contrast agent due to its ability to lower the T1 relaxation time in MRI imaging. Known as a gadolinium-based contrast agent (GBCA), GBCAs can exist either as linear or macrocyclic compounds, with the latter being more stable. Once dechelated, Gd becomes toxic, and in excess, has been linked to kidney disease. This is an increasing concern as there has been a rise in Gd pollution in waterways which poses a threat to human and environmental health. In addition, while Gd is a valuable element, mining methods have been inefficient and expensive. This study utilizes phage display screening to investigate the binding capabilities of a peptide library to two Gd compounds: Gd2O3 and Gd-PBNP. The phage display library has a 109 peptide complexity with randomized 12-mer peptides on each phage. The phage display screening process narrows the number of peptides such that only Gd-specific peptides remain. Analysis of the bound peptide sequences has determined a peptide common to both Gd2O3 and Gd-PBNP. These results can be used to design gadolinium-based projects to create novel MRI contrast agents, create bioremediation solutions, or improve current mining methods.

DEVELOPING UNBALANCED FERMENTATION TECHNOLOGY FOR ESCHERICHIA COLI

Presenter(s): Carrie Gregg (Lake Superior State University)
Biochemistry & Molecular Biology
Mentor(s): Michaela TerAvest (College of Natural Science)

Fossil fuels are harmful for the environment, so we are interested in creating alternative energy sources that come from microbes. One promising approach is microbial fermentation, but strict anaerobic conditions create limitations on the products that can be generated. One solution to this limitation is creating unbalanced fermentation by manipulating electron flow. By adding an electron donor or electron acceptor, we can broaden the range of possible products and direct carbon flow toward desired products. We are testing unbalanced fermentation in a strain of E. coli engineered to use Fe(III) as an electron acceptor. Using Iron as an electron acceptor will redirect electron flow and redistribute carbon metabolism to acetic acid. In the future, we can use Fe2+ or an electrode as an electron donor to change carbon metabolism to favor ethanol as the main metabolite product. Manipulating Escherichia coli, and understanding how different carbon sources disrupt this carbon flow will help us understand whether microbial electrosynthesis is a better alternative for creating ethanol then how it is currently produced.

BIOSYSTEMS & AGRICULTURAL ENGINEERING

PRECISION IRRIGATION MANAGEMENT TO COMBAT CLIMATE CHANGE EFFECTS ON BLUEBERRY PRODUCTION

Presenter(s): Kylie Jamrog (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Younsuk Dong (College of Agriculture & Natural Resources)

The Michigan Blueberry industry has been impacted by climate change. Changes in precipitation patterns can be damaging: periods of drought or excessive rain result in dried out or decayed bushes. Efficient irrigation is important for increasing the resiliency of crop production to climate change. Through efficient irrigation strategies, water usage, overirrigation, and underirrigation can be minimized. This results in an increased yield of higher quality crops, maximizing return on investments. Irrigation scheduling is a tool that uses evapotranspiration and soil moisture data to maximize irrigation efficiency. There is a lack of understanding of the benefits of irrigation scheduling in reducing the effects of climate change on blueberry orchards. Therefore, the purpose of this project is to evaluate irrigation scheduling tools to improve irrigation water use efficiency, increasing fruit quality and production. This blueberry irrigation study was conducted at the Trevor Nichols Research Center (TNRC). Four irrigation strategies are compared. The first strategy is the current grower's common method, which applies 1-inch/week of water with an overhead system. The other strategies apply water when the soil moisture in the root zone reaches 50% and 70% depletion, and late cut-off. These strategies utilize different methods based on evapotranspiration, soil tension, and volumetric soil water content. Soil and environmental conditions are monitored using LOCOMOS (Low Cost Sensor Monitoring System) stations, an IoT-based Sensor Monitoring System. Additionally, irrigation is controlled by the LOCOMOS platform. Total fruit yields per plant, 50-berry weight, firmness, bud counts, and branch lengths are monitored, and compared through one-way ANOVA.

IMPLICATIONS OF NOROVIRUS DOSE-RESPONSE MODEL SELECTION ON RISK ASSESSMENT

Presenter(s): Lillian Bieszke (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Jade Mitchell (College of Agriculture & Natural Resources), Kara Dean (College of Agriculture & Natural Resources)

Norovirus, also known as winter vomiting disease, is a virus commonly transmitted by contaminated surfaces, food, and water. It is one of the most common food and waterborne illnesses worldwide and contributes to 684 million cases and 212,000 deaths annually. While not much is understood about norovirus, researchers have been using Quantitative Microbial Risk Assessment (QMRA) to try and develop a better understanding. QMRA is a mathematical modeling framework that characterizes human health risks associated with pathogens in the environment. The dose-response assessment is a component of QMRA that involves the calculation of the relationship between the potential for infection and the number of pathogens an individual ingests. There are multiple norovirus dose-response models available in the peer-reviewed literature due to complexities associated with its pathogenicity such as immunity and whether the viruses were assumed to be aggregated or disaggregated. Immunity dose response models consider how much of the population will be susceptible to a norovirus infection. Aggregation determines whether all the virus particles will be clumped together in a sample which will play a role in the number of infections caused. Currently, the impact of dose-response model selection within norovirus QMRAs is not well understood. To address this data gap, a literature review was conducted to identify peer-reviewed norovirus dose-response models and available outbreak data. Twenty models were found, and the majority (n=11) assumed disaggregated viruses. Comparatively, 10 models assumed some level of immunity within the population. Three outbreaks were collated from the literature that reported attack rates and the concentration of norovirus in the ingested matrix.

PERSISTENCE MODELING OF MICROBIAL SOURCE TRACKING MARKERS IN SURFACE WATERS WITH VARYING ENVIRONMENTAL CONDITIONS

Presenter(s): Stephanie Nomoto (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Jade Mitchell (College of Agriculture & Natural Resources), Kara Dean (College of Agriculture & Natural Resources)

Pathogens in surface waters can be ingested when used for recreational activities and as a source for drinking water treatment plants. Indicator organisms are used to monitor for pathogens; however, they may decay faster than pathogens, leading to possible under-estimated health risks associated with ingesting contaminated water. Microbial source tracking (MST) refers to the methods used to identify host-specific markers in microbial populations, allowing for the identification of the source of pollution. Pathogens may persist in water, which is why it is important to analyze how long pathogens, indicators, and MST markers survive in water matrices. A system literature review was conducted using Web of Science database to identify available MST marker persistence datasets for mining and analysis. Twenty-six total studies were identified and included in this analysis. Five persistence models, both linear and nonlinear, were fitted to the 338 datasets extracted from the literature to identify which model type provided the best fit. The JM2 (nonlinear) model fit 92% of the datasets while the exponential model (linear) only provided a good fit to 31% of the datasets. Factor analyses were conducted to compare environmental conditions to the marker persistence behaviors, and temperature was found to significantly impact the decay of markers. This study determined that although the exponential model is commonly relied upon for estimating marker, indicator, and pathogen persistence, the JM2 model provided the best fit to marker data analyzed herein. This suggests that the assumption of first-order decay may introduce uncertainty into water manager decision making with MST information.

AI-ENABLED DETECTION OF SALMONELLA SEROTYPES USING HYPERSPECTRAL MICROSCOPE IMAGES

Presenter(s): Aarham Wasit Khan (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Jiyoon Yi (College of Agriculture & Natural Resources)

Emerging technologies have revolutionized foodborne pathogen detection, particularly in the case of Salmonella, a major cause of foodborne illnesses. This study leverages hyperspectral microscopic imaging (HMI) and artificial intelligence (AI) to differentiate between five Salmonella serotypes: Kentucky

(KY), Enteritidis (SE), Heidelberg (SH), Infantis (SI), Typhimurium (ST). Specifically, we focused on improving the analysis of spatial data using a rich dataset of HMI images provided by the USDA ARS research lab. We applied a variant of EfficientNetv2, coupled with data augmentation techniques to enhance generalizability. The model's performance was evaluated at various microbial incubation times. Our results demonstrated high accuracy in serotype detection, reaching up to 99% at 10 hours of incubation. The promising results support the viability of AI-assisted HMI as an effective tool for rapid, accurate foodborne pathogen detection at serotype-level and present opportunities for further improvements, particularly in integrating spectral data into the model.

AN AUTOMATED, DECENTRALIZED, ENERGY POSITIVE WASTEWATER AND FOOD TREATMENT SYSTEM

Presenter(s): Ryan Heileman (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Wei Liao (College of Agriculture & Natural Resources)

A decentralized wastewater treatment is a potential solution to the sustainability and economic problems of current wastewater treatment processes on military bases. A solar-powered electrocoagulation unit filters blackwater for domestic use and produces sludge to be mixed with food waste as feedstock for a two-step anaerobic digester. The operation is powered with solar energy from photovoltaic panels and biogas accumulated from anaerobic digestion. The goal of the operation in the summer was to stabilize the digestion process and power the system solely on solar energy. Total nitrogen, total phosphorus, total solids, volatile solids, and soluble carbon oxygen demand were measured to successfully stabilize the anaerobic digestion process to start generating biogas. The operation was maintained with solar energy stored in batteries throughout the summer despite occasional cloudy weather conditions.

TIME STUDY ON AN END-TO-END NANO-BIOSENSOR PLATFORM FOR SALMONELLA DETECTION

Presenter(s): Peyton Ma Wong (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Evangelyn Alocilja (College of Agriculture & Natural Resources)

Foodborne pathogen detection is necessary to prevent foodborne disease and infection. Foodborne pathogens are responsible for causing 9.4 million instances of foodborne illness, resulting in 55,961 hospitalizations (Scallan, 2011). Notably, in the case of salmonella infection, there are an estimated 1.3 billion cases of infection, leading to approximately 3 million deaths worldwide(Kurtz, 2017) Conventional methods to detect Salmonella such as culturing in selective growth media and polymerase chain reaction (PCR)-

based assays provide reliable results; however, the analysis is arduous and the results may take several hours to several days, making it difficult to assess any contamination with urgency. Currently, biosensors as methods of rapid detection are explored as alternatives to conventional detection techniques. This study examines the analysis time of the nano-biosensor for Salmonella detection in turkey meat samples being developed by the Nano-Biosensors laboratory at Michigan State University. The nano-biosensor platform involves sample preparation, magnetic cell enrichment using glycan-functionalized magnetic nanoparticles (MNPs), DNA extraction, and detection of Salmonella DNA using oligonucleotide-functionalized gold nanoparticles (GNPs). Preliminary results reveal that the end-to-end analysis time of the nano-biosensor is significantly shorter in contrast with current detection system. The DNA extraction and DNA biosensing steps are also observed to benefit by increasing the number of samples processed at one time. Using a detection system with a shorter analysis time would help the food industry keep products safe to consume.

A COMPARISON OF A STEADY-STATE SEED WITH A MANURE AND A PAUNCH AND MANURE MIXTURE SEED THROUGH ANAEROBIC DIGESTION

Presenter(s): Daniel Aburto (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Sibel Uludag-Demirer (College of Agriculture & Natural Resources)

Anaerobic digestion (AD) is a valuable technology for converting organic waste into biogas. The startup process of AD involves using an inoculum with a substrate to make biogas. The inoculum comes from a local full scale anaerobic reactor operating under steady-state conditions. The startup of AD processes in rural/farm areas faces additional challenges because of the proximity to these reactors to collect inoculum. This study focuses on alternative inoculum for AD processes from the materials available in animal (dairy and beef) farms to lift the burden of inoculum collection during the startup or operation stages of the process. Anaerobic fungi and other key microbial communities in AD have been found in the rumen and guts of large herbivores that drive lignocellulose degradation in anaerobic environments. Therefore, the paunch manure (semi-digested material in rumen) and manure can be used to develop the inoculum for AD process.

COMPARISON OF ORGANIC AND NON-ORGANIC COAGULANTS USED FOR SMALL-SCALE MEAT PROCESSING WASTEWATER TREATMENT THROUGH COAGULATION/FLOCCULATION

Presenter(s): Jordan Dashner (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Greg Rouland (College of Agriculture & Natural Resources), Steven Safferman (College of Agriculture & Natural Resources)

Coagulation/flocculation is a wastewater treatment method that uses positively charged coagulant to neutralize negatively charged wastewater. This reduces repulsive forces, causing clumping and flocculation. This technology is currently being tested as a potential pre-treatment method for small-scale meat processing wastewater. This technology will be evaluated based on a cost analysis, ease of use, and environmental impact. Coagulants used can be organic or non-organic, organic coagulants potentially have less negative environmental impact, however they might not be as effective as non-organic coagulants. This project will compare chitosan, an organic coagulant derived from chitin to non-organic coagulants such as ferric chloride, poly-aluminum chloride, and aluminum sulphate. Jar tests with samples collected from the septic tanks of two facilities will be performed. One facility is only processing, the other facility also slaughters. Turbidity, biological oxygen demand and total suspended solids of each sample will be measured before and after treatment to determine effectiveness. From this, optimal operation settings and coagulant doses for maximum removal for each coagulant can be determined. Then by running a cost analysis it can be determined if organic coagulants can be a viable replacement for non-organic coagulants.

NANOPARTICLE-AIDED ENRICHMENT OF SALMONELLA ON GROUND MEAT OBTAINED FROM VARIOUS TURKEY PARTS

Presenter(s): Devyn Hill (Florida A&M University)
Biosystems & Agricultural Engineering
Mentor(s): Evangelyn Alocilja (College of Agriculture & Natural Resources)

Salmonella causes 1.35 million infections annually in the United States, including 26,500 hospitalizations and 420 deaths. One of the ways to reduce the incidence of these illnesses is by detecting harmful pathogens in food and food systems. Existing detection methods such as the culture method and PCR are effective, however, they can be time-consuming and costly. The novelty use of nanoparticles is being extensively investigated as a potential alternative to current food pathogen detection methods. In this study, a biosensor system that employs magnetic nanoparticles (MNPs) and gold nanoparticles (GNPs) is used to detect Salmonella Enteritidis in ground turkey meat obtained from various parts of the bird. The glycan-coated MNPs are used to concentrate the bacterial cells by adhering to cells, and using a magnet, the MNPs together with the cells are attracted and thus permit the concentration of the cells in a small volume. The DNA of the concentrated cells is extracted and used directly in a DNA biosensor. The biosensor works based on GNPs attached with oligonucleotide probes that bind specifically to Salmonella DNA. The GNPs retain their red color in the solution if Salmonella DNA is present and turns blue if absent. UV-Vis spectrometric measurements were performed to have a quantitative measure of the color of the solution.

This experiment helps to understand the occurrence of Salmonella in poultry products, which in turn can create implications on how to better target industrial food safety and sanitation.

DUCKWEED TOXICITY TESTING IN CRAFT BEVERAGE WASTEWATER

Presenter(s): Jackson Hotchkiss (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Carley Allison (College of Agriculture & Natural Resources), Steven Safferman (College of Agriculture & Natural Resources)

Wastewater treatment allows for otherwise hazardous or dirty water to be rehabilitated to cleaner water that can then be consumed or used for other commercial, agricultural, and industrial purposes. Decentralized wastewater treatment can be carried out at the same site from which the wastewater is produced and has the potential to provide specific treatment on a smaller scale than centralized treatment, which typically treats larger daily volumes and receives water from different sources. This allows for the process to be engineered to provide customized treatment which can reduce overall costs, energy, and land use as well as protect public health and increase the post-treatment water quality. Greenhouse ecosystem processes are a form of decentralized treatment which utilize vegetation and microorganisms to treat wastewater by utilizing aerobic conditions in tandem with natural processes carried out by the plants and microbial life. The craft beverage industry in Michigan has over 600 wineries, breweries, and cideries and the efficacy of such decentralized treatment in cleaning wastewater from this sector is largely unexplored. The goal of this study is to investigate the performance of a greenhouse ecosystem in treating wastewater from Michigan wineries for non-potable use and to investigate the impact of the wastewater on the vegetation through the application of various concentrations of organic and inorganic components. The results can be used to evaluate the potential for implementing similar designs within craft beverage companies by analyzing the extent to which the wastewater is treated.

INVESTIGATING ISOTHERMAL TECHNIQUES FOR SALMONELLA INACTIVATION IN RED CHILI FLAKES, OREGANO, AND ROSEMARY: TOWARDS ACHIEVING FDA-RECOMMENDED 5-LOG REDUCTION

Presenter(s): Jemel Fanfan (Florida A&M University)
Biosystems & Agricultural Engineering
Mentor(s): De'anthony Morris (College of Agriculture & Natural Resources), Kirk Dolan (College of Agriculture & Natural Resources), Natoavina Faliarizao (College of Agriculture & Natural Resources), Teresa Bergholz (College of Agriculture & Natural Resources)

Spices are considered as Ready-to-Eat (RTE) foods with low moisture content and are commonplace in meals to add or improve flavors. Although red chili flakes have natural antimicrobial properties, they have been linked to multiple salmonella outbreaks. Recent FDA reports have also found that oregano and rosemary are also at higher risks for salmonella contamination. Processing techniques for RTE food products are recommended to have at least a 5-log reduction in the target pathogen. A large knowledge gap exists in the investigation of isothermal techniques required to reduce salmonella contamination in red chili flakes, rosemary, and oregano. This study aims to investigate (1) isothermal inactivation of Salmonella Montevideo in these three spices and (2) modeling of the D - and Z - values of salmonella in these three spices. The spices investigated were inoculated with Salmonella enterica serovar Montevideo (S. Montevideo) and Salmonella enteritidis phage type 30 (S. PT30). Inoculated spices were then subjected to heat treatments at 60, 65, 70, and 75 degrees celsius for up to 75 minutes. Survival of the bacteria was assessed via plating on a selective and differential media. The water activity of these spices along with the antimicrobial properties were measured during the experiment. Overall, this investigation will determine the isothermal inactivation parameters for these spices as well as the creation of a mathematical model to reach the FDA recommended 5-log reduction of salmonella within them.

A HIGH-EFFICIENCY DIRECT-AIR CAPTURE AND CO2 UTILIZATION SYSTEM FOR FUEL AND CHEMICAL PRODUCTION

Presenter(s): Bryan Li (Georgia Tech University)
Biosystems & Agricultural Engineering
Mentor(s): Wei Liao (College of Agriculture & Natural Resources), Yan Liu (College of Agriculture & Natural Resources)

Carbon dioxide emissions have increased by 90% since 1970. The cultivation of microalgae has been identified as process that can potentially reduce these emissions by consuming carbon and gaining biomass. A recent study involving the use of formate as the carbon source in this process yielded promising results and a variety of benefits. This research involves the cultivation of algae in the same conditions, but utilizing bicarbonate as a carbon source to compare the two results.

ANALYZING IMPACTS OF LONG-TERM WETLAND PLANTS ON INFILTRATION IN ESTABLISHED SITES AND DEVELOPMENT OF FUTURE CITIZEN SCIENCE RESEARCH

Presenter(s): Ella Harrell (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Dawn Dechand (College of Agriculture & Natural Resources)

Infiltration rates of soils are important for determining water management practices in both agricultural and urban areas. For example, the effectiveness of urban Low Impact Development practices like bioretention basins and stormwater wetlands are substantially impacted by the fraction of water that infiltrates and the dominating treatment processes. Previously conducted studies on the role of plant roots in affecting infiltration have yielded conflicting results on which root type is more conducive to infiltration. Additionally, research has largely utilized new bioretention and wetland columns and sites; therefore, the effects of wetland plants in the long-term are largely unknown. Our project aims to clarify the influence of vegetation on infiltration in established bioretention and wetland sites while developing methods for a citizen science approach to assessing infiltration rates due to plants. Using four different infiltrometers, infiltration rates over three types of vegetation and bare soil will be measured for each site, including one bioretention basin and one wetland that are both older than 10 years. Plants will represent a range of root types. Based on preliminary results, we expect to see an increased rate of infiltration when plant roots are present, with the greatest infiltration rates being in the presence of tap roots. Furthermore, we will compare the quality of data obtained with different infiltrometers. We will also investigate the use of sensors to assess infiltration rates. Ultimately, this research will characterize plant root impacts on infiltration, which allows for more detailed infiltration models to be built based on plant type.

EVALUATING CHANGES IN MICHIGAN'S WEATHER PATTERNS AND THE EFFECTS ON AGRICULTURE

Presenter(s): Christian Loveall (Michigan State University)
Biosystems & Agricultural Engineering
Mentor(s): Ehsan Ghane (College of Agriculture & Natural Resources)

Given recent predictions of an increase in precipitation and heavy rain events throughout the Midwest US, there is an increasing need to explore the effects that these changes in weather patterns will have on agriculture in the region. The current understanding is that the Midwest will see increased precipitation and temperature levels in the coming years, and the goal of this project is to confirm this for Southern Michigan and draw any appropriate conclusions for the agricultural industry in the area. This will be done by collecting the daily weather data, including precipitation, maximum temperature, and minimum temperature, from 5 primary sites throughout Southern Michigan, along with some additional informative sites. Using these sites, a 5-year moving average for daily precipitation and temperature will be determined for the region. The initial results indicate a general trend of increasing precipitation and temperature, a potential correlation between this increase with a decrease in the number of viable planting days for farms in the same area, and that these changes are dominated by a small fraction of days during specific times in the year.

FOODOXS: A DATABASE OF DIETARY OXIDIZED LIPIDS

Presenter(s): Yashasvi Vaidya (University of Michigan)

Biosystems & Agricultural Engineering
Mentor(s): Ilce Medina Meza (College of Agriculture & Natural Resources)

Dietary oxysterols (DOxS) or cholesterol oxidation products (COPs) are molecules derived from the oxidation of a parent compound (cholesterol and phytosterols), but with an additional hydroxyl, ketone, or epoxy group. They are known to exert pro-inflammatory, pro-oxidant, pro-fibrogenic, and pro-apoptotic toxic effects, leading to chronic diseases. They can be produced in the body or by food processing because of the reaction of reactive oxygen species (ROS) with cholesterol. DOxS are of major concern due to their prevalence in ultra-processed foods (UPFs), which are defined by the NOVA classification system as industrially manufactured, ready-to-eat meals with minimal whole foods. Analyzing DOxS' content in foods can provide insight into their fate across the food supply chain, the current need for changes in food processing methods, and the reevaluation of their presence in our diet. DOxS presence in tissues can also be used as biomarkers for chronic diseases such as osteoporosis, hypertension, and atherosclerosis, among others. Phytosterol oxidation products (POPs) are suspected to have a similar effect as DOxS due to the structural similarity of phytosterol and cholesterol. There is substantial data from several studies on the presence of DOxS and POPs in common food items, however, this data has not been uniformly presented. The FooDOxS database contains data from 100+ studies converted into uniform units with NOVA categorization of each food item. This will allow food industrialists and healthcare professionals to easily review DOxS and POP data to help reduce exposure, lowering their adverse health effects on human health.

CELL BIOLOGY, GENETICS & GENOMICS

PREDICTING CO-FUNCTIONAL GENE PAIRS IN YEAST

Presenter(s): Sophie Bekerman (Harvey Mudd College)
Cell Biology, Genetics & Genomics
Mentor(s): Shinhan Shiu (College of Natural Science)

Experimentally identifying co-functional genes is a laborious process, but doing so is vital for understanding gene functions. We used computational methods to accelerate the process of identifying co-functional gene pairs. A genetic interaction (GI) between two genes occurs when mutations in both genes result in an unexpected phenotype. Thus, we hypothesized that GIs may be predictive of co-function. We defined co-functional gene pairs as two genes belonging to the same metabolic pathway. We then used previously published fitness data from the global yeast genetic interaction network, which contains fitness information for single and double mutants, to test existing definitions of GI and to find better methods for identifying co-functional genes from fitness values. Commonly used definitions for genetic interaction consist of taking the product, sum, minimum, or logarithm of fitness values of single mutants to get the expected value of double mutant fitness for a gene pair. We showed that these existing GI definitions do not accurately predict co-functionality. By training a Multilayer Perceptron model on the fitness values, we were able to more accurately predict co-function, indicating that this method better captures genetic interaction. These results help us better understand how GI networks can be used to identify co-functional gene pairs, leading to better predictions in genetic studies.

STUDY OF PTPN11 DRIVER MUTATIONS IN HEMOPHAGOCYTIC HISTIOCYTIC SARCOMA IN BERNESE MOUNTAIN DOGS

Presenter(s): Ishana Kapoor (Michigan State University)
Cell Biology, Genetics & Genomics
Mentor(s): Alexander Engleberg (College of Natural Science), Vilma Yuzbasiyan-Gurkan (College of Veterinary Medicine), Ya-ting Yang (College of Veterinary Medicine)

Histiocytic sarcoma (HS) is an aggressive cancer of cells of macrophage and dendritic cell lineage. While HS is a rare cancer in both humans and dogs, certain breeds of dog such as the Bernese Mountain dog (BMD) have a high prevalence rate, about 25%, which gives us an opportunity to study to understand this rare disease. Previous studies from our lab have identified driver mutations in PTPN11, an oncogene in a major cell proliferation pathway, the MAPK pathway. Hemophagocytic histiocytic sarcoma (HHS) is another type of malignant histiocytic disease which is characterized by destruction of normal erythrocytes by the proliferating cancer cells. The aim of this study was to find the frequency of driver mutations in the PTPN11 gene for HHS. We extracted DNA from 21 BMD tissue samples, with confirmed HHS, and carried out genotyping and sequencing. Our preliminary results reveal that 7 of 21 cases (33%), carry a mutation in PTPN11 associated with oncogenesis, resulting specifically in E76K or the G503V amino acid substitutions, residues that are major hotspots for mutations identified in our previous studies. Our findings indicate that HHS tissues have a similar prevalence of mutations in the PTPN11 gene as do HS tissues, where the prevalence is about 43%. Most importantly, the findings point to activation of the same pathway in both HS and HHS. Specific inhibitors of this pathway are available, and thus can be utilized for HHS cases. Further studies investigating other mutations in HHS are ongoing and can identify additional targeted therapies.

ANALYSIS OF CARDIAC STEM CELL SIGNALING MEDIATORS USING ZEBRAFISH EMBRYO MODELS

Presenter(s): Summer McLane-Svoboda (Michigan State University)
Cell Biology, Genetics & Genomics

Mentor(s): Aitor Aguirre (College of Engineering), Amanda Huang (College of Natural Science)

Previous data collected from the Aguirre lab indicates some omega-3 fatty acid-derived oxylipins could be important signaling mediators in cardiac stem cells. Using Zebrafish embryos as a study model, in vivo analysis of these fatty acids was conducted. Zebrafish were bred to incorporate double transgenic mlc2v-dsRed and fli1-eGFP genes in the embryos. Both genes allow for the labeling of the heart in red fluorescence and blood vessels in green fluorescence. Pronase was used to remove the chorion from the embryo before a target drug screening process. Selection for double transgenic embryos without chorions was performed to identify abnormalities in cardiac development. The main objective is to identify at least one drug that inhibits a specific oxylipin, leading to abnormal development that identifies cardiac development mediators.

EVALUATING THE EFFECTS OF PH ON BACTEROIDES FRAGILIS GROWTH

Presenter(s): Damone Charleston (Michigan State University)
Cell Biology, Genetics & Genomics
Mentor(s): Sean Crosson (College of Natural Science)

Bacteroides fragilis is an anaerobic organism that makes up 0.5% in healthy individuals in their gut microbiota. B. Fragilis often blooms in the guts of those who suffer from inflammatory bowel disease (IBD). With B. Fragilis reaching up to 50% or greater in those individuals with compromised gut microbiota. The gut microbiota is a dynamic community of microorganisms made up of bacteria, fungi, viruses fungi, and within this complex microbial interactions are taking place. These interactions in the gut have local and systemic effects on other microbes as well as the host itself shaping the ecological networks of the gut microbiota. These microbial cells have to overcome vast conditions adapting to gradients in O2, and pH. Little to much is known or studied about the mechanisms and the process that these bacteria go through within the gut microbiota. A B. fragilis strain was isolated from an ulcerative colitis (UC) patient to assess the pathways and genes that impact fitness in varying pH levels. A well plate reader was used to assess the growth rate of each B. fragilis strain. As well as nonyl acridine orange (NAO) dye to see the amount of cardiolipin within the cell. Bacteroides fragilis defect was observed across all acidic pH levels. Showing the important role cardiolipin plays in reducing membrane leaking.

INVESTIGATING POSSIBLE LINKS BETWEEN VASCULAR DISRUPTIONS AND CONGENITAL CLEFT PALATE

Presenter(s): Madelyn Jeffrey (Michigan State University)
Cell Biology, Genetics & Genomics
Mentor(s): Brian Schutte (College of Osteopathic Medicine)

1 in 1500 children across the globe are born with cleft palate making it one of the most common birth defects. Cleft palate is potentially lethal because it prevents proper nutrition and may lead to aspiration. Cleft palates are congenital defect causing abnormal opening of the roof of the mouth due to failure in apoptosis of periderm, a tissue that temporarily covers the surface of a developing fetus. We use animal models of cleft palate to research palate formation and genetic risks. One of our studies followed a large family of dogs with an abnormally high frequency of cleft palate in the offspring. A portion of these offspring also suffered from Terminal Transverse Limb Deficiency (TLD) when limbs are not fully or properly formed. TLD is associated with vascular disruption events causing improper angiogenesis. Angiogenesis occurs in fetal development to create channels to deliver nutrients and oxygen to extremities; deficiencies are associated malformations. We are researching if vascular disruptions are also associated with cleft palates as in TLD. In our previous studies using immunohistochemistry, we obtained results suggesting expression of CD31, a protein marking angiogenesis, is reduced in dogs with cleft palate. We are conducting western blots to further study and quantify expression of CD31.

ENGINEERING EXTRACELLULAR VESICLES AS THERAPEUTIC DELIVERY VEHICLES FOR TYPE 1 DIABETES

Presenter(s): Jeannie Lam (Michigan State University)
Cell Biology, Genetics & Genomics
Mentor(s): Masako Harada (College of Engineering)

Type I diabetes (T1D) is an autoimmune disease that results in the body's immune system attacking its pancreatic β cells, leading to β cell destruction and decreased insulin production. Insulin replacement is the current method of managing T1D. One limitation of this treatment is that it is not a cure and must be regularly administered. This treatment does not promote the regeneration of β cells. Extracellular vesicles (EVs), naturally occurring membrane-bound vesicles. EVs are mediators of intercellular communication through transporting and delivering proteins, lipids, and nucleic acids. Their functional capabilities have led to the potential use of engineered EVs as therapeutic delivery vehicles. Our project aims to generate EVs presenting a β cell targeting single chain variable fragment (scFV), SCAB1, on the surface. These engineered EVs generated will then be tested on a pancreatic β cell line, NIT-1, to assess their capacity to target β cells. These results will contribute to the development of a targeted delivery system for therapeutic drug delivery to pancreatic β cells aiming to ultimately provide a β cell regenerative EV treatment option for T1D patients.

THE ROLE OF CIDI.3.2 IN DROSOPHILA MELANOGASTER EYE DEVELOPMENT

Presenter(s): Gabrielle Makonnen (University of Detroit Mercy), Maryam Qoda (University of Detroit Mercy)
Cell Biology, Genetics & Genomics
Mentor(s): Jacob Kagey (University of Detroit Mercy)

A novel allele of Cid (centromere identifier), CidI.3.2, was recently discovered to result in a complete lack of a head in a mosaic eye genetic background. It is important to understand the reasoning behind this so that it can be used to help cancer research in humans. Our research goal is to utilize larval dissection, recombination, and immunohistochemistry to identify how this mutation results in a loss of head during development. The CidI.3.2 allele is an insertion likely eliminating protein function. To utilize a model of reduction, but not loss of Cid, we moved to an RNAi system to reduce expression without complete removal. From these experiments we have found that reducing Cid expression in early eye development results in a dramatic loss of eye size, while reducing Cid expression later in eye development has minimal effects on tissue size. Additionally, we find smaller impacts of Cid reduction in the posterior compartment of the wing. Overall, our findings show the importance of developmental timing with regards the necessity of Cid for Drosophila development.

A GENETIC SCREEN IDENTIFIES ENHANCERS AND SUPPRESSORS OF THE APOPTOSIS-INDUCING FACTOR (AIF) MOSAIC PHENOTYPE IN DROSOPHILA MELANOGASTER

Presenter(s): Emily Danile (University of Detroit Mercy)
Cell Biology, Genetics & Genomics
Mentor(s): Jacob Kagey (University of Detroit Mercy)

Apoptosis-Inducing Factor (AIF) is a gene that contributes to cell death and the formation of the respiratory chain. AIF is found on the gene 2L of the Drosophila, we recently identified a strong mosaic eye phenotype for the allele AIF18244. Given that there is not much known about the genetic interactions of AIF during Drosophila development, we conducted an EMS mutagenesis screen to look for enhancers and suppressors of this phenotype. The work is now focused on mapping and characterizing individual mutants, including mutant 4.14.

ENGINEERING EXTRACELLULAR VESICLES AS GENE DELIVERY CARRIERS FOR TYPE 1 DIABETES

Presenter(s): Vasudha Nimmagadda (Michigan State University)
Cell Biology, Genetics & Genomics
Mentor(s): Masako Harada (College of Engineering)

Extracellular vesicles (EVs) are a type of small, membrane-bound structures that are released by cells into the extracellular space. EVs play a vital role in intercellular communication as they are able to circulate cargo such as nucleic acids, proteins, and lipids. The specific composition of EV cargo is dependent on the cell from which they are secreted from. The therapeutic potential of engineered EVs as a means of delivery primarily stems from their remarkable capacity to transport cargo effectively, safeguarding it during the delivery process. This project specifically centers around harnessing this potential in the context of Type 1 Diabetes (T1D). T1D is an autoimmune condition in which the body is unable to produce sufficient amounts of insulin, a hormone essential for regulating blood sugar levels, due to the autoimmune destruction of pancreatic b cells. At present, there exists no conclusive and enduring treatment option for T1D apart from the daily administration of insulin injections or the use of insulin pumps. This project seeks to create a focused therapeutic delivery vehicle utilizing engineered EVs, with the aim of targeting pancreatic b cells for curative treatment using an in vitro model.

CRISPR-CAS9 KNOCKOUT OF TPPP3 IN CISPLATIN-RESISTANT OVARIAN CANCER CELLS REDUCES TUMOR GROWTH IN VIVO

Presenter(s): Samuel Sanderson (Michigan State University)
Cell Biology, Genetics & Genomics
Mentor(s): Adriana Ponton Almodovar (College of Human Medicine), Sachi Horibata (College of Human Medicine)

Ovarian cancer is the deadliest gynecological condition and is predicted to be the fifth leading cause of cancer-related death among women in 2023. Many patients respond well to the current chemotherapeutic regimen of platinum-based drugs in combination with paclitaxel. However, approximately 80% will later develop recurrent tumors that are highly resistant. This has led to a need for new targets to be identified in chemo-resistant ovarian cancer to inhibit growth and prevent metastasis. Previous RNA sequencing experiments have revealed the gene Tubulin Polymerization Promoting Protein 3 (TPPP3) to be highly upregulated in cisplatin-resistant ovarian cancer. TPPP3 is known to be involved in proliferation and metastasis in non-small cell lung carcinoma (NSCLC); however, its role in ovarian cancer has not yet been investigated. To study the role of TPPP3 in tumor growth in vivo, we utilized a BALB/c mouse xenograft model. We administered subcutaneous flank injections of cisplatin-resistant ovarian cancer cells with and without CRISPR-mediated TPPP3 knockout. Over 4 weeks, TPPP3 knockout mice displayed a significant decrease in tumor growth and weight, suggesting that TPPP3 serves an important role in the growth of cisplatin-resistant ovarian cancer.

SINGLE PIECE CLONING OF PLASMID USING SEAMLESS LIGATION CELL EXTRACT (SLICE)

Presenter(s): Jishnav Arcota (Michigan State University)

Cell Biology, Genetics & Genomics
Mentor(s): Masako Harada (College of Engineering)

Gaussia Luciferase (gLuc) is the most advantageous bioluminescent reporter in the scientific community, due to its properties allowing for easy kinetics analysis. (Maguire et al. 2009). This project aims to clone a fragment of the pcDNA gLuc-C1C2 plasmid to then be able to make a smaller plasmid of pcS gLuc-C1C2 through the Seamless Ligation Cell Extract (SLiCE) method. The Seamless Ligation Cell Extract Method entails the recombination of homologous DNA fragments into a single DNA molecule. Having a smaller plasmid will typically have fewer base pairs, making them easier to manipulate during cloning procedures. They are often easier to isolate, purify, and handle in the laboratory. To get this specific part of the plasmid, the plasmid was denatured into single strand DNA and amplified using PCR. Using techniques such as gel electrophoresis, purification, and quantification will allow for there to be ample PCR products for further testing. Seamless Ligation Cell Extract will be used to recombine the amplified single piece of DNA into pcS gLuc-C1C2. Further steps include transformation and colony PCR to determine if the inserted DNA is present or not in the bacterial colony. Finally, through the process of inoculation and miniprep, the amount of recombinant plasmid will be amplified, so that it can be used for further experiments. In the future, this prepared DNA can be used in extracellular vesicles (EVs) experiments due to its bioluminescent properties. This DNA will code for proteins that will attach to the surface of EV's allowing for the tracking of EVs.

THE ROLE OF IRF6 IN PERIDERM FUNCTION AND PALATE DEVELOPMENT

Presenter(s): Akilah Hodge (University of the Virgin Islands)
Cell Biology, Genetics & Genomics
Mentor(s): Brian Schutte (College of Osteopathic Medicine)

Cleft palate is a birth defect that affects 1 in 1700 babies born in the United States. This congenital disorder is characterized by an opening in the roof of the mouth. This opening occurs during early fetal development when the tissues that form the palate fail to fuse properly. Severity can vary, ranging from a small opening at the back of the palate to a complete separation extending through the entire palate. The developing palate is composed of three cell types, the mesenchymal cells, a single layer of basal epithelial cells and a superficial (outermost) layer of periderm. Previous evidence has linked DNA variation in the Interferon Regulatory gene 6 (IRF6) with an increased risk of developing cleft palate. During palate development, IRF6 is expressed in the periderm, initially, and then the basal epithelial cells. To identify the unique role of IRF6 in the periderm, we expressed a mutant form of IRF6 specifically in periderm in mouse embryos. We hypothesize that the mutant embryos will have abnormal oral epithelial adhesions between the palatal shelves and the tongue, which may lead to cleft palate. To test this hypothesis, we will perform morphological analysis of coronal section mouse embryo heads (collected on embryonic day 13.5) to screen for abnormal adhesions of oral tissues. To date, I have analyzed eleven embryos and have seen no evidence of abnormal oral adhesions. However, the genotypes of these embryos has not been revealed yet, so I do not know if the embryos are wild type or mutant. keywords: Cleft palate, IRF6 gene, periderm, mice, embryos

A PROMISING PULMONARY IMAGING METHOD: MAGNETIC PARTICLE IMAGING

Presenter(s): Eric Thompson (Alabama State University)
Cell Biology, Genetics & Genomics
Mentor(s): Ping Wang (College of Human Medicine), Saumya Nigam (College of Human Medicine)

Imaging is an integral part of precise clinical diagnostics and therapies. Various imaging modalities have been explored and subsequently employed in current clinical settings like Magnetic resonance imaging (MRI), Positron emission tomography (PET), computerized tomography (CT), single-photon emission computerized tomography (SPECT), etc. To further aid and improve their performances and spatial resolution, imaging probes/tracers are used, to which field nanotechnology can contribute. These nanoparticles can be tailored according to the intended use and maximize the imaging capabilities of the abovementioned techniques. Magnetic Particle Imaging (MPI) is one such technique that was developed about 2 decades ago. It directly detects superparamagnetic iron oxide nanoparticles and their non-linear magnetization to generate high-quality images. Herein, we propose to fabricate iron oxide nanoparticles with improved magnetic qualities which in turn enhance both their signal intensity and spatial resolution. Agarose phantoms of these nanoparticles were imaged in MPI and their corresponding intensities were recorded for known concentrations. These nanoparticles were then administered into the lungs of a mouse model and 2D and 3D MPI scans were acquired. The results showed that 2D MPI intensity was linearly proportional to the concentration of iron in the samples. Also, it was seen that the nanoparticles were successfully delivered to the lungs without any off-target accumulation. The intensity from the lung was seen to be substantially high with a precise outline of the lung further conforming to our claims of improved resolution. The observed results showed that improvement of the properties of nanoparticles can directly affect their MPI performances. In addition, MPI proved to be a valuable tool for lung imaging applications in small animal models.

IMPACT OF NEUROGENIN 3 ON ZEBRAFISH ENTERIC NERVOUS SYSTEM DEVELOPMENT

Presenter(s): Ben Oudsema (Michigan State University)
Cell Biology, Genetics & Genomics

Mentor(s): Julia Ganz (College of Natural Science)

The enteric nervous system (ENS) is a mesh of neurons along the gastrointestinal tract that controls its functionality including gut motility, secretion of gastrointestinal enzymes, and blood flow. Despite the important function of the ENS, its development is not fully understood, particularly what genes control neuronal development in specific regions of the gut. Neurogenin3 (neurog3) is a member of the Neurogenin family of transcription factors, which play a role in the specification of neuronal differentiation. Neurogenin3 is predicted to be involved in nervous system development. Preliminary data suggest that functional loss of neurog3 results in loss of ENS neurons in the intestine. We hypothesize that if neurog3 has an impact on the development of the zebrafish ENS there should be a difference in the ENS in larvae where Neurogenin3 functions normally and larvae with a mutant allele that renders Neurogenin3 inactive, sa211. To test this hypothesis, we performed immunohistochemistry using ElavL to mark the neurons present in 5-day-old zebrafish larvae from a cross between heterozygous carriers of the mutant neurog3 allele. We then determined the genotype of each larva. Next, we would have analyzed if there was a noticeable difference in neuron expression between wild-type, and homozygous mutant larvae however, the ElavL staining had faded by the time we genotyped the larvae. This meant we were unable to continue forward with the phenotype analysis. This project aims to further our understanding of how the ENS develops, by further understanding this we can provide better treatment for those with ENS disorders.

DETERMINING THE MOLECULAR FUNCTION OF PDH1
Presenter(s): Carvin Coleman (University of Detroit Mercy)
Cell Biology, Genetics & Genomics
Mentor(s): Nicole Najor (University of Detroit Mercy)

Putative 2-methylcitrate dehydratase (PDH1), is a S. cerevisae mitochondrial protein that plays a role in respiration. It is known to be involved in the propionate metabolic process, but its specific molecular function has not been identified. To determine this function, PDH1 underwent a series of fitness tests. These tests consisted of two types of media, UV light and temperature variation. Previous tests suggested a growth defect on glycerol media which is likely due to the diauxic shift the yeast undergoes when a switch from a high glucose media to a non-fermentable carbon source (glycerol) occurs. Also, previous data demonstrated a growth defect when exposed to ultraviolet radiation. According to research, oxidative stresses from UV can hinder the growth of mitochondrial proteins resulting in a defect. However, with more recent tests, we're noticing the opposite of growth defects on glycerol media and exposure to UV. We're beginning to see little to no effect of PDH1 on glycerol media while UV seems to improve its growth. It is unclear what is causing this change. Therefore, further testing is necessary to fully understand the behavior of this mitochondrial protein and determine its molecular function.

A KILLER COMBINATION: GENOMIC CODON POLYMORPHISMS CONTRIBUTIONS TO PREDISPOSITION OF CHRONIC WASTING DISEASE

Presenter(s): Devin-Danielle Webb (North Carolina Agricultural & Technical State University)

Cell Biology, Genetics & Genomics

Mentor(s): Joseph Darish (College of Veterinary Medicine), Srinand Sreevatsan (College of Veterinary Medicine)

Background or Significance: Transmissible Spongiform Encephalopathies (TSEs or Prion Diseases) are transmittable, fatal, and untreatable neurodegenerative diseases TSE's have been expressed as Zoonotic diseases and thus pose a significant threat to human beings. For instance, TSEs have manifested as scrapie in sheep, Bovine Spongiform Encephalopathy in Cattle, Creutzfeldt-Jakob Disease in Humans, and Chronic Wasting Disease (CWD) in the Cervine family. Similar to other prion diseases, CWD is caused by misfolding of prion protein. According to recent discovery, polymorphisms of prion protein (PrnP) at codons 95, 96, 116, and 226 may play a significant role in the genetic predisposition or deterrence of CWD susceptibility; e.g. Heterozygous prion protein at the 116 codon (AG) are assumed to be less susceptible to prion misfolding in White-Tailed Deer in comparison to homozygous prion protein at the 116 codons (AA). Real-Time Quaking-Induced Conversion (RT- QuIC) is an assay utilized to improve specificity in detecting specimens infected with the CWD prion. Prion seeds (PrP molecules) have the ability to misfold regularly folded proteins and form prion aggregates (amyloid fibrils). Clinical laboratory test specimens being studied for detection of Prion Protein are combined with Syrian hamster brain homogenate that has a known excess of PrP molecules. Relatedly, an amyloid-sensitive dye that detects the presence of amyloid fibrils is added to a buffer. Subsequently, the plate is inserted into an ultrasensitive fluorescent plate reader that shakes the reaction and measures fluorescence; if prion seeds are present, an increase in fluorescence will appear.

CHEMICAL ENGINEERING & MATERIALS SCIENCE

STRUCTURES AND DYNAMICS OF SOLVENT-FREE POLYETHER BASED SOLID POLYMER ELECTROLYTES

Presenter(s): Brooke Hirst (Michigan State University)

Chemical Engineering & Materials Science

Mentor(s): Shiwang Cheng (College of Engineering), Soma Ahmadi (College of Engineering)

Solvent-free solid polymer electrolyte is a critical component to next-generation battery technology, such as lithium-metal batteries. However, current development of the solvent-free solid polymer electrolyte has been limited by their low ionic conductivity. In this work, we investigate the influence of ion to the structures and dynamics of several newly synthesized polyethers. Differential scanning calorimetry (DSC), broadband dielectric spectroscopy, and rheology has been employed to characterize the phase separation, polymer dynamics, ionic conductivity, and flow properties of these solvent-free polyether electrolytes and will be presented in this work.

EMPLOYING NUCLEAR SPIN FREE LIGANDS FOR THE SYNTHESIS OF LANTHANIDE BASED QUBITS

Presenter(s): Katie Colesa (Grand Valley State University)
Chemical Engineering & Materials Science
Mentor(s): Saroshan Ranpati-Devage (College of Natural Science), Selvan Demir (College of Natural Science)

Modern society relies on computers for education, business, healthcare, and social interaction. In a classical computer, data is stored in a classical bit which can achieve the states '0' or '1'. In contrast, a qubit, the processing unit of a quantum computer, functions in a superimposed state of the two. Therefore, N number of qubits can process data that is equivalent to what can be processed by 2N number of classical bits and provide the potential to increase processing speed, store more information, and solve intricate problems. The performance of a qubit is greatly influenced by its coherence time, which is the lifetime of the superposition. Due to the quantum nature of electrons and their two well-defined spin states, they are currently probed as potential qubit candidates. As the fundamental understanding of molecular electronic spin expands, there is an emphasis placed on lanthanide coordination complexes for a new class of spin qubits. Lanthanides often exhibit paramagnetic ground states that may benefit applications in quantum information science. Here, we develop lanthanide-oxocarbon complexes as a promising platform for spin-based qubits, as the nuclear spin-free oxocarbon ligand largely prevents decoherence. We will discuss the synthesis and characterization of these new lanthanide compounds along with the studies of their qubit behavior.

A PLANT IMMUNE RECEPTOR WITH DIVERSE REPEATS: STABILITY CALCULATIONS OF MUTATED FLS2 LEUCINE RICH REPEATS

Presenter(s): Samantha Schulte (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Ben Dolgikh (College of Natural Science), Daniel Woldring (College of Engineering)

There have been no small number of bacterial infections throughout history that have devastated entire crop populations. To defend against bacterial infections, plants possess an innate immune system consisting of receptors for highly conserved signatures of microbes, termed microbe-associated molecular patterns (MAMPs). Perception of bacteria in Arabidopsis thaliana is facilitated by FLAGELLIN-SENSING2 (FLS2), a receptor like kinase that binds bacterial flagellin. Some bacteria species have evolved to evade recognition by FLS2. To improve pathogen perception by generating improved FLS2 sequences, we believe mutations must be made to the extracellular leucine-rich repeat (LRR) domain, which binds flagellin. Generating random mutations is unlikely to result in improved or even functional proteins, as most modifications to existing protein sequences are destabilizing. This limits our ability to generate novel sequences. By using computational modeling tools, we can predict the positions most amenable to mutation. The change in stability associated with every possible point mutation in the LRR domain of FLS2 was predicted utilizing two computational algorithms, FoldX's PositionScan and Rosetta's ddG_monomer. The results were compared to identify mutations predicated to be stabilizing by both softwares. This information will be used to guide mutagenesis of FLS2 toward improved pathogen recognition.

A COLORFUL FLOW REACTION TO BRING CHEMICAL ENGINEERING TO THE ARTS

Presenter(s): Kat Hummer (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Maddalena Fanelli (College of Engineering)

The current study applies chemical engineering principles, such as fluid flow, process control, and kinetics, to make colorful and ever-changing living art. We mix a red cabbage indicator solution and solutions of varying pH, made from sodium hydroxide and acetic acid, to generate colorful liquid streams that can be pumped through transparent tubing or printed channels to create colored designs. Using small peristaltic pumps and an Arduino UNO, we can program the colors to change over time to fit given themes or artistic effects. Red cabbage (Brassica oleracea var. capitata f. rubra) is a natural pH indicator that is commonly used because of its safety, accessibility, and vibrant colors. Red cabbage contains anthocyanin compounds whose ionic nature results in a range of observable colors based on its environment. Acidic environments (pH less than 7) induce red hues, while basic environments (pH greater than 7) lead to green or yellow hues. Red cabbage indicator solutions are very versatile, allowing for a reversible transition through the color spectrum by manipulating the pH. Although this work is only a proof of concept, we envision developing more intricate designs to further explore the relationship between chemical engineering and the creative arts.

TOWARDS A NOVEL TECHNIQUE FOR ISOTOPE HARVESTING AT THE FACILITY FOR RARE ISOTOPE BEAMS (FRIB)

Presenter(s): Suvan Campbell (Andrews University)
Chemical Engineering & Materials Science
Mentor(s): Katharina Domnanich (Facility for Rare Isotope Beams)

At the Facility for Rare Isotope Beams (FRIB) secondary, rare-isotope beams are generated for nuclear physics experiments. In this process, the unreacted portion of the primary beam is directed into a water-cooling beam dump system by which a variety of radionuclides is created. The radionuclides can be collected from the water using collector materials and separated into isotopically pure samples using a mass separator in a process termed 'isotope harvesting.' Metal oxides are seen as a viable collector material to use in the process of isotope harvesting due to their high temperature resistance which enables the direct combination of isotope collection and the mass separation process. The project goal is to expand the catalog of potential metal oxides in the isotope harvesting project at FRIB and to discover the effect that the point of zero charge (PZC) has on adsorption effectiveness. This was achieved by performing batch mode simulation experiments using stable element homologues of arsenic, chromium, cobalt, copper, manganese, nickel, scandium, selenium, vanadium, and zinc derived from ICP standards. PZC determination was performed via similar experiments utilizing pH-balanced matrices and measuring the change in pH. So far several metal oxides, including ZrO_2, Y_2O_3, MgO, TiO_2, CeO_2, and 100nm TiO_2 nanoparticles, were tested. MgO was the most effective of the metal oxides with adsorption efficiencies between 83-100% for all of the tested metal ions. The results indicated that the adsorbent capabilities of various metal oxides could be valuable for isotope harvesting from the water-cooling beam dump system of FRIB.

PHASE BOUNDARY MAPPING

Presenter(s): Brian Tijan (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Ashiq Shawon (College of Engineering)

I am conducting research for the Zevalkink Research Group, specifically on an AMX compound semiconductor, CaAgSb, and varying the composition to determine how the thermal and electronic properties vary. I am trying to lower the carrier concentration, as CaAgSb proves to be a decent thermoelectric given its orthorhombic crystal structure.

QUANTUM EMITTERS IN HEXAGONAL BORON NITRIDE FOR QUANTUM INFORMATION PROCESSING APPLICATIONS

Presenter(s): Theresa Alberth (Elmhurst University)

Chemical Engineering & Materials Science
Mentor(s): Jonas Becker (College of Natural Science)

Defects in hexagonal boron nitride (hBN) have attracted wide interest as quantum sensors and single photon sources. Due to its ultra-wide bandgap, hBN has been found to host a variety of optically active point defects. We focus on the negatively charged boron (VB-) within hBN as it has been shown to be an especially sensitive quantum sensor. However, although these defects provide promising results for quantum sensing, current fabrication methods preclude their use in arrays and photonic devices. Ultrafast laser fabrication has been demonstrated to create single defects with high precision and yield within the solid state. Here, we present confocal fluorescence spectroscopy and optically detected magnetic resonance (ODMR) of both helium ion irradiated hBN as well as spectroscopy of laser written arrays in hBN. We detected emission between 700 nm and 1000 nm indicating the presence of the VB- defect. By measuring the ODMR of these defects, we demonstrated a contrast of up to 13.4%, which was optimized with respect to a microwave power of 22 dBm. These results are comparable and, in some cases, exceed the ODMR values observed by others. Being able to understand how to maximize ODMR contrast while also minimizing the microwave power will help us develop more efficient fabrication methods for the VB- defect which can be used to further improve quantum sensing technology.

ANALYZING THE RELATIONSHIP BETWEEN HARDNESS AND AGING OF HEAT TREATED ATI 718PLUS NICKEL BASED SUPERALLOY

Presenter(s): Prottoy Samir (Bard College)
Chemical Engineering & Materials Science
Mentor(s): Tanzilur Rahman (College of Engineering)

ATI 718Plus nickel superalloy samples were solutionized at 1000˚C for 1 hour and then one-step aged at 900˚C for 2 hours, 720˚C for 10 hours and two-step aged first at 900˚C for 2 hours and then at 720˚C for 10 hours. They were then exposed to 704˚C for varying times from 0 hours to 200 hours. Microstructural images of the samples were taken to look at gamma prime (γ') precipitates. Vickers Hardness (HV) values were collected for each sample to correlate with precipitation size and volume fraction. The results show that the two-step aged bimodal samples overage at 50 hours, the 900˚C aged sampels overage at 50 hours and the 720˚C aged samples do not overage before 200 hours. With few exceptions, the HV data remain consistent with images of precipitates that show precipitation size and volume fraction. The results bring motivation to find more accurate techniques to measure precipitation parameters, such as size and volume fraction, to understand inconsistencies at exception-points with hardness measurements.

POLYETHER SYNTHESIS UTILIZING AMINE BASED INITIATORS

Presenter(s): Anthony Zhu (Ohio State University)
Chemical Engineering & Materials Science
Mentor(s): Robert Ferrier (College of Engineering), Shaylynn Crum-Dacon (College of Engineering)

Polyethers are a branch of polymers that have uses in a wide range of fields including but not limited to separation membranes, lithium-ion batteries, surfactants, cosmetics, and drug development. This versatility can be attributed to the precursor of polyethers - epoxides, which make incredible monomers due to their ring strain and varying side chains. The ring strain provides a constant driving force for polymerization while adjusting the functional group attached allows for fine tuning of properties to fit the desired purpose. In an attempt to enhance biocompatibility of polyethers for biomedical application, this study looks to utilize three different amine-based initiators. The starting material for these initiators were aminopropanol, N-ethylethylenediamine, and benzylamine respectively. All starting materials were reacted with trimethylaluminum to obtain the initiator product. These initiators were then each combined with a common catalyst, NAI adduct, and various epoxide monomers to synthesize three different polyethers: polypropylene oxide (PPO), polybutylene oxide (PBO), and polyepichlorohydrin (PECH). The resulting polyethers with amine head groups are useful industrial compounds with adaptable functionality.

IDENTIFICATION OF A PEPTIDE FOR TARGETING DNA-LOADED EXTRACELLULAR VESICLES IN CANCER CELLS

Presenter(s): Fahim Ahmed (Medgar Evers College, City University of New York)
Chemical Engineering & Materials Science
Mentor(s): Dr. Masamitsu Kanada (College of Natural Science), Dr. Assaf A. Gilad (College of Engineering)

Breast cancer has the highest incidence and mortality rates among all types of cancer in the United States [1]. Approximately one in eight women will develop breast cancer at some point during their lifetime [1]. Chemotherapy is considered the primary therapy for metastatic breast cancer, but it lacks specificity in targeting cancer cells. To address this challenge, researchers are exploring targeted therapy as nanomedicine. Nevertheless, significant challenges arise from biological barriers within the blood, brain, and tumor microenvironments, imposing limitations on these approaches. Extracellular vehicles (EVs)-mediated transfer is an emerging form of therapy to transfer biomolecules to cancer-specific cells. Over the past decade, researchers have applied several genetic engineering approaches to modifying the EV's surface to target specific cells or tissues. EVs may carry foreign DNA to deliver to cancer cells. Consequently, the delivered DNA could express therapeutic molecules in the recipient cancer cells and induce cell death. This study focuses on targeting peptide sequences that bind to the surface of EVs. These peptides will serve as a targeting agent to facilitate the transport of EVs to specific cells. We aim to introduce foreign DNA into MDA-MB-231 breast cancer cells through EV engineering. We utilized EV membrane modification, as described in "A Dual-Reporter Platform for Screening Tumor-Targeted Extracellular Vesicles [2]." By utilizing this article, we have discovered a collection of peptides. We aim to characterize the ability of DNA-loaded extracellular vesicles to deliver DNA to cancer cells through receptor-mediated membrane endocytosis and peptide conjugation on the surface membrane of EVs.

ELECTROSPUN GELATIN-BASED SCAFFOLDS: AN ALTERNATIVE PROCESS TO 3D BIOPRINTING

Presenter(s): Pranavi Gudi (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Christina Wark (College of Engineering), Scott Calabrese Barton (College of Engineering)

Materials designed for cell viability have become an important factor in tissue engineering applications. Gelatin and some of its hybrid polymers have been shown to serve as a more readily available alternative to collagen while also improving cell viability. A common approach to creating a mesh of polymer for cell growth has been 3D bioprinting where hydrogel inks of polymer and cells are 3D printed into a matrix. However, extrusion printing can be too harsh on the cells which can cause death. In current work, we have begun to electrospin gelatin materials at various concentrations. Because providing sufficient oxygen to sustain cell survival is a challenging problem, calcium peroxide was incorporated into the electrospinning process. Electrochemical water splitting will allow for advanced tuning of oxygen presence. For a scaffold to act as an anode, a suitable material for an OER electrode is necessary. Carbon Black (CB) provides a high electrical conductivity, high surface area, and high porosity so it was also incorporated into the electrospinning process. Upon completion, we characterize the mats by thickness, weight, and fiber diameters measured in SEM images. These measurements allow for estimation of area available for cells to be embedded.

ANALYSES OF STRAIN-INDUCED DEMIXING OF ENTANGLED POLYMER SOLUTIONS THROUGH TEMPERATURE-MODULATED DIFFERENTIAL SCANNING CALORIMETRY AND BROADBAND DIELECTRIC SPECTROSCOPY

Presenter(s): Princess Kandji (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Shalin Patil (College of Engineering), Shiwang Cheng (College of Engineering)

Decades of rheological measurements assume homogeneous phases of polymer solutions under large deformation, where molecular theories and constitutive equations have been built on. However, recent small-angle scattering experiments show a clear signature of strain-induced demixing in both extension and shear for polymer solutions, challenging the basic assumption of the prevailing molecular understanding. In this work, we develop new analyses based on temperature-modulated differential scanning calorimetry and broadband dielectric spectroscopy to examine the characteristics of strain-induced demixing and even phase separation at large strain under uniaxial extension. Our results show both signs of demixing of small strains and a clear signature of strain-induced phase separation at large strains for entangled polymer solutions, calling for a revisit of the previous molecular understanding of the nonlinear rheological behavior of entangled polymer solutions.

CONSTRUCTING A MICROSCOPE TO EXPLORE ULTRAFAST DYNAMICS AND SPIN COHERENCE IN NANOSCALE QUBITS

Presenter(s): Austin Hayes (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Tyler Cocker (College of Natural Science)

Scanning tunneling microscopy (STM) captures images of individual atoms by moving a sharp, needle-like tip over a sample surface while measuring quantum tunneling of electrons through the vacuum space between them. Recent experimental advances have built on the STM concept to access important new material properties with atomic spatial resolution. For example, terahertz STM (THz-STM) uses ultrafast laser pulses at terahertz frequencies to control the electron tunneling. These pulses are as short as a single oscillation cycle in length and create stroboscopic snapshot images and even movies of atoms and molecules moving on their intrinsic timescale. Meanwhile, electron spin resonance STM (ESR-STM) uses high frequency electronics and strong magnetic fields to interrogate single electron spins on surfaces, and even measure the coherence time of single atoms for quantum information applications. A recently proposed architecture for a new, atomically precise qubit (quantum bit) holds promise for future technology but requires both THz-STM and ESR-STM to validate its performance. Yet, these techniques have never been combined in a single instrument. In this project, we are building a unique microscope capable of both THz-STM and ESR-STM to probe the new qubit and characterize other interesting material properties that were previously inaccessible.

USING LASERS TO COUNT ATOMS TO DETERMINE THE ASTRONOMICAL ORIGINS OF COPPER AND SILVER

Presenter(s): Roberto Hernandez (University of South Florida)

Chemical Engineering & Materials Science
Mentor(s): Jaideep Singh (Facility for Rare Isotope Beams)

There are 118 different chemical elements on the periodic table. Yet, the origins of how these elements came to be are not precisely known. Nuclear astrophysicists believe that most chemical elements heavier than helium were created within stars. These heavier elements, such as copper and silver, are formed when lighter elements capture several neutrons and then subsequently undergo radioactive decay. Our long-term goal is to quantify the neon plus helium reaction that produces neutrons that can be used within the neutron capture process. This reaction produces a small number of products, as well as occurring rarely to where we can not study it properly. To accomplish this goal, we are developing the Single Atom Microscope (SAM) technique for nuclear astrophysics. In SAM, we capture the product atoms resulting from nuclear reactions inside a cryogenically frozen noble gas film such as krypton. These atoms are subsequently imaged by a sensitive camera via the fluorescence light emitted when illuminated by laser light. I will be describing my work analyzing camera images with the use of computer programming.

ASSESING THE ROBUSTNESS OF VBMC FOR EXTRACTING PARAMETERS IN DIFFERENTIAL EQUATIONS

Presenter(s): Alia Valentine (Michigan State University)
Chemical Engineering & Materials Science
Mentor(s): Rachel Kurchin (Carnegie Mellon University)

We evaluate the robustness of Variational Bayesian Monte Carlo (VBMC), a recently introduced Bayesian inference algorithm for expensive black-box likelihoods for evaluating parameters in ordinary differential equations (ODEs). We find that VBMC realizes state-of-the-art performance for successful runs for a plethora of ODEs with varying amounts of noise. However, we also show that VBMC is highly susceptible to internal (non-noise) randomness that results in occasional complete failure of inference.

CIVIL & ENVIRONMENTAL ENGINEERING

INNOVATING CELL COUNTING WITH COMPUTER-VISION

Presenter(s): Eli Knaup (Stoney Creek High School), Mason Knaup (Stoney Creek High School)
Civil & Environmental Engineering
Mentor(s): Sarah Beetham (Oakland University)

Cell counting is a cumbersome task that is inefficient and prone to error when done by humans. However, it is necessary when characterizing cell growth. For example, single-cell algae have the potential to be used for biofuel. This practice requires extensive cell counting to ensure successful results. Our investigation focuses on finding a method of automated cell detection in order to aid lab researchers in cell counting. We have completed an algorithm that is able to identify single-celled organisms, in this case, algae. First, the user uploads an image and crops it to the area of interest. Then, the researcher is able to change the color range with HSV sliders to exactly choose what color cells they would like to detect. With this information, the algorithm is able to create a mask of the original image, but only keep the pixels that fall in the color range the user picked. This results in only the cells being shown. Then with computer vision, the program is able to outline the cells with contours and find their areas and diameters. A text file of data is then given to the user containing the cell count, diameters, and areas. We have shown that this algorithm is able to provide more accurate and consistent data at rates much more efficient than manual cell counting. In addition, our method of counting is automated. This results in significant time savings and data like cell diameter and area, which is hard to find manually.

EXAMINING THE ENVIRONMENTAL IMPACTS OF SELF-DRIVING ELECTRIC VEHICLES

Presenter(s): Ashley Jung (University of Southern California), Kimberly Suarez (West Chester University), Shannon Collins (Virginia Tech)
Civil & Environmental Engineering
Mentor(s): Annick Anctil (College of Engineering), Kaisen Lin (College of Engineering)

Traffic-related pollutants, such as PM 2.5, can result in adverse health impacts to people who live near major roadways. Marginalized communities are often the ones who live near these roadways, resulting in an environmental justice issue as they are the ones being disproportionately impacted. By switching to self-driving, electric cars, the PM level in those impacted areas may be alleviated. However, these solutions result in tradeoffs, as pollutants would be emitted elsewhere. These pollutants, like the traffic-related ones, can cause health issues and have serious implications for those that live near these power plants. This research focuses on the relation between AV use and the percentage of Detroit residents that is predicted to fully adopt AVs by the next few decades. This is expected to have implications on the modes of transit that are to be publicly used and the socioeconomic disparities that exist throughout communities. The data gathered was obtained from MOVES3, a motor vehicle emission simulator provided by the U.S. Environmental Protection Agency (EPA); other resources that were used comprise past papers and data collected from the Michigan Department of Environment, Great Lakes, and Energy (EGLE) MiEJScreen Environmental Justice Web Map. The outcomes will inform city-wide AV adaptation - especially in the face of environmental injustices that underprivileged communities undergo. Analysis will be applied to Michigan residents and simulate mid-sized (SUV) electric AVs. Results will contribute to further understanding the behavioral implications of AVs and their related impacts on environmental justice issues.

HYDROGEL-BASED COLORIMETRIC DETECTION OF PFAS

Presenter(s): Clara Liao (University of Michigan)
Civil & Environmental Engineering
Mentor(s): Chuwei Ye (College of Engineering), Shaoting Lin (College of Engineering), Tsz Hung Wong (College of Engineering)

PFAS, known as per- and polyfluoroalkyl substances, are a group of chemicals that can be found in various modern-day products such as car lubricant, paint, fire-extinguishing foam, non-stick pans, air fryers, and cosmetics. Their incredibly stable structure, degradation resistant nature, and ability to accumulate in the environment has recently branded PFAS as organic pollutants. The increasing concentrations of PFAS found around the world in drinking water, wildlife, plants, and the atmosphere, along with the health risks that come with exposure to them, has led to a serious need for a rapid, cost effective, sensing technology. PFAS present a challenge in sensing technology as they lack chromophores and their incredible stable composition means light cannot sense them and very little reacts with them. In this project, we propose to develop a hydrogel-based colorimetric device capable of detecting low-level concentrations of PFAS. Using a combination of PEG-thiols, F-thiols and gold nanoparticles, we can induce a colorimetric response through the reaction between PFAS molecules and functionalized gold nanoparticles. By analyzing the diffusion profile of aggregates formed by PFAS and gold nanoparticles passing through hydrogels, we can demonstrate the device's ability to sense PFAS at lower detection limits compared to existing colorimetric methods. Overall, the hydrogel-based colorimetric-based device holds great promise for the rapid and cost-effective detection of PFAS, monitoring and mitigating the presence of these harmful substances in the environment.

ASSESSING THE REACTIVE POTENTIAL OF THE MARTIAN REGOLITH SIMULANT JEZ-1 FOR FUTURE CONSTRUCTION ON MARS

Presenter(s): Nathan Denning (Michigan State University)
Civil & Environmental Engineering
Mentor(s): Matias Leon (College of Engineering), Qingxu Jin (College of Engineering)

One of NASA's major goals in its mission of deep-space exploration is to establish a sustained presence on Mars. To make this economically feasible, local resources such as Martian soil (regolith) must be used, which is an approach known as in-situ resource utilization (ISRU). It is vital that potential regolith-based construction materials have adequate hydraulic and pozzolanic reactivity to create composites strong enough to mimic cementitious construction materials on Earth. In this study, the reactivity of the Jezero Delta Simulant (JEZ-1) was assessed in its unaltered state. It was then introduced to two treatments in an effort to improve its reactivity: thermal calcination and mechanical grinding. Thermal calcination aimed to alter the mineralogy of the material, and mechanical grinding was used to vastly increase the specific surface area of the material. To measure hydraulic reactivity, thermogravimetric analysis (TGA) and isothermal calorimetry were used, and a conductivity measurement was used to measure pozzolanic reactivity. In its unaltered form, JEZ-1 showed no hydraulic reactivity, but the conductivity measurement indicated good pozzolanic reactivity. After being thermally treated at 600oC, the pozzolanicity of JEZ-1 experienced a slight decrease; however, there was an increase in hydraulic reactivity. Despite a significant decrease in particle size, the mechanical treatment of JEZ-1 showed an unexpected decrease in both hydraulic and pozzolanic reactivity. The results/framework presented in this study can be applied to assess the reactivity of other regolith simulants for further development of deep-space construction.

HEALTH IMPACTS OF AUTONOMOUS VEHICLES

Presenter(s): Adare Cario (University of Michigan), Lyla Boatman (Louisiana State University), Maria Costa (Georgia Institute of Technology)
Civil & Environmental Engineering
Mentor(s): Zeenat Kotval-Karamchandani (College of Social Science)

Technology and mobility are constantly developing and as advancements continue, autonomous vehicles (AVs) will provide an additional mobility option for the public. As manufacturers work towards enhancing AVs to Level 5, fully autonomous vehicles, it is vital to consider the implications of these self-driving vehicles on the user. Current research in the United States focuses primarily on the perceived impacts of AVs on the general public. It lacks focus on vulnerable populations, such as seniors or parents with children. This study investigates the perceived impacts of widespread adoption on the physical and mental health of these populations through interviews of 17 participants. The respondents consisted of seniors 65 years of age or older and parents with children under the age of 16 living in their household. The seniors interviewed tended to be stressed when questioned about implementing autonomous vehicles into their daily lives leading to the conclusion that their mental health could be negatively affected. These findings were different from the results found with the parents' perceptions. Parents tended to be more open-minded, and we concluded that due to this their mental and physical health could potentially be positively impacted. We also found that both seniors and parents were able to identify how the implementation of AVs would benefit their health. Our findings contribute uniquely to the ongoing

research on autonomous vehicles and their implications upon integration into society by looking at the health impacts of adopting AVs, an aspect underrepresented in research.

EFFECTS OF RECYCLED PLASTIC GEOSYNTHETICS ON THE STABILITY OF MIDWEST SUBGRADE SOILS

Presenter(s): Matt Thelen (Michigan State University)
Civil & Environmental Engineering
Mentor(s): Bora Cetin (College of Engineering)

Geogrids are reinforcing barriers commonly used to improve the durability of roads. They are types of geosynthetics, which are products aimed to stabilize terrain in civil engineering applications. In road constructions, geogrids are usually applied within the subbase or subgrade layers of the foundation. They work by interlocking with the soil and aggregates to produce a strong stabilization matrix. This prevents aggregates from slipping past each other due to shear. Grids consist of repeating geometric patterns, usually made of plastics such as polyester due to its low production cost. Though plastics such as PET are stronger and more resistant to degradation. Considering that more than 35 million tons of plastic waste were produced in the US last year, proper plastic disposal is a huge challenge. Although plastic recycling has its downsides, it is still one of the best available ways of limiting the amount of plastic that ends up in landfills. Plastics such as PET and HDPE are moldable and highly recyclable. Due to low risk of microplastic leech, it is both environmentally suitable and affordable to use a highly recyclable material such as PET in the manufacture of geogrids. This study investigates the use of recycled plastic geogrids and their effect on the mechanical properties of Iowa soils. As long as proper precautions are taken during waste management, this would reduce the amount of plastic that ends up in landfills and the wastewater. This indicates that geogrids can be a good candidate for a recycling program implementation.

DENSITY OF COMMON URBAN ACCESSIBILITY BARRIERS FOR PEOPLE WITH DISABILITIES

Presenter(s): Wanda Quan (University of San Francisco)
Civil & Environmental Engineering
Mentor(s): Justin Scott (College of Engineering), Tamara Bush (College of Engineering)

In 2021, nearly 1 in 8 American adults had a mobility disability. Despite their significant population, people with disabilities (PWDs) face frequent accessibility issues that prevent them from traveling as much as able-bodied people, inhibiting their social activity and causing detrimental mental and physical health effects. Autonomous urban transportation provides a possible way by which PWDs can gain access to more aspects of community life, and it is crucial to consider how equitable accessibility is shaped by the urban environment. Understanding common accessibility barriers, as well as differences between PWD and able-bodied perceptions of barriers, allows for accessible autonomous transportation infrastructure design to improve the quality of life of PWDs. To achieve this, the goal of this study was to analyze the responses of able-bodied researchers and wheelchair using-PWDs in assessing the locations and inaccessibility of urban infrastructure obstacles in downtown East Lansing. While the able-bodied researchers observed less than half the amount of barriers PWDs observed, the barriers researchers identified were the most difficult for PWDs to overcome. PWDs considered factors the researchers hadn't, such as the mental effort needed to scan for obstacles battery consumption in power wheelchairs, and broken glass's risk to manual wheelchair users' hands. This knowledge disparity makes it clear that PWD voices need to be included in infrastructural design to ensure accessibility. Future research could focus on barriers in other urban areas, barriers for devices other than wheelchairs, and the correlations between barrier-dense areas.

AN ASSESSMENT OF THE SEVERITY OF COMMON BARRIERS TO URBAN ACCESSIBILITY FOR PERSONS WITH DISABILITIES

Presenter(s): Grace Oswald (The University of Alabama in Huntsville)
Civil & Environmental Engineering
Mentor(s): Justin Scott (College of Engineering), Tamara Bush (College of Engineering)

The 27% of Americans who have been reported to have disabilities are less likely to travel outside their homes because they experience restricted mobility in external environments, limiting their opportunities to engage with their communities. For example, a wheelchair user may not be able to enter a restaurant as a result of a missing ramp. Things that may seem innocuous to an able-bodied person may potentially pose a challenge for a person with a disability (PWD), so it is important to collect data from PWDs on what constitutes an accessibility barrier. The goal of this project was to examine areas of downtown East Lansing for barriers to accessibility for persons who use mobility devices. Interviews were conducted with persons with disabilities to gain information on the severity of barriers to mobility. Results indicated that lack of sidewalk maintenance (i.e. cracks in sidewalks) and steep and grassy curb cuts were the most common barriers, while uneven crosswalks and stairs were the most severe. The severity of a barrier often relied on the effort the user expended to overcome the obstacle. This information corroborated previous research on barrier severity, which mentioned highly-trafficked areas as barriers to mobility for PWDs. Results also indicated that researchers rated barriers as more difficult than participants, pointing to a discrepancy between able-bodied and PWD perceptions of travel ease. Finally, easy fixes to accessibility are ramps beside staircases, leveler and smoother sidewalks, and painted and smooth crosswalks.

NAVIGATIONS AROUND COMMON BARRIERS TO URBAN ACCESSIBILITY FOR PEOPLE WITH DISABILITIES

Presenter(s): Claire Dahlin (Taylor University)
Civil & Environmental Engineering
Mentor(s): Justin Scott (College of Engineering)

1 in 8 Americans have a disability, and people with disabilities have been shown to be less likely to leave their homes, as they commonly experienced restricted mobility in outside environments. Because this lack of mobility has led to detrimental social and mental effects, the assessment of urban accessibility is increasingly necessary. The accessibility of city streets and sidewalks is important to accessibility, as are accessible alternatives in the case that a street is inaccessible. The goal of this project was to examine streets and sidewalks in downtown East Lansing, MI for barriers to accessibility for people who use mobility aids to identify aspects of the built environment that supported accessible alternative paths. Interviews were conducted with people with disabilities to gain information on the severity of barriers to mobility, how participants would navigate those barriers, and what an alternative path would be to circumvent the barrier. Some of these barriers included lack of sidewalk maintenance, lack of curb cutouts, and construction. Results indicated that more commonly, people with mobility-related disabilities would most often take the most even and flat path. Understanding what aspects of built environments are barriers to accessibility, as well as what aspects make accessible alternative paths more accessible, will inform infrastructure choices that make cities more accessible. This accessibility will affect not only the streets and sidewalks themselves but any services that rely upon them, such as urban transportation services.

FORECASTING IMPACTS OF FORWARD COLLISION WARNING (FCW) AND AUTONOMOUS EMERGENCY BREAK (AEB) SYSTEMS

Presenter(s): Alejandra Meza (University of San Francisco), Derrick Hill (Illinoise Institute of Technology), Prem Shah (Idaho State University)
Civil & Environmental Engineering
Mentor(s): Peter Savolainen (College of Engineering)

Several assumptions related to fundamental aspects of driving behavior are critical to roadway design. Continuing technological advances associated with autonomous vehicles (AVs), including forward collision warning (FCW) and autonomous emergency braking (AEB) systems, are expected to impact these assumptions. As more AV technology is integrated into the vehicle fleet, current assumptions may be relaxed allowing for increased flexibility in design practices. The potential impacts of these systems are still being investigated. Rear-end collisions are the most common crash type of collision, accounting for almost one-third of all crashes in the United States. Research shows that

vehicles with FCW and systems reduce such collisions by 50%. This study evaluated FCW/AEB test data, along with human driver reaction time data from the second Strategic Highway Research Program (SHRP 2) Naturalistic Driving Study (NDS). Reaction times were compared across various driver distractions, which were subsequently compared to performance data from FCW/AEB systems. The FCW/AEB tests showed improved effectiveness over time. Differences were also shown with respect to sensor type and location. Systems were shown to perform more poorly at higher test speeds. Similar tests for vulnerable road users (VRU) under both day and night conditions also showed improvements over time. The results of this study suggest that increasing market penetration has the potential to significantly improve safety and reduce the frequency and severity of traffic crashes. Forecasting the impacts of AV systems opens the door to future work on increasing sustainability, accessibility, and equity in mobility and transportation.

EXPLORING THE DIVERSITY OF MONOOXYGENASES ASSOCIATED WITH CONTAMINANT BIODEGRADATION IN SOIL AND GROUNDWATER SAMPLES

Presenter(s): Katy Foss (Michigan State University)
Civil & Environmental Engineering
Mentor(s): Alison Cupples (College of Engineering), Zohre Eshghdoostkhatami (College of Engineering)

Monooxygenases are important enzymes for the biodegradation of many environmental contaminants, such as trichloroethene, tetrachloroethene and 1,4-dioxane. Many molecular methods, such as quantitative PCR (qPCR), target the genes encoding for these enzymes to help predict contaminant biodegradation rates. The current research adopted a different approach (shotgun sequencing) to explore the occurrence and diversity of these important biomarkers in soil and groundwater communities. This approach enables the investigation of a larger number of biomarkers compared to traditional qPCR. For this, shotgun sequencing reads were assembled, annotated and binned in metagenome assembled genomes (MAGs). The results indicated the importance of toluene-4-monooxygenase and phenol hydroxylase in the groundwater samples. Additionally, many samples contained soluble methane monooxygenase and particulate monooxygenase. The phylotypes associated with these genes were investigated in the MAGs. Further, sequences for a group of monooxygenase subunits were compared to the closest matches from the NCBI database to enable the construction of phylogenetic trees. The data generated provides novel insights into the presence of key enzymes in environmental samples.

STUDY OF PLUME AND AEROSOLS PRODUCED BY HIGH VELOCITY AIR JET HAND DRYERS

Presenter(s): Alyssa Murphy (Michigan State University)
Civil & Environmental Engineering
Mentor(s): Kaisen Lin (College of Engineering)
Hot-air operated hand dryers were first introduced in the 1990s and are now used in bathroom settings as a main hand drying method. While this method is quick and seemingly effective, hot-air hand drying may cause the aerosolization of harmful bacteria and other microorganisms that are present on washed hands. The goals of this study are to explore how high velocity air dryers mobilize bacteria from washed hands to air and to determine where these germs are dispersed around an indoor space. A 6′x12′x9′ enclosed test chamber with installed commercial hand dryers was built to simulate a bathroom. To simulate drying hands with microbes present after hand washing, we pipetted E.coli culture onto gloved hands, distributed evenly across hands, and dried hands for 10 seconds. In order to identify the aerosol plume generated by the hand dryer, and to measure the mobilization of microbes around this space, we collected passive and active air samples to quantify the airborne bacteria concentration. Passive sampling included 45 petri dishes placed at various vertical and horizontal positions around the chamber. Active samplers included collecting airborne bacteria on a gelatin filter by pulling air with a pump sampler. Results indicated that there's a concentration gradient throughout the chamber. When comparing both dryers, the greatest release of particles from hands is produced by Dyson. This work will enable current hand dryer companies to engineer new dryers that mitigate the spread of leftover microorganisms from our hands to public space, and thus reduce the infection risks.

INVESTIGATION OF KNOWLEDGE GAPS IN MASS TIMBER ENGINEERING CURRICULUM

Presenter(s): Cade Person (Michigan State University)
Civil & Environmental Engineering
Mentor(s): Christiana Kiesling (College of Engineering), Kristen Cetin (College of Engineering)

In typical construction projects, timber is often overlooked, with steel and concrete serving as the primary materials used in the design. Mass timber is a new building material with promising results due to its structural integrity, aesthetic qualities, sustainability, and low carbon footprint. There is limited awareness regarding mass timber in the United States, resulting in few projects incorporating mass timber materials. These limitations could be the result of insufficient education on mass timber and timber engineering in general. A Developing a Curriculum (DACUM) panel was held to identify the skills expected of structural engineers working on timber projects. The present study consists of a three-part approach. First, an analysis found that only 58 percent of the largest public universities in each state offer courses related to timber design, engineering, and construction. Second, available syllabi from these courses were compared to the results of the DACUM. This analysis provides evidence that a gap exists between the curriculum currently available and the industry expectations. Lastly, interviews were held with current educators to identify what instructional resources are currently available and what needs still need to be addressed. The results can be used as a starting point to promote the creation of instructional materials and curricula that can be incorporated into existing or new structural engineering courses.

COMMUNICATIONS ARTS & SCIENCES

SOCIAL MEDIA CONTENT AND FAT PHOBIA

Presenter(s): Sarah Hoogstraten (Michigan State University)
Communication Arts & Sciences
Mentor(s): Dar Meshi (College of Communication Arts Sciences)

Fat phobia is a deeply understudied area generally, and its relation to the social media platforms Instagram and TikTok has gone wholly unstudied. Previous studies on mental and behavioral correlates of social media have looked only at overall social media use, despite the wide-ranging variety of content consumed on social media. The present study examines the possibility of correlations between particular types of content on social media and fat phobia as well as body image using a survey of a college student population. It is hypothesized that negative body-related social media content (e.g. content containing "thinspiration") would be associated with higher levels of fat phobia and higher levels of negative body image than more positive body-related social media content (content containing body positivity or body neutrality). Additionally, we have predicted that consumption of this content on TikTok would result in stronger correlations to fat phobia and negative body image than on Instagram. This study is currently in the data collection phase.

PARENTS' CONCERNS ABOUT THEIR CHILD'S STUTTER: A THEMATIC ANALYSIS

Presenter(s): Danielle Jones (Michigan State University)
Communication Arts & Sciences
Mentor(s): Bridget Walsh (College of Communication Arts Sciences)

Research into the lived experiences of adults who stutter reveal that stuttering not only impacts speech production but may also have broader consequences for one's quality of life. Children who stutter are also at risk for adverse impact related to stuttering including bullying, social anxiety, negative communication attitudes, and strain on family relationships. Adverse impact not only affects a child who stutters, but also the child's parent. The aim of this study is to identify the specific concerns that parents have stemming from their child's stuttering. Within the survey-based study we analyzed responses from 233 parents to a prompt that asked them to share their concerns regarding their child's speech and stuttering. We will conduct a thematic analysis to identify major themes of parents' concerns about stuttering. Results of this study will highlight parents' concerns about stuttering and have implications for how parents' concerns can be effectively addressed in speech therapy.

THE ROLE OF FAMILY COMMUNICATION AND SOCIAL SUPPORT AVAILABILITY IN SLOVENE ADULTS' ROMANTIC RELATIONSHIP SATISFACTION

Presenter(s): Marcus Ward (Alabama State University)
Communication Arts & Sciences
Mentor(s): Elizabeth Dorrance Hall (College of Communication Arts Sciences)

The goal of this paper is to understand the relationships between family communication patterns and how it is associated with romantic relationship satisfaction and happiness in Slovenia. We also look at family communication patterns and the correlations between them and resilience. For this study we surveyed 95 Slovenia adults and Considering people in Slovenia often have more access to parental assistance than adults in the United States, this study focuses on women in Slovenia. Families high in conversation orientation often involve parents who encourage their children to develop and express their thinking (Ritchie, 1991). In other studies, pluralistic families (families with high conversation and low conformity) are shown to have a positive effect on resilience in young adults. Based on these studies, we anticipate discovering a relationship between increased happiness in romantic relationships and family communication patterns. We also anticipate a correlation between resilience and family communication patterns, specifically, conversation orientation having a positive effect on resilience. Participants were recruited using email and Facebook to take a 30-minute survey. We predict that results will indicate that conversation orientation is positively associated with relationship satisfaction and happiness. Results also show that conversion orientation is a positive predictor of resilience. Conformity orientation is shown to be negatively associated with relationship satisfaction as well as resilience. One limitation of this study was that it was rather small in sample size. With a larger sample size results could vary significantly. Results imply that family communication patterns will have a positive effect on relationship satisfaction and overall happiness.

RELATION BETWEEN WORKING MEMORY CAPACITY AND RHYTHM DISCRIMINATION ABILITY IN ADULTS WHO STUTTER

Presenter(s): Bailey Rann (Michigan State University), Teresa Starr (Rhodes College)

Communication Arts & Sciences
Mentor(s): J McAuley (College of Social Science)

Developmental stuttering is a speech disorder that typically begins before the age of five and has the potential to persist into adulthood. Stuttering is characterized by disruptions in the rhythmic flow of speech, including prolongations and repetitions of sounds, syllables and words and silent blocks. Consistent with an internal-beat deficit hypothesis, children and adults who stutter evidence poorer auditory rhythm discrimination than their typically developing peers, especially for complex rhythms that don't have a consistently marked beat (World Health Organization, 2010). This suggests that individuals who stutter may have a deficit in beat-based timing and rely to a greater degree on interval-by-interval comparisons to discriminate rhythms. If this is the case, we would expect a stronger relationship between working memory capacity and rhythm discrimination performance for adults who stutter compared to typical adults, as interval-by-interval comparisons are likely to place a greater burden on working memory than beat-based timing. To test this possibility, we combined data from two previous studies that assessed working memory capacity and rhythm discrimination. The combined sample consisted of 45 adults who stutter and 44 typical adults completed an operation span task that measured working memory capacity and a rhythm discrimination task. Results show significant positive correlations between operation span and rhythm discrimination for both simple and complex rhythms for adults who stutter, but not for typical adults. These results support the hypothesis that individuals who stutter rely to a greater degree on interval-based timing mechanisms to discriminate auditory rhythms where working memory capacity is likely to play a more important role.

WHAT ARE PEOPLE SAYING ABOUT GMOS ON TWITTER?

Presenter(s): Victor Milanes (University of Central Florida)
Communication Arts & Sciences
Mentor(s): Taiquan Peng (College of Communication Arts Sciences)

The landscape of attitudes toward genetically modified foods (GMOs) has polarized the public in recent years. Contrasting news sources citing various empirical scientific studies contribute to the complexity of the landscape, and public opinion appears to be highly scattered. To better inform, educate and guide individuals on how to better navigate their relationship with GMOs this study seeks to understand and establish empirical analyses of individuals' attitudes and their diffusion on Twitter. This will be accomplished by answering three research questions: What has been said about GMOs on Twitter, when are people engaging in their discussion about GMOs on Twitter, and how are semantic characteristics/temporal patterns related to the popularity of tweets (Defined by the number of retweets, likes, and replies they receive). To answer these questions, a hashtag analysis will be conducted that denotes the occurrence of hashtags in Tweets marked with a particular perspective (positive, neutral, negative, angry, scared, etc). This is done via topic modeling and sentiment analysis by pulling all the Tweets that have mentioned keywords related to GMOs on Twitter from 2019. These computational models of Twitter interactions are developed in R/RStudio. This study expects to coincide with previous research and produce results suggesting that those who engage on Twitter do so in the later hours of their days, and semantic characteristics do not play a significant role in Twitter engagement. Lastly, this study aims to establish and solidify qualitative data scraping techniques related to character content to provide context for further research in data mining on social media.

COMPUTER SCIENCE & ENGINEERING

GRAPH SIGNAL PROCESSING FOR COMMUNITY DETECTION IN BRAIN NETWORKS

Presenter(s): Jack Parkhouse (Carnegie Mellon University)
Computer Science & Engineering
Mentor(s): Selin Aviyente (College of Engineering)

Graph clustering is an important problem with a variety of applications in computer science as well as social and biological network analysis. Traditional methods focus on using the graph connectivity or the adjacency matrix. On the other hand, traditional data clustering only utilizes the data attributes. Recently, methods that combine both the connectivity and the attributes have been suggested. These existing attributed graph clustering approaches include graph neural networks and spectral filtering. However, a problem with this method is that the graph filter is chosen for clustering purposes. Therefore, there is no guarantee that the filter used is anywhere near optimal. Instead, we propose an alternating algorithm that optimizes both the clusters and the filter. We will then use this algorithm on brain networks. We expect that this new algorithm will increase the success of clustering on test data and neurological data.

IDENTIFYING WORLDWIDE ASTROPHYSICISTS FROM SCIENTIFIC LITERATURE

Presenter(s): Tripp Dow (University of Minnesota)
Computer Science & Engineering
Mentor(s): Vicente Amado (College of Natural Science), Wolfgang Kerzendorf (College of Natural Science)

Computational methods for meta-research have the potential to improve peer review, fairly allocate academic resources, identify experts and topics, and predict research outcomes. The implementation of these methods is complicated by the possibility of authors using multiple different names, or having the same name as another author, referred to as the problem of Author Name Disambiguation (AND). Here, we have implemented an algorithm capable of solving the AND problem within the field of astrophysics. Using a co-author network to compute author reference attributes, and classifying these author references using a random forest, our algorithm performs an order of magnitude better than the previous best name-based techniques. The resulting dataset of disambiguated authors will give us a clearer picture of the academic community, informing future research decisions, such as funding and peer-review.

BUILDING AN ANALYSIS PIPELINE FOR INVESTIGATING TURBULENCE IN MASSIVE GALAXIES

Presenter(s): Keara Hayes (Michigan State University)
Computer Science & Engineering
Mentor(s): Brian OShea (College of Natural Science)

In "Direct Detection of Black Hole-driven Turbulence in the Centers of Galaxy Clusters" (2020), Li et al discovered that, in observations of massive galaxy clusters such as Virgo and Perseus, the turbulent spectrum takes on an abnormal, steep shape. This project, through a new analysis pipeline developed in Python and Bash on MSU's HPCC, attempts to explain the abnormal shape of the 2D turbulent spectrum applying the central mathematical tool employed by Li et al, the velocity structure function (VSF), to 3D, idealized cluster simulations. This is done in the hopes of filling the knowledge gap created by 2D observations which, by their nature, obscure vital information about the kinematics of the system. New idealized cluster simulations are being run using a variety of simulation parameters and the new analysis pipeline will be applied to these clusters to address the discrepancies in the observed turbulent spectrum.

PREDICTING SCIENTIFIC COLLABORATIONS USING GRAPH NEURAL NETWORKS

Presenter(s): John Ahlin (University of Michigan)
Computer Science & Engineering
Mentor(s): Hanzhe Zhang (College of Social Science)

With the rise of machine learning techniques in recommender systems, as in online shopping and entertainment, it is natural to wonder if the same methods can be applied in the realm of science. Can we predict whether two scientists (specifically economists) will co-author a paper together, and estimate its success? Our goal was to construct a large networked dataset of economists containing detailed information about their careers, and then apply graph neural networks to this dataset to assess the likelihood of a productive collaboration between any two economists (or to "recommend" a coauthor for a paper). We constructed the dataset using web scraping techniques to extract relevant demographic and career information, as well as publications and coauthorships, from open-source resources like RePEc (Research Papers in Economics). We compiled these into a graph, with nodes representing individual economists, and edges representing various types of connections, including mentor-mentee relationships, colleagues, and coauthored papers. From there, we used graph neural networks to analyze the patterns between nodes and edges and create a prediction algorithm for whether any given collaboration might be successful. The applications of this algorithm are clear as a tool that can be used by economics departments to fill faculty positions; although the prediction of successful collaboration is not the only consideration, it can provide valuable insight on how a prospective member would interact with the existing faculty. From it we also hope to interpret some key features of successful collaborations.

UNVEILING BLUETOOTH SYMPHONY: TRACKING BLUETOOTH DEVICES AND THEIR INFORMATION LEAKAGE

Presenter(s): Brendan Bushbaker (Michigan State University)
Computer Science & Engineering
Mentor(s): Huacheng Zeng (College of Engineering), Qijun Wang (College of Engineering)

A person living in North America has an average of 13.4 personal electronic devices (PEDs) in 2023. Bluetooth Low Energy (BLE) is used extensively to communicate data between devices. PEDs are constantly emitting BLE data signals and syncing advertisements that reveal location data such as Angle of Arrival (AoA), Angle of Departure (AoD) and Received Signal Strength Indicator (RSSI). Distance is approximated with RSSI, and angle is calculated using arrival estimation via MUSIC algorithm. This information is used to approximate the location of a PED in outdoor and indoor scenarios. Additionally, BLE occasionally may leak information about the user's current activity or sensitive, personal information. Open literature is lacking pertaining to the application of BLE based tracking and data collection. To fill this knowledge gap, we develop a system capable of localizing BLE signals. Algorithms for approximating location are translated into a probability problem using Markov-chains and weighting techniques. The historical location data of various PEDs is collected and inputted into a proposed under-development machine learning model. Expected results are trajectory analysis, smoothing, spatiotemporal patterns and behavioral classification. Model development is still in progress and targeted results may be applicable in data science, logistics, marketing, and security fields.

QUANTIFYING THE TEMPORAL VARIABILITY OF RESERVOIR STORAGE CAPACITY IN THE COLORADO RIVER BASIN USING REMOTE SENSING AND MACHINE LEARNING

Presenter(s): Reed Fitzpatrick (California State University San Bernardino)
Computer Science & Engineering
Mentor(s): Ahmed Elkouk (College of Engineering), Yadu Pokhrel (College of Engineering)

Reservoirs play a crucial role in effectively managing water resources, serving many essential purposes such as supplying drinking water, supporting irrigation systems, generating hydroelectric power, controlling floods as well as droughts, and facilitating various other applications. The Colorado River supplies water to seven states making it a vital water resource. The Upper Basin contributes approximately 92% of the basin's natural streamflow. Since the 2000s, the basin has had an average annual water supply that is 18% lower than its historical average. Remote sensing can be used to determine the surface water level as well as the surface water area of the reservoirs. Satellite radar altimetry datasets, for example from the U.S. Department of Agriculture's Global Reservoir and Lake Elevation Database, allows for monitoring of reservoir water elevation. Similarly, the Moderate Resolution Imaging Spectroradiometer instrument aboard the Terra and Aqua NASA satellites offers a 250 m spatial resolution and a 16-day temporal resolution imaging of Earth which allows for estimating reservoir surface area. These datasets provide better representations for reservoirs with irregular shapes. By establishing a relationship between surface level and surface area, we estimate the storage capacity of the reservoirs. Furthermore, approaches like machine learning can be employed to identify relevant features and predict the storage capacity of reservoirs. This research aims to explore multiple methods for accessing the temporal and spatial variability in storage capacity of large reservoirs in the Colorado River Basin and provides valuable insights into potential errors and uncertainties that may arise in each method used.

INTELLIGENT TOOLS FOR IMAGE UNDERSTANDING: A COMPARATIVE STUDY BETWEEN MANUAL AND MACHINE IMAGE SEGMENTATION

Presenter(s): Katie Reagan (Smith College)
Computer Science & Engineering
Mentor(s): Dirk Colbry (College of Natural Science)

An issue faced by researchers that work with image data is that no single image algorithm exists to fit all scientific problems. As a result, time and resources are spent annotating each image or reworking pre-existing algorithms to fit their specific research needs. In most cases, scientists must manually annotate their images to extract the information needed to test hypotheses. However, this manual annotation is time-consuming and subject to error. In this work, we measure the time it takes to manually annotate

images by a handful of researchers. By then comparing the annotations to each other, we establish a baseline variability in the manual image annotation process. This baseline measurement is key to understanding and evaluating the effectiveness of automated annotation algorithms.

DETECTION OF MILD COGNITIVE IMPAIRMENT FROM LANGUAGE MARKERS

Presenter(s): Bao Hoang (Michigan State University)
Computer Science & Engineering
Mentor(s): Jiayu Zhou (College of Engineering)

In the older population, aged 65 and above, Alzheimer's disease carries a significantly high mortality risk. Those affected by Alzheimer's experience years of illness as the condition progresses. The initial stage of the disease, called mild cognitive impairment (MCI), holds significant value in terms of early intervention and treatment. Accurately identifying MCI often involves expensive procedures like brain magnetic resonance imaging (MRI) scans. In this study, we investigate the efficacy of using language markers (lexical, syntactic, and semantic) extracted from participants' conversations with doctors, which is a more cost-effective approach, to detecting MCI. Through our experimentation, we demonstrate that a machine learning model trained with these language markers achieves high performance in detecting MCI. Our findings provide valuable insights into the potential of leveraging conversational data for early MCI detection, which could facilitate timely interventions and improve patient outcomes.

AUTOMATING IMAGE ANNOTATION FOR SCIENTIFIC RESEARCH: ENHANCING SEARCH SPACE USING HUGGING FACE MODELS

Presenter(s): Navya Bhardwaj (Michigan State University)
Computer Science & Engineering
Mentor(s): Dirk Colbry (College of Natural Science)

Advancements in technology have led to the widespread use of image data in research across many scientific disciplines such as self-driving vehicles and plant biology. However, manual processing and retrieval of specific information from image data can be time-consuming and burdensome for researchers. Automating this process would significantly save researchers' time and effort. This project aims to develop an easy-to-use tool that utilizes genetic algorithms to speed up image annotation for scientific problems. To enhance the project's capabilities, pretrained models from Hugging Face are incorporated into the SEE-Insight algorithm search space. Hugging Face is a company that maintains an open source library of pretrained models.. By leveraging Hugging Face models, the SEE-Insight team aims to improve speed and quality of the results of their existing image annotation tools. The research involves understanding and utilizing the Hugging Face API to assess the performance of their annotation tools in comparison with our team's current models. By integrating Hugging Face models into the search space, the team aims to identify the most effective model for image annotation tasks.The ultimate goal of this project is to develop an automated image annotation tool that significantly reduces the time and effort required by researchers. By including Hugging Face models in the SEE-Insight search space, this project aims to streamline the time consuming image annotation process, enabling researchers to spend their time on higher-level interpretation and insights derived from the segmented images. (Although ideas presented in this document are the authors, the language has been improved using ChatGPT).

A TEAM EFFORT: REDESIGNING A SPHERICAL GEOMETRY EDUCATIONAL APPLICATION TO IMPROVE USABILITY

Presenter(s): Hannah Cline (Grand Valley State University)
Computer Science & Engineering
Mentor(s): Vinicius Lima (Grand Valley State University), William Dickinson (Grand Valley State University)

Despite the ubiquity of spherical geometry in our surroundings, the American education system focuses on teaching Euclidean geometry. This system is supported by several web applications that facilitate students' learning of this geometry. To address this issue, Spherical Easel, a browser-based web application, was first introduced in 2004 to promote the teaching and learning of Spherical geometry by allowing users to construct arrangements of spherical points, lines, segments, circles, and more. In 2020, an updated version that caters to an outdated user-centric approach began. The current version is based upon years of individual feature development, catering to each feature rather than the overall user experience. This project focuses on reconstructing the application's user interface to create system that allows for flexibility and longevity. A new interface direction emerged after completing a heuristic analysis of the existing interface to enhance usability. This approach ensures optimized usability and improved user experience for the application's planned international user base. A team consisting of a student designer and developer worked collaboratively to implement the new design; therefore, efficient communication will be necessary to implement these improvements. My team member will use a Vue-based web application written primarily in Typescript. Although the new design is not yet finalized, specific components are ready for implementation. Nevertheless, further modifications are still necessary, yet notable enhancements have been achieved regarding the graphical interface. This project is funded by the Student Summer Scholars grant by the Grand Valley State University Office of Undergraduate Research and Scholarship.

SPHERICAL EASEL: APPLICATION DESIGN AND DEVELOPMENT COLLABORATION

Presenter(s): Dat Nguyen (Grand Valley State University)
Computer Science & Engineering
Mentor(s): Hans Dulimarta (Grand Valley State University), William Dickinson (Grand Valley State University)

Spherical geometry literally surrounds us, but despite this fact, the American education system focuses on the teaching of Euclidean geometry and is supported by several web applications that facilitate students' learning of this geometry. To address this issue, Profs. Austin and Dickinson introduced Spherical Easel in 2004, a browser-based web application, to promote the teaching and learning of Spherical geometry that allows users to construct arrangements of spherical points, lines, segments, circles, and more. In 2020 Profs. Dickinson and Dulimarta began an update that focused primarily on the application's functionality. Therefore, there are many ways to improve the user experience design. There were two phases to this project:" adding an Earth Mode feature and implementing the design team's recommendations to improve the usability of the application. Earth Mode is a 3D layer that displays the globe and allows users to explore the earth in the context of spherical geometry. This functionality could expand the user base of the application by allowing younger students to connect with spherical geometry in a familiar context. To implement this I used Three js, WebGL, and CesiumJs and found out that Three Js is a library for 3D earth layers on top of a 2D layer SVG canvas provided by TwoJS. Also, I researched material UI design language and work with the design team to design the language and system for the app. Create new components for the application and start implementing new interfaces based on the low-fidelity prototype from design folk.This project is funded by the Student Summer Scholars Grant by Grand Valley State University.

MOBILE APPLICATION FOR RAPID DETECTION OF FOODBORNE PATHOGENS USING GOLD NANOPARTICLES

Presenter(s): Eliezer Amponsah (Michigan State University)
Computer Science & Engineering
Mentor(s): Evangelyn Alocilja (College of Agriculture & Natural Resources)

Accurate detection of food pathogens is essential in preventing foodborne diseases. In recent years, studies have shown that biosensors using gold nanoparticles (GNP) can be utilized to detect common pathogens like salmonella and E.coli. This approach is more affordable, efficient and easier to operate than techniques such as centrifugation and filtration. However, the spectrophotometer required to get the results of this approach requires a specifically designated lab space and a sizable amount of money to obtain and maintain. In addition, the equipment requires trained personnel and a lab facility. Thus, the objective of this research is to replicate the results of the spectrophotometer data from the biosensors within a reasonable margin of error in a reliable manner. At this time, the algorithm used to quantify the results from the nanoparticles is promising. Following preliminary results, the application is expected to be a viable contender or a supplementary tool to the spectrophotometer that is currently used to calculate the results from samples.

EVEN WITH ENCRYPTION, CAN WE INFER PRIVATE INFORMATION USING THE PACKETS COLLECTED FROM THE NETWORK TRAFFIC?

Presenter(s): Destiny Davis (Northeastern Illinois University)
Computer Science & Engineering
Mentor(s): Guan-Hua Tu (College of Engineering), Jingwen Shi (College of Engineering)

The advent of 4G wireless communication technology, specifically LTE (Long-Term Evolution) networks, has significantly transformed the way we connect and communicate. However, the widespread adoption of LTE also introduced security vulnerabilities that could be exploited by adversaries. We explore a particular vulnerability wherein adversaries can analyze downlink network traffic and launch attacks on users connected to a target base station. By eavesdropping on radio signals within the base station's coverage area, adversaries can intercept downlink messages and potentially gain unauthorized access to sensitive information. We employed similarity measurements to provide quantitative assessments of the similarities or differences between different instances of radio traces, aiding in various tasks such as trace classification, trace identification, or detecting abnormal behaviors. The process involves generating embeddings for each trace using the trained model and measuring the similarity between pairs of trace embeddings using cosine similarity or other suitable distance metrics. The resulting similarity scores are then used to rank the trace pairs in descending order, indicating their degree of similarity. By setting an appropriate threshold, the pairs can be classified as either similar or dissimilar. The effectiveness of the approach relies on the quality of the generated embeddings and the ability of the model to capture meaningful features from the traces. As a result, the most comparable traces within a given collection may be quickly and automatically identified. Additionally, this study gains a crucial dimension from the consideration of security. They can also enable network operators, security analysts, or researchers to gain insights into the characteristics of radio traces and make informed decisions regarding network optimization, troubleshooting, or security measures.

RESEARCH QUESTION: IS IT POSSIBLE TO DESIGN A WEB-BASED INTERFACE TO CARRY OUT AN INTERACTIVE GAME BETWEEN HUMAN PLAYERS AND ALGORITHMS?

Presenter(s): Krishna Artis-Mickens (City University of New York - Medgar Evers College)

Computer Science & Engineering
Mentor(s): Shaunak Bopardikar (College of Engineering), Shivam Bajaj (College of Engineering)

We consider a perimeter defense problem in which a single vehicle seeks to defend a compact region from intruders in a one-dimensional environment parametrized by the perimeter size and the intruder-to-vehicle speed ratio. The intruders move inward with fixed speed and direction to reach the perimeter. In this project, we are working on a perimeter defense project in a linear environment. With this in mind, we approach this by designing a web widget to simulate two (2) algorithms (i.e., Sweep, Compare and Capture) designed earlier for worst-case scenarios. This widget will be used by students tonderstand and bridge the gap between worst-case scenarios and real-life scenarios. Specifically, a student would select an algorithm to play against and can release adversaries into the environment.

PREDICTING PROJECT PERFORMANCE BASED ON EARLY COMMUNICATION DYNAMICS IN INTERDISCIPLINARY AND INTERORGANIZATIONAL PROJECT TEAMS: A CASE FROM THE ARCHITECTURE, ENGINEERING, AND CONSTRUCTION INDUSTRY

Presenter(s): James Hager (Michigan State University)
Computer Science & Engineering
Mentor(s): Sinem Mollaoglu (College of Agriculture & Natural Resources)

Effective project management is crucial in the Architecture, Engineering, and Construction (AEC) industry, where timely completion and successful delivery of projects are paramount. Furthermore, the unique challenges faced in AEC project management (i.e., one of the most prominent domains for inter-organizational and interdisciplinary project teams) such as complex scheduling, resource allocation, risk management, and stakeholder coordination, emphasize the need for accurate predictive models to optimize decision-making and improve project outcomes. By using real-world email communication data from a large-scale construction project that went on for two years, we performed social network analysis. The implementation of machine learning models on early communication data were then utilized to predict project delivery success (i.e., issue resolution rate over the project timeline) and consequently were used to develop an algorithm to help improve project outcome projections. To do this, machine learning models were used on early episode communication and delivery success/outcome data and then used to predict project outcomes based on communication data later in project delivery. By comparing the ability to classify project success by each machine learning algorithm, the potential methods of deriving project success can be outlined. In the future, this method can be utilized to predict success in other construction projects quickly and efficiently.

HEN ACTIVITY CLASSIFICATION TO PREDICT FLOOR EGG APPEARANCE

Presenter(s): Ivy Zhang (University of Central Florida)
Computer Science & Engineering
Mentor(s): Daniel Morris (College of Agriculture & Natural Resources)

For healthier and more ethical egg farming, states have started requiring that hens be raised in a cage-free environment. Although these provide more humane living conditions, this poses the problem of hens possibly laying eggs in the litter instead of in their nesting area. These eggs, also known as floor eggs, pose health risks for both humans and hens alike. While past work has focused on identifying and automating collection of floor eggs, our work focuses on the prevention of floor egg laying. This work is the first step in creating a dataset which differentiates hen egg laying behavior. We first develop an algorithm that can select high-confidence positive and negative examples of hen activities which reveal eggs. From these clips, we adapt convolutional neural networks to predict whether an once occluded egg was revealed. For both aspects of our work, we validate our models on a curated video dataset of hens from the Michigan State aviaries. Our future work will aim to further classify hen activity between egg laying and revealing existing eggs.

STREAMLINING NUCLEAR PHYSICS DATA AND UNCERTAINTY QUANTIFICATION WITH THE BAYESIAN MASS EXPLORER

Presenter(s): Landon Buskirk (Michigan State University)
Computer Science & Engineering
Mentor(s): Kyle Godbey (Facility for Rare Isotope Beams)

Obtaining up-to-date, reliable data is a necessary challenge across all domains of science, especially in nuclear physics. Nuclear data with uncertainties are often found in different places and formats, requiring significant effort to properly consolidate and compare. To address these challenges, the Bayesian Mass Explorer (BMEX) aims to provide an open-source suite of user-friendly web applications for on-the-fly data retrieval, visualization, and Bayesian uncertainty quantification. BMEX Masses, the project's flagship app, focuses primarily on plotting experimental and model data, allowing for immediate model performance analysis and experimental feature extraction. BMEX also serves as a cloud-enabled stage for projects leveraging machine learning and advanced statistics, such as reduced basis methods and neural networks. In a current project, neural networks are trained to learn a normalizing flow that learns Bayesian posterior distributions of model parameters for a relativistic mean field mass model. These networks can then be deployed to a web app in BMEX to quickly sample parameters and generate quantified predictions. In the future BMEX will continue to provide new user-focused, accessible tools to the nuclear physics community in the fields of model emulation, online model calibration, and experimental design.

USING NATURAL LANGUAGE PROCESSING TO MAP THE DATA SCIENCE CAREER LANDSCAPE AND INFORM CURRICULUM DESIGN

Presenter(s): Jacob Underwood (Arizona State University)
Computer Science & Engineering
Mentor(s): Devin Silvia (College of Natural Science), Rachel Frisbie (College of Natural Science)

Data science is an evolving field with a seemingly ever-changing career landscape, a daunting prospect for those graduating with a degree in this or similar disciplines. It would thus benefit universities to have an easy way to determine shifting tides in industry and adjust teachings for data science degrees based on new information. However, the vast scale of job postings on the internet can make it difficult to find any trends as a human observer. An effective solution could be automated processing of up-to-date job listing data collected by web scraping. We use different forms of natural language processing, such as named entity recognition models and latent Dirichlet allocation, to find patterns in the verbs, nouns, and phrases that employers often list as requirements for their job. We expect to get a glimpse into what skills, ranging in category from programming to interpersonal, employers emphasize when looking for job candidates in fields related to data science. This provides a broadly applicable framework that can return quantitative information to improve future curriculum design in the Computational Mathematics, Science, and Engineering Department at Michigan State University, with the potential for expanded usage in the future.

WIRELESS COMMUNICATION FOR A SNAKE INSPIRED ROBOT

Presenter(s): Vu Phi (Michigan State University)
Computer Science & Engineering
Mentor(s): Xiaobo Tan (College of Engineering)

In order to improve the accuracy of the data used in planning agricultural drainage systems spatially tagged measurements of flow rate and nitrate levels are needed from within the existing drainage infrastructure. Current methods rely on visual inspections while the drainage network is overloaded by rain and the limited functionality of cable-based camera inspection methods. This necessitates the development of a system which can transport agricultural sensors throughout the drainage network to provide data for the development of accurate models. To achieve this goal a bioinspired snake robot is being developed to carry the requisite sensors. The advantages of a snake inspired design include the ability to function in restricted environments such as the common 4-inch corrugated drainage pipes. Additionally, as the water level in these pipes varies depending on the amount of rain the environment can vary from completely dry to fully submerged. Such an uncertain and difficult to traverse environment is well suited to snake inspired designs as their high degrees of freedom, compliance, and varied mode of locomotion (serpentine, concertina, and sidewinding) make them highly adaptable to their environment. Due to the needs of this project the snake inspired platform is to be capable of autonomous exploration of drainage systems after being deployed. This necessitates carrying its own power supply, being able to identify its location and the layout of the drainage system and being able to return to its deployment point with its recorded data in a reasonable timespan.

ENVIRONMENTAL SCIENCE & NATURAL RESOURCES

MOLECULAR LEVEL UNDERSTANDING OF PFAS INTERACTIONS WITH SOILS

Presenter(s): Libby Ashby (Michigan State University)
Environmental Science & Natural Resources
Mentor(s): Angela Wilson (College of Natural Science), Narasimhan Loganathan (College of Natural Science)
Per- and polyfluoroalkyl substances (PFAS) are a group of emerging contaminants of concern that have been detected in the environment due to their widespread use in various industrial and household products over the last six decades. The unique physical and chemical nature of PFAS provides them extreme stability towards degradation. Unfortunately, there is increasing evidence that exposure to PFAS can result in detrimental health impacts to human and animals. PFAS exposure can occur through air, water, soil, and sediments. In the present research, the behavior of PFAS molecules in surface soils and sediments has been investigated. Classical molecular dynamics simulations were performed to simulate the presence of PFAS in clay minerals, representing natural pH conditions. Our studies clearly indicate that the adsorption behavior of PFAS varies significantly between different clay minerals and is strongly dependent on the mineralogical composition and their structure. In addition, the magnitude and the location of the surface charge are critical in dictating the adsorption and transport of PFAS in soil environments. This insight about the behavior of PFAS molecules in soil environments will help to understand the extent of the spread of these molecules throughout the environment and enable suitable clean-up of PFAS contaminated sites.

ELECTROCATALYTIC AMMONIA OXIDATION USING SIMPLE ORGANIC AMINES

Presenter(s): Rachel Goike (Albion College)
Environmental Science & Natural Resources
Mentor(s): Timothy Warren (College of Natural Science)

Ammonia (NH_3) holds immense potential as an energy-rich carbon-free fuel via its catalytic oxidation to N_2. Ammonia offers two potential applications in fuel cells: it can be used directly through the ammonia oxidation reaction (AOR) that converts ammonia to nitrogen gas, protons, and electrons, or it can serve as a hydrogen (H_2) carrier when converted to nitrogen and hydrogen gas. The development of molecular electrocatalysts for ammonia oxidation is an emerging field, with only a few reports of capable catalysts based on first and second row transition metals. This work focuses on a metal-free approach based on simple organic amine 1,4-diazabicyclo[2.2.2]octane (DABCO). Operating at an overpotential of 1.3 V, DABCO oxidizes into a radical cation that abstracts a hydrogen atom from ammonia and stabilizes the subsequent amidyl radical to facilitate the oxidation. To outline the relationship between structure and catalytic performance to further the development of next generation metal-free catalysts for ammonia oxidation, cyclic voltammetry experiments were performed to examine catalytic activity and determine the kinetic parameters of DABCO and similarly structured amines, such as 1-azabicyclo[2.2.2]octane (quinuclidine) in the presence of saturated ammonia solution (1.3 M) in acetonitrile. Additionally, ^1H NMR titration experiments were performed to observe the H-bonding interactions with amines and provide further evidence to support the mechanistic understanding of metal-free ammonia oxidation systems.

COATING BAGASSE PAPER FOR ENHANCED BARRIER PROPERTIES
Presenter(s): Dionne Mitchell (North Carolina Central University)
Environmental Science & Natural Resources
Mentor(s): Eva Almenar Rosaleny (College of Agriculture & Natural Resources), Purva Khule (College of Agriculture & Natural Resources), Qiang Yang (College of Agriculture & Natural Resources)

Food packaging manufacturers must provide products that contain food goods, safeguard these against the environment, and do not leach chemicals into them. When designing food packaging, it's crucial to take sustainability, biodegradability, and recyclability into account. Given the toxicity of commonly used synthetic plastics, paper and paperboard have drawn attention as alternative food packaging materials. Although paperboard is natural, environmentally friendly, and affordable, its physiochemical and mechanical qualities prevent some food products from being packaged with it. Paperboard lacks mechanical strength, water resistance, low oxygen transmission, and microbial contamination prevention; these deficiencies have been addressed by barrier coatings. Shellac is an all-natural polymer derived from insect excretions. This biopolymer has drawn a lot of interest because of its exceptional barrier qualities, which include minimal oxygen and water penetration. While shellac is an effective barrier, it is exceedingly brittle and breaks down quickly. Previous research has demonstrated barrier coatings with low permeability rates that are also adequate mechanically are possible thanks to the synergistic effect of shellac and additives. The creation of multilayer citric acid and shellac barrier coatings for untreated bagasse paper is the main topic of this work. Various curing temperatures and number of layers of shellac were analyzed to find the most efficient coating. The mechanical qualities might be enhanced with additional shellac coatings. For both cured and uncured films, the rates of oxygen and water vapor transfer were examined. Additionally, several shellac layers were employed. The brittleness of simply shellac was addressed by experimenting with various curing temperatures and atmospheres. When cured at 80 degrees, the shellac/citric acid composite has the lowest water vapor permeability.

EVALUATING THE SUCCESS OF TWO DIFFERENT MONITORING TECHNIQUES FOR THE DETECTION OF HEMLOCK WOOLLY ADELGID (HWA)

Presenter(s): Kathryn Geller (Grand Valley State University)
Environmental Science & Natural Resources
Mentor(s): Charlyn Partridge (Grand Valley State University - Annis Water Resources Institute)

Eastern hemlock (Tsuga canadensis) is a foundation species found throughout the cool, humid regions of North America. Currently, Eastern hemlocks are experiencing significant mortality as the result of the invasive insect hemlock wooly adelgid (HWA) (Adelges tsuga). Untreated infestations of HWA can result in hemlock mortality in 4-6 years, and since its introduction HWA has devastated hemlock stands in the northeastern United States. Current monitoring methods in Michigan include visual assessment of the lower branches for HWA ovisacs, however this method requires excessive time and resources while also being relatively unreliable. Other methods have been proposed as alternatives to ground visual assessment. One method used by the Canadian Forest Service (CFS) is ball sampling, which is the act of slingshotting a velcro-covered racquetball through hemlock stands to collect HWA material from the upper canopy. Another method is the use of collecting airborne environmental DNA (eDNA) for monitoring HWA. For my project I plan to explore the relative success of the ball sampling method when paired with genetic analysis compared to airborne eDNA monitoring. I plan to do this by estimating the probability that the ball sampling method will detect HWA when a nearby eDNA trap also detected HWA. The presence of HWA will be assessed using quantitative real time PCR (qPCR) with HWA DNA specific primers and probes. Sampling will be conducted in areas with low HWA infestation rate, and in areas considered to have a high risk of being infested but where no HWA has been observed.

DETERMINING PARTICLE SIZE FOR SAPONIN-TREATED SOYBEAN HULL FILLER

Presenter(s): Nia Martin (North Carolina Central University)
Environmental Science & Natural Resources
Mentor(s): Eva Almenar Rosaleny (College of Agriculture & Natural Resources)

The escalating issue of plastic waste generated from food packaging has compelled the search for sustainable and eco-friendly alternatives. This study explores the utilization of soybean byproducts (soymeal) and waste (soybean hulls) to develop environmentally friendly packaging materials. Specifically, soybean hulls were modified and used as a plastic filler and soy saponins were extracted from the soybean meal and employed as a coupling agent to bind hulls and polymer that would not bind naturally, in order to create a novel packaging material. In the experimental process, soy saponins were extracted from the soybean meal and then combined with the hull to form a material that was a ratio of 90% filler and 10% saponin. To obtain an effective filler, soybean hulls were subjected to a ball milling process and sieving, resulting in various particle sizes (< 75 µm, 75-105 µm, >105 µm). The research hypothesis posits that smaller particle sizes will enhance bond formation, thus improving the overall combination of hull and saponin. The standard saponin, saponin extracted from the soymeal, and soybean hulls were subjected to Fourier-transform infrared spectroscopy with an attenuated total reflectance (FTIR-ATR) analysis to detect the presence of saponins and examine the formation of bonds within the composite material. The FTIR-ATR results successfully confirm the presence of soy saponins from the extraction process. The results also reveal a correlation between particle size and the abundance of functional groups thereby promoting superior potential bond formation with saponins. After conditions for combining saponins and hull, the next step is to incorporate polymer. This research contributes to the development of sustainable and environmentally friendly food packaging materials by harnessing soybean byproducts and waste.

EXPLORING COMPLEX STRUCTURES OF ANCIENT STARS

Presenter(s): Iliomar Rodriguez-Ramos (University of Puerto Rico at Mayaguez)
Environmental Science & Natural Resources
Mentor(s): Joshua Shields (College of Natural Science), Wolfgang Kerzendorf (College of Natural Science)

In this research project, we present the calibration of the open science code, STARDIS, which is a versatile tool for simulating and modeling stellar atmospheres and spectra. This research endeavors to unlock the secrets of ancient stellar objects in the future, specifically focusing on the most distant star discovered to date, Earendel, located 12.9 billion light-years away. The significance of this finding lies in the opportunity it presents to explore the Universe's early stages and gain insights into the composition and evolution of stars during the nascent era of our cosmos. Although the main project is centered around studying Earendel using STARDIS, the current research focuses on calibrating the code. To achieve this, we used data from the solar disk center and of the limb near the Solar poles taken at the UTS-IAP & RIAAM (the University of Tabriz Siderostat, telescope, and spectrograph jointly developed with the Institut d'Astrophysique de Paris and Research Institute for Astronomy and Astrophysics of Maragha) and make comparisons with the STARDIS solar synthetic spectra. This research also involves comparing Phoenix synthetic stellar spectra with STARDIS synthetic stellar spectra to determine their respective accuracies. In the long term, this research aims to unravel the properties of Earendel and other stars from the dawn of time. Through a future comprehensive analysis, STARDIS promises to shed light on fundamental aspects of star formation and evolution, ultimately enhancing our understanding of the cosmic processes that have shaped our Universe.

NUCLEAR REACTION EXPERIMENTS TO UNDERSTAND EXPLOSIVE STELLAR ENVIRONMENTS

Presenter(s): Conrad Moenga (Essex County College)
Environmental Science & Natural Resources
Mentor(s): Artemisia Spyrou (Facility for Rare Isotope Beams)

Nucleosynthesis in neutron-rich stellar environments is where most of the elements above iron are created. One of the processes in these environments is the intermediate neutron capture process, or i-process. Of particular interest for the i-process are neutron capture reactions on barium isotopes; some of these neutron capture rates have been experimentally measured. Here I employ the TALYS nuclear reaction code to theoretically calculate these reaction rates, allowing for a comparison with the experimental data obtained. Here I perform a comparative analysis of experimental data from the EXFOR database, a comprehensive repository of experimental nuclear reaction data, with theoretical calculations done in TALYS. By comparing our theoretical TALYS calculations with this extensive dataset, we validate and expand our understanding of neutron-gamma reactions involving stable barium isotopes. By comparing different theoretical models in our TALYS calculations to experimental data, we hope to illuminate which theoretical models are most accurate and which will be best to use in the calculation of reaction rates that have not yet been measured. This study provides valuable insights into the fundamental processes occurring in stellar environments as well as trends in the nuclear theory used to model these stellar environments.

HEALTH SCIENCES

STUDYING NEGATIVE SOCIAL EFFECTS AND MISCONCEPTIONS OF CYSTIC FIBROSIS OF PATIENTS AGED 17-24, PRELIMINARY DISCUSSION FOR PULMONARY ORGANOID DEVELOPMENT

Presenter(s): Destiny Kanning (Michigan State University)
Health Sciences
Mentor(s): Ashlee Price (College of Human Medicine), Ryan Thomas (College of Human Medicine)
An ongoing study discussing preliminary research for the purpose of motivational background for pulmonary organoid development with the intent to broaden understanding and outreach efforts to patients diagnosed with Cystic Fibrosis (CF) within university environments. Thanks to revolutionary medication substantially affecting life expectancy for those diagnosed with the disorder, these students are faced with a greater concern than that of the symptoms of cystic fibrosis itself. The misrepresentations and underrepresentation of students facing the extreme mental and physical effects of pulmonary disorders within university environments are primarily overlooked and misconcepted by both the campus community and faculty. Ranging from medical misinformation amongst faculty/staff to ill-preparedness and inaccessibility, students diagnosed with CF, becoming an ever-growing population seeking higher education, is a concern in the event that proper treatment is not upheld and understood between the student body and campus community. Following approval by the IRB, survey data collected over the course of the past few months reveal extreme lack of understanding of the disorder and its effects amongst faculty, staff, and students alike, whilst equally highlighting the underrepresentation of those affected within the Michigan State University community, unlike those faced with similar disorders who are predominantly highlighted. This will discuss not only the concerns of misrepresentations but also underrepresentation amongst the diverse student body at Michigan State University and, as mentioned above, will encourage the development of research with a clinical focus prioritising organoid development in order to establish a baseline understanding of CF exacerbation triggers within standard university environments.

VISUALIZING ENAMEL: HISTOLOGICAL METHODS IN ANTHROPOLOGY

Presenter(s): Siri Vangavolu (Michigan State University)
Health Sciences
Mentor(s): Gabriel Wrobel (College of Social Science), Joseph Hefner (College of Social Science)

Common histological methods often make it difficult to visualize certain aspects of human tissue, such as the enamel of mature teeth. Hematoxylin-eosin staining and toluidine blue, for example, target acidic and basic cellular structures such as nuclei or granules, which are not present in the enamel of adult teeth. Due to this drawback of traditional staining methods, a new technique was explored to ensure that the enamel of teeth from archaeological collections would remain intact for further analysis. The purpose was to create a time-efficient and simple procedure for future students looking to analyze histological sections without having to stain tooth specimens. After trial and error, we discovered that this process involved embedding the desired tooth in epoxy resin and vacuum sealing it to prevent breakage when sectioning. Various thin sections were tested under a microscope to determine the ideal thickness for enamel visibility. The goal was to be able to observe linear enamel hypoplasia in the teeth. Linear enamel hypoplasia was selected amongst other features seen in enamel because it can only be seen in a thin section that allows light to pass through it, and because it is a nonmetric anthropological factor used to track genetic migration, as future students might do. The specimens that were analyzed were taken from the Caesarea Maritima collection in the MSU Bioarchaeology Lab and analyzed in the Forensic Anthropology Laboratory.

IS EXPOSURE TO SECOND-HAND SMOKE ASSOCIATED WITH GESTATIONAL AGE AT BIRTH IN A MICHIGAN PROSPECTIVE PREGNANCY COHORT?

Presenter(s): Ami Brooks (University of New Orleans)
Health Sciences
Mentor(s): Jean Kerver (College of Human Medicine)

Background: Pre-term (pre-mature) birth, defined by a baby being born too early (less than 37 weeks of pregnancy), also known as having a shorter gestational age, is associated with many adverse birth outcomes (ABO). Maternal smoking and exposure to tobacco smoking (cigarettes) are key predictors and risk factors for a pre-term birth, as well as linked to a shorter gestational age (Stock & Bauld, 2020.) Smoking is widely known to have consequential health effects and associations with cancer; however, less is known about the impact of second-hand smoke (SHS) and its association with pre-term birth, a defined adverse birth outcome (ABO) (Hoyt et al., 2018b.) This study assesses the association between SHS exposure and GA at birth in a Michigan prospective pregnancy cohort. Materials and Methods: Participants (n = 848) were from the Michigan Archive for Research on Child Health (MARCH), a prospective pregnancy cohort. Sociodemographic characteristics and self-reported maternal health data were collected via birth certificates and a pre-natal 1 questionnaire survey. We selected a subset of participants who each answered questions regarding our categorical exposure: "Were others in the household smoking tobacco during or before your pregnancy?" This study is a longitudinal observation study that collected sociodemographic variables: education status, race, age, and income of each participant. In conclusion, the study contained a stratified subset of the sample size between only White and Black reported participants.

ACUTE EFFECT OF LATANOPROST ON THE MORPHOLOGY OF IRIDOCORNEAL ANGLE IN DOGS WITH ADAMTS10-OPEN-ANGLE GLAUCOMA (ADAMTS10-OAG)

Presenter(s): Phillip Buckman (Michigan State University)
Health Sciences
Mentor(s): Andras Komaromy (College of Veterinary Medicine)

Latanoprost is a prostaglandin F2 analog used to treat glaucoma in humans. In humans, latanoprost applied over time activates matrix metalloproteinases within the trabecular meshwork increasing uveoscleral outflow of the aqueous humor. In dogs, latanoprost is used to rapidly reduce IOP in emergency situations. The goal of this study is to examine the effects of topical latanoprost on the morphology of the ciliary cleft region and anterior chamber of the eye using ultrasound biomicroscopy (UBM) and A-scan in ADAMTS10 open-angle glaucoma dogs.his study included 16 eyes of 9 glaucomatous beagles. Subjects were sedated prior to their first series of examinations. UBM scans, IOP, pupil diameter, Pachymetry, tonography, and A-scans will be performed. The same series of exams will be performed before and after topical application. The subjects will then be treated with latanoprost 0.005% ophthalmic solution once every 30 minutes for 2 hours. Totaling 5 eyedrops per eye. After topical treatment, subjects will then receive their second series of examinations. The Images of the ciliary cleft region taken using UBM will be analyzed based on the iridocorneal angle (ICA), angle opening distance (AOD), ciliary cleft length (CCL), ciliary cleft width (CCW), and, depth of the anterior chamber (AC). We hypothesize that there will be a measurable difference in morphology between the anterior segment and anterior chamber of the eye before and after latanoprost treatment. Latanoprost application significantly shrinks the Iridocorneal angle as ciliary body thickness and overall IOP is reduced. Despite there being no significant change in the ciliary cleft area the ciliary cleft width was significantly increased. Our findings showed IOP was reduced by 52.6% while the CBT was reduced by 25.4% two hours after application. This is consistent with non-glaucomatous canine studies that showed a reduction of CBT by 13%. We also found that the CCW increased by 25.5% further supporting the hypothesis that intermuscular spaces within the extracellular meshwork are opened by the relaxation of ciliary muscle. This study directly supports the established hypothesis that the ocular hypotensive mechanism of the prostaglandin latanoprost is induced through the relaxation of the ciliary muscle.

OLOSHO ETHNOBOTANY PROJECT: INVESTIGATING TRADITIONAL MEDICINE IN NAROK, KENYA

Presenter(s): Jordan Cauvel (Grand Valley State University)
Health Sciences
Mentor(s): Kristin Hedges (Grand Valley State University)

The Olosho Ethnobotany Project began in 2017, as a community request to document traditional medicine used by the Purko Maasai in Kenya. This traditional medicinal knowledge (TMK) within this community is at risk of being lost due to encroaching influences, such as modernization and generational gaps. Traditionally this knowledge has only been passed down to the next generationally orally. The overall goal of the project is to document the knowledge in written format of a field guide. To date two editions of the field guide have been created with a primary focus on College of Human Medicine and over 200 copies disseminated throughout the local community. This most recent stage of the project focused on ethnoveterinary medicine, documenting TMK used for livestock. Methods included two weeks of participant observation with agro-pastoralists in Narok, Kenya. Additional methods were a focus group among the 80-year-old age set of elders and plant walks. Plant documentation during the walks consisted of photographs, written descriptions, and audio interviews detailing medicinal usage. A total of 11 traditional medicinal remedies for livestock were documented for the third edition field guide. Findings demonstrated even more rapid erosion of TMK with veterinary medicine than human traditional medicine.

IS SELF-REPORTED MATERNAL STRESS ASSOCIATED WITH GESTATIONAL AGE AT BIRTH IN A MICHIGAN PROSPECTIVE PREGNANCY COHORT?

Presenter(s): Gabrielle Harper (Bennett College)
Health Sciences
Mentor(s): Jean Kerver (College of Human Medicine)

Numerous studies have been conducted to assess associations between stress in mothers during the prenatal period and adverse birth outcomes such as preterm birth. However, findings of these studies have continued to fluctuate making the results inconclusive. The aim was to assess the association between maternal self-reported stress during pregnancy and gestational age at birth by analyzing data from a Michigan prospective pregnancy cohort, hypothesizing that higher stress leads to earlier gestational age at birth. Demographic characteristics including income, highest level of education, race, age, and marital status were described for cohort participants (n=215). Maternal self-reported stress was assessed with the Perceived Stress Scale 4 (PSS-4), a 4-question survey completed during the second prenatal visit. Higher scores are associated with increased levels of stress. Regression analyses were used to examine the associations between maternal stress and gestational age at birth. Marital status was assessed as a potential confounder. The majority of the sample was either white (n=151) or black (n=39). Education level varied between three groups: high school education or less (n=49), some college including trade (n=64), and associate's degree or higher (n=101). Preliminary results show no significant association between self-reported stress and gestational age at birth. Marital status was not included in the regression analysis because it was not associated with higher scores of the PSS-4. This research adds to the body of literature about life stressors and preterm birth and can be used to develop interventions that will help women ensure successful pregnancies and birth outcome.

GUN VIOLENCE AS AN EPIDEMIC: A PUBLIC HEALTH-BASED POLICY INTERVENTION

Presenter(s): Julia Warznie (Michigan State University), Kirthika Krishnan (Michigan State University), Rhea Raut (Michigan State University)
Health Sciences
Mentor(s): John Zubek (College of Natural Science)

Gun violence is a prevalent issue across the nation, occurring at a rate 26 times greater than in other high-income countries. Because gun violence occurs in certain areas and targets certain communities at a greater rate than expected, it can be classified as an epidemic per the definition by the Center for Disease Control and Prevention (2012). Schoolage youth and young adults are more likely to be impacted by gun violence than their adult counterparts, so they are a prime demographic of consideration in gun violence research. This proposed study focuses on the impact of gun violence on universities, considering intersecting disproportionalities among racial, geographical, and age groups. Using student perceptions on gun violence as an epidemic, this study will derive solutions from the public health model, emphasizing both prevention and response while exploring the impacts of gun violence at all levels, from the individual to broader society. Therefore, our proposal is to survey current and past students at Michigan State University and sister academic institutions on their perceptions of gun violence as a public health matter, proposed solutions, and resources they might desire to ensure safety on campus and beyond. This project proposes to develop actionable items that are student and community driven to further propose a model that will not only broaden our approach to solutions that will work for communities but also for individuals within the community.

OVARIAN TISSUE TRANSPLANTATION

Presenter(s): Osemenga Celey-Okogun (City University of New York - Medgar Evers College)
Health Sciences
Mentor(s): Darius Amos (College of Human Medicine), Ping Wang (College of Human Medicine)

A cutting-edge technique known as ovarian tissue cryopreservation (OTC) and transplanting is being used more frequently to assist maintain fertility after gonadotoxic therapies, particularly in cancer patients. With the aid of in-vitro fertilization, about 30% of patients who have undergone autotransplant are able to give birth to living children. For women who are having trouble getting pregnant or who are receiving chemotherapy or radiation therapy, which can harm the ovaries and impair their ability to reproduce, ovarian tissue transplantation is a procedure with a lot of promise. A part of the donor's ovarian tissue is first taken out during a laparoscopic procedure prior to the transplant. After being vitrified or slowly frozen, the tissue is then thawed and transplanted after being cryopreserved. As Brown Adipose Tissue (BAT) will graft and produce vasculature quickly, we will be transplanting the ovarian tissue samples into this tissue type for this research. During this research, we will use scientific methods like western blot, H&E staining, OCT imaging, and so on. In this research, we will be breeding mice and surgically removing the ovaries of the females and then transplanting them into the BAT of the mice. Ovarian tissue transplantation, as a whole, is an exciting new area of reproductive medicine, offering hope for regaining fertility and enhancing the lives of women who are struggling with infertility. The process will likely be improved, and its range of potential applications will increase over time as a result of ongoing studies and breakthroughs in the field.

THE INDIETRAINER SYSTEM A CLINICAL TRIAL PROTOCOL EXPLORING THE RELATIONSHIP BETWEEN LIWC ANALYSIS OF CAREGIVER INTERVIEWS AND ALP PHASE DEVELOPMENT OF CHILDREN WITH CEREBRAL PALSY

Presenter(s): Dominik Vanderest (Grand Valley State University)
Health Sciences
Mentor(s): Dominik Vanderest (Grand Valley State University)

The IndieTrainer System, consisting of a mobility device and gamified training modules, was created to support powered wheelchair (PWC) skills acquisition in children with cerebral palsy (CP). The purposes of this study were to: (1) quantify and explore parental perceptions of their children pre and post a PWC skills training intervention using the IndieTrainer System; and (2) to investigate possible relationships between parental perceptions and their children's phase of PWC skills learning. This small-scale, open-label, single-arm clinical trial involved six, 60-minute PWC training intervention sessions over three weeks with a single follow up session four weeks after the completion of the intervention. Twenty-five child-parent/care-giver dyads participated in the study. Each child participant was 3 to 21 years of age and had a diagnosis of CP or other similar condition. The Assessment of Learned Powered mobility use was administered at T0 (baseline), T1 (immediately post-intervention), and T2 (at the four-week follow up session) to determine children's phase of PWC skills learning. Semi-structured, audio-recorded parental interviews were conducted at T0 and T1 and consisted of questions regarding parents' descriptions of their child and their perceptions of how their child would respond/responded to a PWC skills training intervention using the IndieTrainer System were transcribed and analyzed using the Linguistic Inquiry and Word Count program (LIWC), a computerized text analysis program. Understanding the possible relationships between parental perceptions and their children's phase of PWC skills learning may provide insights into PWC skills training interventions and outcomes.

ADDRESSING FALLS IN NURSING HOMES

Presenter(s): Chaitanya Vadlamudi (Michigan State University)
Health Sciences
Mentor(s): Murthy Gokula (Concierge Connected Care)

This study aims to implement person-centered, non-pharmacological interventions in the Cognitive Spa, a dementia care unit at Orchard Villa Skilled Nursing Facility, with the objective of reducing behavioral disturbances, falls, and readmissions among patients. The current schedule will be improved by incorporating stimulating activities for a select group of patients, while a control group will be used for comparison. Patients admitted to the facility will be assessed using various scales, including the global deterioration scale, social service assessment, CAA Review, and FAST scale. The study will begin by providing training to State Tested Nurse Aides (STNAs) on dementia care, addressing the gaps in their knowledge. Certified trainers will create presentations to educate and prepare the STNAs in caring for patients with dementia or Alzheimer's disease. Additionally, recreational therapy and other trained specialists will train the STNAs involved in the dementia care unit to enhance their involvement in providing quality care. A revised schedule will be created, allowing three nurse aides to be available to the patients, with two focused on safety and hygiene and one involved in recreational therapy during daily activities. By improving STNAs' knowledge and involving them in recreational therapy, it is anticipated that patient care quality will be enhanced, potentially reducing falls.The second part of the study will involve implementing aromatherapy and light therapy. A specific group of patients will receive these interventions after dinner. Red light therapy and the use of lavender or other essential oil diffusers will be employed during this time, along with administering regularly scheduled medications and ensuring increased hydration.

KINESIOLOGY & NUTRITION

EFFECTIVENESS OF OSTEOPATHIC MANIPULATIVE MEDICINE IN CHRONIC LOW BACK PAIN

Presenter(s): Moaid Shaik (Michigan State University)
Kinesiology & Nutrition
Mentor(s): Clarence Nicodemus (College of Osteopathic Medicine), Jessica Epstein (College of Osteopathic Medicine)

Chronic low back pain (CLBP) is a condition affecting many individuals worldwide. This study investigated the short-term and long-term effects of Osteopathic Manipulative Medicine (OMM) in individuals with CLBP. OMM utilizes manual therapy techniques to improve musculoskeletal function and alleviate pain. A total of 101 participants with non-specific CLBP were enrolled in a single-cohort observational study. The National Institutes of Health Minimum Dataset for Chronic Low Back Pain was used to assess pain intensity. The Roland Morris Disability Questionnaire and the Numerical Rating Pain Scale were also used to measure pain intensity. Data was collected at multiple time points from baseline to 52 weeks. The results demonstrated reductions in pain intensity after OMM treatment. Over the 52-week period, there were sustained decreases in pain intensity. The percent change analysis revealed persistent improvements in these measures, particularly at the 24-week mark. These findings emphasize the efficacy of OMM in managing CLBP and its long-lasting impact on pain intensity. This study provides evidence of the short-term and long-term effects of OMM in individuals with CLBP. The sustained reductions in pain intensity highlight the value of OMM as a comprehensive treatment approach for CLBP. Further research incorporating larger, samples with larger demographic variability is necessary to validate these findings and enhance understanding of OMM's effectiveness in CLBP management.

VALIDITY OF THE MOTIONLOGGER ACCELEROMETER FOR ASSESSING PHYSICAL ACTIVITY IN TODDLERS

Presenter(s): Amber D'mello (City University of New York - Hunter College)
Kinesiology & Nutrition
Mentor(s): Cailyn Vancamp (College of Education), Karin Pfeiffer (College of Education)

It is unknown if an accelerometer could accurately measure both PA and sleep in toddlers. Purpose: To assess the validity of the Motionlogger accelerometer for measuring PA among toddlers. Methods: This study recruited 30 toddlers, aged 12 to 36 months, and their families from early childhood care centers at University of Colorado and Michigan State University. The remaining toddlers were recruited from the Denver and East Lansing metro areas through various contacts and listservs. Ankle accelerometers were attached to each toddler, and their free-play activities, both indoors and outdoors, were recorded on video for a minimum of 30 minutes in either a childcare center or home environment. The activity level, ranging from 1 to 5 (1 being sedentary and 5 being fast), was determined through direct observation, following the Observational System for Recording Physical Activity in Children - Preschool (OSRAC-P). The accelerometer data was sampled in 15-second intervals and then aggregated to 60-second intervals for analysis. The correlation between the accelerometer data and OSRAC-P was assessed using Spearman correlation ($p < 0.001$). A moderate correlation ($r_s \geq 0.414$) exists between the Motionlogger accelerometer and direct observation of PA. This research will contribute to our current understanding of the Motionlogger device and its validity in assessing physical activity among toddlers. Furthermore, it will better our ability for 24 hr. monitoring of physical activity in toddlers and expand the literature on the validation of accelerometer measurements to assess physical activity in toddlers.

IMPACT OF RACE AND SENSITIVE PERSONALITIES ON INSOMNIA IN COLLEGIATE ATHLETES

Presenter(s): Asia Rogers (Bennett College)
Kinesiology & Nutrition
Mentor(s): Nicole Hoffman (College of Education)

Insomnia is defined as difficulties initiating or maintaining sleep and early awakening before achieving optimum sleep. A highly sensitive person is someone who has a low tolerance for stimuli, a characteristic exemplified as sensory processing sensitivity. Levels of sensitivity are not fully understood in collegiate athletes, especially in individuals based on race. College athletes, particularly those from racial minority backgrounds, may suffer from these traits due to numerous environmental stimuli/stressors they encounter within sport. Consequently, demanding schedules can potentially negatively impact their sleep, especially if they are highly sensitive. The purpose of this study was to determine whether race and the degree of hypersensitivity predict whether collegiate athletes will have an insomnia disorder. We performed a cross-sectional study of Division I collegiate athletes (age:19.8±1.7 yrs.; 2 groups: racial minority and white) from Michigan State University. Participants (n=377) were asked to complete a 5-10-minute survey, administered via Qualtrics, which included demographics and two self-reported questionnaires: Highly Sensitive Person (HSP) and Pittsburgh Sleep Symptom Questionnaire - Insomnia (PSSQ_I). The HSP examines a person's sensitivity to environmental stimuli and their awareness of the subtleties of the world around them. The PSSQ_I examines participants' sleep symptoms during the past month and looks for insomnia characteristics. Our findings indicated that collegiate athletes who were racial minorities with higher degrees of sensitivity had greater odds of experiencing an insomnia disorder compared to white collegiate athletes. Future research should explore causes of the racial disparity in collegiate athletes with higher levels of sensitivity and their relationship with insomnia.

CHANGES IN ATTITUDES AND KNOWLEDGE FOR THE BUILDING BRIDGES THROUGH BASKETBALL PROGRAM

Presenter(s): Grant Palmer (Morehouse College)
Kinesiology & Nutrition

Mentor(s): Karin Pfeiffer (College of Education)

The research question addressed in this study is focused on exploring how Building Bridges, a program aimed at fostering positive interactions and understanding between youth and law enforcement through basketball, can contribute to a change in attitudes and knowledge, subsequently strengthening community relations. This research aims to investigate the potential impact of the Building Bridges program in bridging the gap between these two groups and promoting harmonious community relationships. The study has a mixed-methods approach, incorporating both quantitative and qualitative data collection techniques. By using surveys, questionnaires, and interviews they are given to participants before and after their involvement in the program in order to measure changes in attitudes and knowledge. In-depth interviews and focus groups are conducted to gather qualitative data on participants' experiences and perceptions of the program's effects. The findings of this study will show the potential effectiveness of the Building Bridges program in changing attitudes and knowledge among both the youth and the law enforcement participants. The research is grounded in social psychology theories and community relationship models, which highlight the significance of positive interactions, shared experiences, and increased understanding in promoting trust and cooperation between different social groups. By examining the specific context of youth and law enforcement interactions within the Building Bridges program, this research seeks to contribute to the existing literature on community policing, youth engagement, and intergroup relations. The research means to provide insight into the mechanisms through which these attitudinal and knowledge changes can contribute to the strengthening of community relations.

THE EFFECT OF AGE-RELATED DIFFERENCES AND OBJECT PROPERTIES ON MANUAL EXPLORATORY BEHAVIORS IN INFANTS

Presenter(s): Promise Robinson (University of Texas at Arlington)
Kinesiology & Nutrition
Mentor(s): Mei Hua Lee (College of Education)

Throughout the first years of life, infants explore various objects through throwing, chewing, and dropping toys on the floor. As infants age, they learn how to manipulate objects and interact with the environment around them. However, it is unknown how manual exploratory behaviors change in the first few years of life based on object properties. Hence, the purpose of this study was to examine the effect of age-related differences and object properties on manual exploratory behaviors in infants. To test this, manual exploratory behaviors were observed longitudinally in infants aged six-to twelve- months of age. The infant behaviors were captured via video cameras as they explored nine objects of different shapes (cube vs. sphere), sizes (2" vs. 4"), and textures (soft vs. hard). Datavyu, an open-source behavior coding software, was utilized to code object manipulation behaviors of reaching and grasping. Exploratory behaviors were categorized as actions involving the wrist, fingers, or transportation of the object. The results indicated that finger actions were the most common categorical action across all age groups, with transportation activities as the next recurring behavior. Object properties influenced how the infants interacted with the toys, as larger objects afforded limited ability to be transferred between hands. Overall, the video analysis revealed that infants demonstrated a wide range of manual exploratory behavior patterns. Thus, the findings from this study can serve as an indicator of the developmental undertaking involved in object exploration during the first year of life.

MECHANICAL ENGINEERING

IMAGE PROCESSING OF QUANTUM DOT THERMOMETRY FOR NASA ZERO BOIL-OFF EXPERIMENT

Presenter(s): Matthew Bush (Michigan State University)
Mechanical Engineering
Mentor(s): David Olson (College of Engineering)

Cryogenic propellants are desirable due to their high specific impulse. Their volatility at high temperatures necessitates special storage methods to prevent unnecessary losses from heat leakage into the storage tank. While venting prevents pressure buildup within the tanks, it causes a considerable propellant loss to boil-off, which is unsustainable for long-duration space missions. The Zero Boil-Off Tank (ZBOT) experiments are conducted onboard the International Space Station (ISS) to explore the modeling and design of cryogenic fluid management system that maintain zero boil-off, managing pressure instead with active heat removal and jet mixing. The current research focuses on identifying and replacing unreliable data in images generated with the ratiometric Quantum Dot Thermometry (QDT) technique developed for the ZBOT experiments. QDT employs quantum dot nanocrystal semiconductors that are functionalized to disperse within the cryogenic simulant fluid perfluoro-n-pentane (PnP). The laser-induced fluorescent (LIF) emissions of the QDs are captured with a single Bayer filter color camera. The ratio of blue signal to green signal is calibrated with temperature, yielding a whole-field non-intrusive temperature field that may be measured optically. The non-uniform temperature field causes localized changes in index of refraction, refracting the incident laser light into streaky patterns. This study presents techniques implemented using MATLAB to mitigate these streaks with a missing data smoothing algorithm based on the discrete cosine transform. Furthermore, the temperature response of the ratiometric LIF of multiple QD-PnP solutions are characterized. The results will assist researchers

in model development for engineering design of microgravity zero boil-off cryogenic propellant storage.

ON THE EFFECTS OF PULSE CHARGING FOR LITHIUM SULFUR BATTERIES

Presenter(s): Chad Gilbert (Oakland University)
Mechanical Engineering
Mentor(s): Ankun Yang (Oakland University), Xia Wang (Oakland University)

Lithium-ion batteries (LIBs) have been the forefront for portable electronics and electrification of the automobile industry. However, LIBs are beginning to reach the limit on their specific capacities and capabilities. Lithium sulfur (Li-S) batteries have much higher theoretical specific capacities than current LIBs. Li-S batteries have poor life cycles, however, from phase changes during battery cycling. Similarly, dendrite formation on the anode during charging can internally short circuit the battery and accelerate battery degradation. The objective of this study is to propose a pulse charging strategy to improve Li-S cycle life and suppress lithium dendrite growth. 5 successful Li-S coin cells were assembled. These cells underwent constant current (0.2C charge/discharge rate) testing using a galvanostatic device to generate a baseline. The cells were subjected to a 0.5 Hz charge-rest (0.4C charge rate). Two of these five successful cells reported 21.2% and 89% average increase in discharge capacity, respectively. However, one cell reported an 8.9% decrease in average discharge capacity. In addition, improvements in the discharge capacity of the voltage plateau were noticed in the three cells in favor of pulse charging. Reproducibility of cells will need to be accomplished for definite results, but preliminary results show that pulse charging is beneficial for cells.

NOVEL FORCE TRANSDUCER FOR BIAXIAL BIOMECHANICAL CHARACTERIZATION OF ARTERIES IN SMALL ANIMAL MODELS OF HYPERTENSION

Presenter(s): Matt Fular (Michigan State University)
Mechanical Engineering
Mentor(s): Nathan Tykocki (College of Osteopathic Medicine), Sara Roccabianca (College of Engineering)

Understanding and accurately measuring vascular mechanics is crucial in identifying when and how mechanical forces, such as blood pressure, are fundamental drivers of biochemical processes in soft tissue. For example, the data gathered in mechanical stretching tests of small animal arteries can give insights into vascular remodeling (i.e., arterial stiffening) that occurs in pathological conditions, like hypertension. A standard way to test small arteries is with a pressure myograph, which serves to replicate physiological conditions ex vivo, allowing the user to change the pressure inside the arteries and gather uniaxial data of the circumferential stretch. However, previous research shows that it is also important to measure longitudinal (i.e., axial)

properties of arteries. This is because these properties are also significantly affected by hypertension, and axial changes can also contribute to circumferential remodeling. Implementing a novel force transducer into a pressure myograph allows for the measurement of axial force, and consequently stress, effectively turning a pressure myograph into a biaxial mechanical stretcher. For the device to serve this purpose, the objective was to design and fabricate a low-cost force transducer in-house that is particularly sensitive to small forces and has a high resolution, in the range of micronewtons to millinewtons. The rationale for designing a low-cost force transducer capable of being produced in-house is to avoid the excessive cost and supply chain issues of commercial products, and to make this device accessible to most labs in the world that have access to 3D printers.

DEVELOPING METHODS OF TESTING SHEET METAL ADHESION TO STAMPING DIE SURFACES

Presenter(s): Ryan Murray (University of Virginia)
Mechanical Engineering
Mentor(s): Sergey Golovashchenko (Oakland University)

Stamping processes in the automotive industry must be precise, but they also must be economical, repeatable, and swift. After many thousands of operations, stamping dies are subject to weathering, and galling can occur. The purpose of this study is to identify the most important factors regarding cold-welding in order to determine the threshold values at which galling or fracturing occurs. The experiment was carried out using a drawbead simulator tool installed into a high-speed tensile testing machine. Sheet metal samples were cleaned and deburred, and infrared spectroscopy was used to evenly distribute lubricant prior to testing. Various configurations of die materials and finishes, die geometries, bead penetrations, and lubricants were tested, and the restraining forces were recorded. The final distributions of lubricant on the samples were also observed.

DESIGNING A CUSTOMIZABLE WHEELCHAIR CONTROL INTERFACE

Presenter(s): Joshua Twumasi (Michigan State University)
Mechanical Engineering
Mentor(s): Justin Scott (College of Engineering), Tamara Bush (College of Engineering)

Mobility limitations that come with age or disability significantly impact the ability of elderly persons and persons with disabilities to live independently. Today, over 25% of the world's population require one or more assistive devices such as a wheelchair for daily activities. However, even with these devices, persons with disabilities still face an increased injury risk. Research indicates that individuals with disabilities obtained injuries at higher rates than able-bodied individuals, especially injuries during falls. Intuitive and user-friendly device interfaces would help ameliorate these risks. Therefore, the aim of this project was to create a user-friendly interface that allows wheelchair users to easily interact with their wheelchairs and control an automated repositioning system that redistributes pressure on their bodies. The wxPython and multithreading libraries in Python were used to develop an application to enable user interaction via a screen connected to a Raspberry Pi microprocessor. This microprocessor controlled linear actuators that repositioned the wheelchair. The application provided predefined buttons for navigation and displayed visual feedback on the screen. It allowed users to execute preprogrammed automatic repositioning algorithms and create customized algorithms. Furthermore, similar to conventional wheelchairs, users can adjust specific parts of the wheelchair, such as the thorax, seat pan, lumbar, or seat back supports. With this application, users can interact with their wheelchairs to enhance their independence. The button panel and screen can be adjusted to fit various positions on the wheelchair, offering flexibility during use and allowing users to maneuver their wheelchairs according to their preferences.

REDUCING ENGINE STEADY-STATE TIME THROUGH EFFICIENT TEST PLANNING

Presenter(s): Samantha Ritchie (University of Virginia)
Mechanical Engineering
Mentor(s): Dan DelVescovo (Oakland University)

In the automotive industry, steady-state testing of internal combustion engines plays a critical role in ensuring engine performance, efficiency, and compliance with regulatory standards. These modern automotive engines operate across a wide operating domain, requiring many discrete operating points in engine speed/load space to fully map the engine. This testing requires a significant time investment, leading to increased costs to manufacturers and delays in the product development cycle. Building on previous research, this work explores methods to reduce the time required to complete steady-state engine testing across a full engine map through efficient planning of test point sequencing in order to reduce changes in the thermal boundary conditions that define steady-state conditions. Experiments were conducted on an Armfield CM11-MKII engine test bench equipped with a 1.2L 3-cylinder Volkswagen engine and an eddy current dynamometer, while exhaust gas emissions were measured using a Horiba MEXA-584L Automotive Emissions Analyzer. Day-to-day differences in engine performance, efficiency, and emissions were quantified by operating the engine at a representative operating condition based on typical engine operating conditions in a vehicle at the beginning and end of each test campaign. Three test approaches were utilized to generate engine performance maps, the first being a Constant Speed, Variable Load (CSVL) approach, the second a Constant Load, Variable Speed (CLVS) approach, and the third a Random Order Testing (ROT)

approach. The CSVL method was found to be the most time efficient, reaching steady-state conditions on average 17% faster than the CSVL approach, and 22% faster than the ROT approach.

LASER POSITIONING SYSTEM TESTING FOR USE IN NEUTRINO EXPERIMENT (DUNE-PRISM)

Presenter(s): Kayla Williams (Michigan State University)
Mechanical Engineering
Mentor(s): Kendall Mahn (College of Natural Science)

In the United States, the Deep Underground Neutrino Experiment (DUNE) is being built, an experiment with an intense neutrino source focused on unlocking the mysteries of neutrinos. Underneath Fermilab in Illinois two Near Detectors, a Liquid Argon Cryostat (ND-LAr) and a Multi-Purpose Detector (MPD), will be moved up to around 30.5 meters off axis; the Precision Reaction Independent Spectrum Measurement (DUNE-PRISM). During PRISM motion a position monitor is needed to measure the location of these two detectors. The LLB502-01111 Laser Measuring Device was tested for this application. In order for this Laser Measuring Device to be a good fit for DUNE-PRISM, it needed to meet certain accuracy requirements and perform well under the environment's conditions. This includes vibrations from the near detector's motion, the lifespan of the DUNE-PRISM experiment (5~10) years, and a very small existing magnetic field. The accuracy requirement for this position monitor was 1 mm. If the LLB502-01111 met the accuracy requirements while performing uniformly as time passed, further tests to determine the effects of vibrations and the magnetic field would be conducted. After multiple tests were conducted the LLB502-01111 displayed inconsistencies in results and accuracy, which fell short of our goals. Due to a lack of trend in results, and an inconsistency with the performance abilities detailed in the device's manual, the company of the LLB502-01111 Laser Measuring Device (TR Electronic) will be contacted for explanation.

USING C++ TO OUTPUT ALL POSSIBLE TRANSITION RELATIONS OF A NUSMV PROGRAM

Presenter(s): Tess Murphy (Michigan State University)
Mechanical Engineering
Mentor(s): Borzoo Bonakdarpour (College of Engineering)

The tool, HyperQB, takes a list of models as input in NuSMV format and outputs counterexamples or witnesses. NuSMV is a software tool that allows for finite state model checking. From the NuSMV program, a list of all possible transition relations must be found. These transition relations show the initial and next states of a variable as defined by the input NuSMV program. A C++ program is currently being created to perform this task. The program goes line by line through the NuSMV program as a text file to find the initial and next definitions of each defined variable and stores these definitions as well as the variable types into various data structures. After finding each variable's initial and next states, the transition relations are created and output into a separate text file. Currently, the program only works for simple NuSMV programs, but new functionalities are being added. Once the C++ program can handle more difficult NuSMV programs and has been tested sufficiently, it will eventually be implemented as part of the larger tool, HyperQB, which is used for Bounded Model Checking for Hyperproperties.

IMPACT-DRIVEN NONLINEAR VIBRATION ENERGY HARVESTERS FOR AUTOMOTIVE ENGINE APPLICATIONS

Presenter(s): Alex Hamilton (James Madison University), Jackson Lucas (James Madison University)
Mechanical Engineering
Mentor(s): Chris Cooley (Oakland University), Dan DelVescovo (Oakland University)

This work investigates the energy harvested from the vibrations of automotive engines using a network of electrically-connected and physically interacting piezoelectric beams. The beams are tuned to different frequencies to try to harvest as much energy as possible over a regular operating revolutions per minute range for a three cylinder internal combustion engine. The vibrations of a three cylinder engine are experimentally characterized at a typical operating speed and load. Tip masses are added to the end of the individual piezoelectric beams to tune each beam to a different frequency within the operating range. The tip masses on the ends of the beams have flags on them that interact with adjacent beams. The performance of the individual piezoelectric beams and the network of electrically connected piezoelectric beams is experimentally determined using a vibration shaker. The maximum voltage generated by the open current device connected in series is significantly larger than when it is connected in parallel. The voltage generated by a prototype device is determined from on-engine testing. Devices made by connecting a network of piezoelectric beams may enable new condition monitoring, diagnostics, or other embedded systems for automotive powertrain applications.

INCREASING COMFORT IN LONG-TERM SEATING

Presenter(s): Colin Koot (Michigan State University)
Mechanical Engineering
Mentor(s): Tamara Bush (College of Engineering)

The typical person sits around ten hours per day, yet the effects of extended sitting are not often considered. A well-constructed seat distributes pressure and helps to promote good posture, while a poorly constructed seat results in pressure-related discomfort and poor posture. In this research, six variations of multi-layered cushions were developed using foam layering and gel integration. Each cushion had a base layer, support layers, and a luxury layer. The base layer was constructed using dense, hard foams that would not bottom out and expose the seat. The Indentation Load Deflection (ILD) values of these foams ranged from 70-150, with densities between 3.0-5.0 lbs/ft^3. In the support layer, a polyester honeycomb gel, polyurethane elastic fiber gel, and foams with an ILD of 30-35 and density between 3-6 lbs/ft^3 were selected for their ability to distribute pressure across the entire cushion. In the luxury layer, a soft foam with an ILD of 20 was used to provide an initial softness to the cushion. To test comfort, a pilot participant sat on a pressure map on each cushion for two minutes. A well-distributed pressure map indicated a comfortable cushion due to a lack of high-pressure areas. Overall, the polyester gel and full foam cushions with both base layers showed a decrease in pressure from the single-layer cushion. As a result of this work, manufacturers will be able to design cushions better suited for long-term comfort, helping reduce the musculoskeletal injuries and general discomfort suffered by many people every year.

DRIVELINE VIBRATION CONTROL OF 4WD ROBOTICS PLATFORM USING SIMULATION AND EXPERIMENT

Presenter(s): Kaelea Hayes (Pennsylvania State University), Megan Freid (Oakland University)
Mechanical Engineering
Mentor(s): Ryan Monroe (Oakland University)

Autonomous robotic platforms are becoming increasingly utilized for various commercial and military activities of national importance. These self-driving electric vehicles can include four or more driven wheels, which can each be controlled with independent electric motors. The ability to individually deliver torque to each drive wheel can enable dramatic enhancements in mobility performance, including improvements in vehicle dynamic maneuverability and stability, as well as increased energy efficiency. Especially in off-road terrains, where traction is limited and highly-variable, the need to precisely control the drive torque to each wheel is critical. Impulses in motor torque are common with these platforms, particularly when operating on uncertain terrains. The resulting torque spikes can cause problematic torsional vibrations of the driveline, which reduces vehicle traction/stability and ultimately can result in failure of the rotating driveline components. In collaboration with Pratt Miller, an elastic driveshaft model is developed with MATLAB/Simulink and integrated within an existing co-simulation environment leveraging CarSim, which is a commercial tool for simulating vehicle dynamics. The elastic driveshaft model will provide a correction to the commanded motor torque, which will be used to develop a "smart smoothing" of the torque command to eliminate the onset of the problematic driveline vibrations. The developed control strategy will be optimized to ensure that driveline vibrations are avoided without sacrificing the mobility performance of the vehicle. After a successful prototype, the control strategy will be deployed on a Pratt Miller robotic platform for further testing and refinement.

FACILITATING ROTATION IN A TIGHT OPERATING SPACE

Presenter(s): David Twomley (Michigan State University)
Mechanical Engineering
Mentor(s): Sarah Swierenga (College of Communication Arts Sciences), Tamara Bush (College of Engineering)

When working with large equipment in industrial environments, mobility and visibility are key to productivity and safety. In current industrial vehicles the movement of the operator and their seat is constrained by the space available. A seat that allows the driver to reverse the direction they are facing will maximize the use of the operating environment and limit neck strain. By utilizing a detailed model of an interior space, several different methods for achieving this reverse position were explored. These methods were then evaluated based on functionality, complexity, and how they interacted with the industrial vehicle interior environment. All aspects of the interior environment that constrained the movement of the seat were defined. A vertical axis seat rotation was selected as the most effective option to achieve this goal. Utilizing translation and rotation movements of the seat, more space can be created for both the operator and the seat to rotate, and it is possible to reverse the direction of the driver within a small space. A mechanism that facilitates such a movement has been developed and is showcased in this work. It can be implemented into industrial equipment in order to functionally increase the range of visibility for operators, while also reducing potential neck strain.

STRAIN INDUCED CRYSTALLIZATION OF IDEAL NETWORK POLYMERS WITH TOPOLOGICAL DEFECTS

Presenter(s): Aditya Swarnkar (Michigan State University)
Mechanical Engineering
Mentor(s): Shaoting Lin (College of Engineering)

Strain Induced Crystallization is the process of increasing crystallinity in materials with the introduction of strain. Increased crystallinity is directly co-related to increased strength and toughness of the material. Many common polymers like rubber only experience about 20% increase in crystallinity. This research discusses a new class of polymers known as Ideal Network Polymers which can undergo a 50% increase in their crystallinity. This is important and has applications in many industries such as bioelectronics, tissue adhesive, water harvesting and sustainable heat generation.

DESIGN OF AUTOMATIC REPOSITIONING RECLINER

Presenter(s): Abbey Yager (Michigan State University)
Mechanical Engineering
Mentor(s): Justin Scott (College of Engineering), Tamara Bush (College of Engineering)

Individuals in hospitals, post-surgery patients, and wheelchair users are at risk of developing pressure injuries when they are confined to a bed or chair. Their inability to adjust their position results in prolonged pressures in areas around bony prominences, causing damage to their skin and underlying soft tissue. It is generally difficult for nurses to reposition their patients often enough to avoid such injuries resulting in a 47% prevalence rate for high-risk individuals. A chair that can automatically readjust patients' positions based on time and pressure intervals may mitigate pressure injury occurrences. The primary objective of this project was to create the physical design of a recliner that has the range of motion of hospital recliners and can automatically reposition based on time and pressure feedback. A model of the recliner was designed using Siemens NX and altered to fit customized actuators that drive the automatic repositioning. Parts of the recliner were made of aluminum and manufactured using a mill. The result was the physical structure of an automatically repositioning recliner with rotating seat back, seat pan, thoracic and lumbar, and footrest supports used to create combinations of movements previously shown to redistribute pressure on the body. The recliner has the same range of motion as commercial medical recliners, allowing it to support any position currently available. This recliner has the potential to reduce nursing time spent on pressure injury prevention while providing protection from pressure injury risk. Doing so will ultimately save patients time spent in recovery and money.

MAXIMIZING THE PRODUCTIVE SURFACES/FURNITURE IN A CONFINED SPACE

Presenter(s): Keya Baxi (Michigan State University)
Mechanical Engineering
Mentor(s): Sarah Swierenga (College of Communication Arts Sciences), Tamara Bush (College of Engineering)

In today's fast-paced and dynamic work environments, maximizing productivity and maintaining organizational efficiency is crucial, particularly in tight operating quarters where the workspace is limited. This research explores the integration of a multipurpose work surface to enhance the productivity and organization of personal belongings in compact settings. An assessment of the space available for a worksurface was completed, and the needs of current users were evaluated using the results of a user experience study. As a result, the design of an adjustable desk that allows for the storage of personal belongings including cups, cell phones, tablets, and laptops was sought. To optimize the available space, different methods to adjust the desk's position were explored. These included a desk that could adjust in height using a scissor lift and a swivel desk that could move along a track. Different organizational strategies, including dividers and cup holders, were integrated into both desk designs. Both were drafted and developed in CAD to identify any interferences with the surrounding space. An ergonomic assessment was conducted to analyze the two different variations of the desk. The swivel design was chosen to be further developed, and a 3D-printed prototype was created to evaluate the mechanism. The future objective of this project is to create a full-scale prototype of the swivel design. Finally, the development of this worksurface will contribute to the design and implementation of efficient workspaces, and aid people who frequently work in compact working environments.

MICROBIOLOGY, IMMUNOLOGY & INFECTIOUS DISEASE

COMBATING STAPHYLOCOCCUS ANTIBIOTIC RESISTANCE BY TARGETING NUTRIENT SULFUR TRANSPORT USING THE HERBICIDE BIALAPHOS

Presenter(s): Rosemary Northcote (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Neal Hammer (College of Natural Science), Paige Kies (College of Natural Science)

The opportunistic pathogen Staphylococcus aureus propagates within numerous host tissues and is the leading cause of skin and soft tissue infections, bacteremia, endocarditis, and osteomyelitis. To combat this antibiotic resistant bacterium, the development of new therapeutics is essential. The herbicide bialaphos is a tripeptide that inhibits the enzyme glutamine synthetase, which is essential in glutamine-deprived environments. We previously demonstrated that S. aureus sensitivity to bialaphos is glutamine- and transport-dependent. Genetic studies revealed that the di-tripeptide transporter, DtpT, is responsible for bialaphos import into S. aureus. DtpT also promotes S. aureus utilization of the di-peptide cysteinyl-glycine (Cys-Gly) and tripeptide glutathione (GSH) as sources of nutrient sulfur and a dtpT mutant exhibits decreased pathogenesis. Another staphylococcal species, Staphylococcus epidermidis, also causes nosocomial infections and encodes a DtpT homologue. Therefore, I hypothesized that S. epidermidis displays glutamine-dependent sensitivity to bialaphos. I show that S. epidermidis is more sensitive to bialaphos than S. aureus and increased incubation times are required to isolate colonies resistant to the herbicide. Phenotypic characterization of S. epidermidis bialaphos resistant mutants reveals decreased utilization of DtpT-dependent substrates Cys-Gly and GSH, which strongly suggests that the DtpT homologue has been mutated. To

identify mutations that promote bialaphos resistance, Whole Genome Sequencing (WGS) of these S. epidermidis bialaphos resistant strains is being conducted. Mutations identified via WGS will be confirmed by generating single mutants and testing the contribution of each mutation to S. epidermidis bialaphos susceptibility. Collectively, these results demonstrate that peptide transporters in these bacteria can be targeted by toxic tripeptides.

INDUCING ANTI-TUMORAL RESPONSES THROUGH ACTIVATION OF CGAS-STING PATHWAY

Presenter(s): Tyler Verburg (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Christopher Waters (College of Osteopathic Medicine), Dohun Pyeon (College of Human Medicine), Yasser Aldhamen (College of Osteopathic Medicine)

The STING (Stimulator of Interferon Genes) receptor plays an important role in causing inflammation in the tumor microenvironment (TME), which initiates critical innate and adaptive immune responses to prevent tumor growth. The STING pathway has become an impending target for cancer research with the hope to initiate cGAS (cyclic GMP-AMP synthase) which regulates STING receptors and interferon (IFN) production. Activation of cGAS is dependent on double-strand DNA derived from intracellular and extracellular locations. In previous studies, many researchers show increased efficacy of STING signaling on tumor growth when activated however, activation of cGAS can also initiate a non-canonical NF-kB pathway that causes nuclear translocation of cGAS which inhibits DNA repair proteins and therefore, promoting cancer metastasis. Our research focuses on activating the STING pathway while preventing nuclear translocation of cGAS thus preventing metastasis. Therefore, we have developed three variations of the cGAS protein to compare the efficacy of the signaling pathway by measuring cytokine secretion, CD8+ T cell activation, and dendritic cell recruitment. By altering the cGAS gene we believe that we can control nuclear translocation and promote canonical cGAS-STING signaling driving anti-tumor responses in the TME. So far, we have confirmed that the cGAS-STING can be activated by our plasmids using mass spectrometry as well as increased IFN-beta production in cancer cells using Bio-Plex immunoassays. In the upcoming months we plan to develop an adenovirus containing our variation of cGAS that provides the best activation of the STING pathway to use invivo studies.

EXAMINING PERSISTENCE OF CORONAVIRUS IN SEPTAGE

Presenter(s): Emily Zak (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Joan Rose (College of Agriculture & Natural Resources)

The COVID-19 pandemic has threatened the health of millions of people worldwide. Throughout the pandemic, a network of labs across the state of Michigan have been monitoring SARS-CoV-2 levels through community wastewater systems. These samples were found to reflect trends true to reported cases with some early warning, providing a way to include asymptomatic cases in the data that otherwise would not have been reported. However, 35% of Michigan's population relies on the use of septic tanks, excluding a large portion of the population from this data. As the pandemic continues and there is less testing being done, it is more important than ever to be able to include as much of the population as possible to understand the health of the state as a whole. The goal of this study was to understand how long coronavirus signal could last in septage. This observational study examined the degradation of spiked OC43 virus signal in 7 different septage samples over a span of approximately 4 months. Samples were tested at both room temperature (~22°C) and 4°C. Key findings suggest that in typical septic tank conditions, septage can contain detectable concentrations of coronavirus RNA after a 4-month period, not typically following a constant rate of decay.

THE MYXOZOAN PARASITE TETRACAPSULOIDES BRYOSALMONAE IS INFECTING WILD SALMONID POPULATIONS IN LAKE HURON

Presenter(s): Montserrat Bonfante Malpica (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Bartolomeo Gorgoglione (College of Veterinary Medicine)

Tetracapsuloides bryosalmonae is a myxozoan (Malacosporea) parasite acting a two-host life cycle and causing Proliferative Kidney Disease (PKD) under adequate environmental conditions. Rainbow Trout (Oncorhynchus mykiss) and Brown Trout (Salmo trutta) are well-known hosts across Europe and Northwestern America. Currently, little is known about myxozoan parasites in the Great Lakes. The objective of this study was to assess T. bryosalmonae infection in Great Lakes salmonid species with relevance for local fisheries and ecosystems, thus with an unknown susceptibility to this parasite infection. Lake Whitefish (Coregonus clupeaformis), Lake Trout (Salvelinus namaycush), and Bloater (C. hoyi) were opportunistically retrieved through USGS researchers performing wild salmonid population programs. DNA was extracted from posterior kidney samples and used for PCR targeting T. bryosalmonae 18S rDNA. Genomic sequences were retrieved from positive samples, targeting Malacosporean SSU rDNA and the T. bryosalmonae CO1. Sequences analysis confirmed the detection of T. bryosalmonae from these salmonid species with 100% and 99.76% similarity to T. bryosalmonae CO1 and SSU rDNA sequences deposited in GenBank respectively. This is the first report of T. bryosalmonae from Lake Trout, Lake Whitefish, and a Cisco species from the Great Lakes. Towards understanding the relevance that this parasite may have for fisheries management in the Great Lakes, further study is needed to characterize the specific susceptibility of each of these hosts, viz the occurrence of coelozoic/histozoic parasite stages and of grade of PKD pathology.

ORF8 AND ADAM/TS GENE INTERACTION IN COVID-19 PATIENTS

Presenter(s): Paige Goderis (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Masako Harada (College of Engineering), Michael Bachmann (College of Human Medicine)

COVID-19 patients present with several symptoms ranging from cardiac and respiratory disease to mild flu-like symptoms such as fever and headache. A specific symptom, thrombosis, is being investigated in this project because its direct cause is being questioned. Thrombosis is currently thought to originate after a cascade of inflammatory responses and cytokine storms within the body. The goal of this project is to prove that thrombosis is directly caused by the interactions of the SARS-CoV-2 viral protein ORF8 and the ADAM/TS gene family. ORF8 modulates the body's immune response to inflammation, but current research has yet to prove that the presence of thrombosis is directly associated with ORF8's interactions with the genes in this family. In this project, I amplified ADAMTS1-Short using polymerase chain reaction (PCR) to see if removing a specific sequence from the backbone leads to different interactions with ORF8. After amplification, I ran gel electrophoresis and then further purified and quantified the concentration of the amplified product. Seamless ligation cloning extract (SLiCE), transformation and colony PCR were finally performed to mediate homologous recombination of the sequence and transform the new product into cells.

3D PASSIVE SAMPLING FOR SARS-COV-2 DETECTION IN WASTEWATER

Presenter(s): Corrine Caponigro (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Joan Rose (College of Agriculture & Natural Resources)

With the rise of the COVID-19 pandemic, wastewater monitoring has been conducted for detection of prevalence for the SARS-CoV-2 virus. This tool can act as an early warning system for detection at a noninvasive level. Automatic sampling methods are typically utilized in surveillance monitoring, but many challenges such as high costs and prolonged sampling and processing times are associated with these instruments. Knowing these challenges, alternative sampling methods such as passive sampling have been explored. This project implements a 3D printed torpedo style apparatus that allows for sewage material to be collected with reduced chance of debris clogging. This study compared detection limits of the SARS-CoV-2 pathogen among two sampling types: autosampler composites and 3D passive samplers. Forty-three wastewater samples were evaluated across 6 sewer sites (3 community and 3 dormitory) serving populations of 492-10,092 on the campus of Michigan

State University. Autosampler composites were processed using polyethylene glycol (PEG) and the passives a bead beating method. From the processed samples, viral RNA was extracted, and N1/N2 genes were quantified with digital droplet polymerase chain reaction (ddPCR). Each sampler detected levels of N1/N2 (5.4x101-1.61x104 gene copies/filter for passives and 3.84x102-3.83x104 gene copies/100 mL for composites). Autosampler composites detected higher concentrations than passive samplers; however, similar trends were observed using both methods. With similar trends, implications can be made for passive samplers to be employed as a cost-effective sampling approach to monitor population trends of SARS-CoV-2.

ZINC AND HAPR REGULATION OF VC0515 PHOSPHODIESTERASE IN VIBRIO CHOLERAE VSP-II ISLAND

Presenter(s): Marissa Malleck (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Aathmaja Anandhi Rangarajan (College of Osteopathic Medicine), Christopher Waters (College of Osteopathic Medicine)

Vibrio cholerae is a bacterial pathogen responsible for the diarrheal disease cholera. The El Tor biotype, characterized by two acquired genomic islands, VSP-I and VSP-II, is responsible for the current 7th cholera pandemic. Zur represses the vc0512-vc0515 operon in the VSP-II genomic island in the presence of zinc. The absence of zinc/zur activates the vc0513 (VerA) transcriptional activator, which further induces the expression of the vc0512-15 operon. This operon also includes the predicted chemotaxis-related protein (vc0514) and cyclic di-GMP phosphodiesterase (vc0515). Cyclic di-GMP is a signaling molecule which regulates biofilm formation and motility and contributes to bacterial infection. Cyclic di-GMP is synthesized by diguanylate cyclases (DGCs) and degraded by phosphodiesterases (PDEs). We also observed decreased motility in a Δvc0515 mutant due to the absence of phosphodiesterase activity by vc0515, which leads to high levels of cyclic di-GMP. The upstream region of vc0515 has a predicted HapR binding site which may affect the expression of vc0515. HapR is a transcriptional regulator expressed at high-cell density. We observed that the expression of the promoter fusion of vc0515 (PVC0515-lux) was high at low-cell density and repressed at high-cell density. Genome analysis of 7th pandemic strains isolated from various geographic regions showed that the vc0512-vc0515 operon is prevalent in different El Tor strains, which indicates evolutionary significance and importance for adaptation. We also found conserved HapR and HapR binding sites in El Tor strains. We are investigating the effect of zinc on intracellular levels of cyclic di-GMP in V. cholerae.

COMPARING BLOOD IMMUNOGLOBULIN-E (IGE) IN MICE CROSS-FOSTERED TO DAMS WITH VARIOUS GUT MICROBIOTAS

Presenter(s): Maliyah McGowan (Eastern Michigan University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Ivon Moya Uribe (College of Natural Science), Linda Mansfield (College of Veterinary Medicine), Susan Ewart (College of Veterinary Medicine)

Asthma is a chronic inflammatory and respiratory disease that is characterized by airway hyperresponsiveness (AHR) and associated with elevated immunoglobulin E (IgE) levels in the blood. Because it is one of the most common diseases worldwide and can have life threatening impacts, it is vital to find ways to lessen or prevent the side effects of asthma. One area that has been explored is the relationship of the gut microbiota and the risk of developing AHR and asthma. Studies show that gut microbiota influences immune development and can communicate with the lungs through the circulatory and lymphatic system. Metabolites produced by bacteria are absorbed into the bloodstream and travel to the lungs, altering the immune response to allergies and impacting AHR.57BLACK6 strain mice carrying either humanized gut microbiota or a specific pathogen free microbiota (conventional mouse microbiota) were cross-fostered to determine levels of IgE. Blood was centrifuged and plasma was extracted for ELISA. Mice cross-fostered to a dam with a different microbiota (either Infant B or conventional) will exhibit IgE levels more similar to their foster mother than their birth mother.

QB CONJUGATE VACCINE FOR COMBATING HEROIN ADDICTION

Presenter(s): Lillie Purcell (Western Illinois University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Fatemeh Shafieichaharberoud (College of Natural Science), Xuefei Huang (College of Natural Science)

Opioid misuse is a major cause of death in the United States and worldwide. Currently, the world is experiencing a steep increase in opioid-related deaths, suggesting an urgent need to solve this addiction. Using synthetic techniques, an anti-heroin vaccine has been developed in Huang lab to target heroin molecules and mitigate its effects. This project seeks to further analyze how various parameters affect the vaccine performance. Heroin is a small molecule that enters the blood-brain-barrier and effects the reward centers of the brain, causing a "high" feeling. To prevent the entry of the drug to the brain, a heroin derivative has been attached to a carrier molecule known as bacteriophage Qβ to form a conjugate vaccine. When a vaccine is introduced, the body produces antibodies against the antigen. The immune system remembers the response and can defend itself against any molecules similar to the antigen. The Qβ-heroin conjugate activates the immune system to produce antibodies that trap heroin in the bloodstream. Several different trials were run studying if a booster or an adjuvant was needed for the vaccine, and which adjuvant works best. An adjuvant is a molecule that helps invoke an immune response. The data analysis for this project has been performed using indirect enzyme-linked immunoassay (ELISA). In this presentation, results through data analysis of sera from immunized mice with various treatment on efficiency of the vaccine will be discussed.

THE CELL WALL STRESS STIMULON ENHANCES BETA-LACTAM RESISTANCE IN FERMENTING STAPHYLOCOCCUS AUREUS

Presenter(s): Jessica Bailey (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Neal Hammer (College of Natural Science)

Staphylococcus aureus is the leading cause of morbidity and mortality caused by antibiotic resistant infections in developed countries. To develop new therapeutic strategies to combat this microbial threat, it is necessary to identify factors contributing to increased antibiotic resistance of S. aureus. One mechanism S. aureus employs to resist antibiotics is by entering a fermentative state known as the small colony variant (SCV). SCVs can cause prolonged infections that are difficult to treat. Additionally, upon exposure to cell wall-targeting antibiotics, S. aureus activates the VraRS two component system to induce expression of beta-lactam and glycopeptide resistance genes, reducing vancomycin susceptibility; a commonly used last resort antibiotic. Previous work demonstrated that methicillin resistant SCVs exhibited enhanced resistance to beta-lactam antibiotics that are dependent on the resistance factor MecA. mecA transcription is VraR-dependent, and my work investigates the involvement of VraR in the SCV antibiotic resistance phenotype. Disk diffusion assays were used to demonstrate that the mutated vraR reduces the enhanced beta-lactam resistance displayed by fermenting S. aureus. Additionally, a fluorescent reporter was used to determine the regulation of vraR after exposure to cell wall targeting antibiotics. Together, these assays provide evidence for vraR involvement in resisting Ceftaroline, Ceftriaxone, Ampicillin, and Bacitracin.

AUTOIMMUNE REGULATOR (AIRE) CAUSES EPIDIDYMITIS AND INFERTILITY IN MALE MICE

Presenter(s): Joey Esparza (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Margaret Petroff (College of Veterinary Medicine), Soo Hyun Ahn (College of Veterinary Medicine)

Immune tolerance to self is critical for eliminating self-reactive T cells that could cause autoimmune disease. AIRE (autoimmune regulator) is a transcription factor in the medulla of the thymus that induces expression of self-specific antigens, which in turn causes deletion of autoreactive T cells. In

humans and mouse models, mutation of Aire results in survival of self-reactive T cells that target tissues and cause autoimmunity. For example, targeting of tissues within the reproductive tract can lead to infertility in males and females. Among the antigens regulated by Aire in the thymus are reproductive tract specific antigens. However, it remains unclear which of these antigens are targeted in Aire-mediated autoimmune disease, as well as if these reproductive antigens are expressed in a sex-specific manner. The purpose of this study is to evaluate if reproductive antigens are expressed in a sex-dependent manner. To do this, quantitative RT-PCR for these antigens in male and female thymuses will be performed using whole thymus tissue as well as medullary thymic epithelial cells isolated by flow cytometry. We expect that male reproductive antigens are expressed in male thymus, but not in female thymus, and conversely, we expect that female reproductive antigens are expressed in the female but not the male thymus. These results will contribute to our understanding of how failure immune tolerance contributes to infertility, and thus how we may prevent autoimmune infertility.

EVALUATING CONJUGATIVE TRANSFER OF ESBL GENES BETWEEN HUMAN & DOG-DERIVED E.COLI AND S.ENTERICA STRAINS

Presenter(s): Gabriel Durand (Universidad de Puerto Rico Recinto de Aguadilla)

Microbiology, Immunology & Infectious Disease

Mentor(s): Charles Whitehead-Tillery (College of Natural Science), Linda Mansfield (College of Veterinary Medicine)

Extended-spectrum beta-lactamases (ESBLs) have been on a steady rise over the past decade. ESBLs are enzymes produced by the bacteria that hydrolyze penicillins and cephalosporins which are used to treat infections such as urinary tract infections (UTIs) & pneumonia. Unfortunately, these genes can be transferred through horizontal gene transfer via conjugation which gives bacteria the benefit to exchange genetic material with a recipient through direct contact. Furthermore, these genes can transfer between human and other reservoirs in the community such as animals, livestock, etc. Overall, we want to address if conjugation is the primary mechanism for the transfer of ESBLs between dog and humans. In addition, if acquired is conjugation responsible for ESBL transfer to other commensal gut members. For our experiment human and dog-derived ESBL plasmids were transferred to an E.coli strain from a humanized mouse model (Primary Transfer). Secondary transfer was followed using E.coli strain with acquired ESBL plasmids as our donor with S. enterica as a recipient. In our in vitro conjugation assay donors were cultured in LB Broth with cefotaxime (CTX) and recipients were cultured in LB Broth with rifampicin (RIF). To confirm transfer we used antibiotic selective plates to isolates donors (CTX), recipients (RIF) and transconjugants (CTX RIF) to see if S. enterica acquired ESBL plasmids. ESBL transfer will also be confirmed using polymerase chain reaction (PCR) & gel electrophoresis.

This study will address is ESBL genes are acquired from dogs can they transfer to commensal gut members.

IMPACTS OF ETHYLENE SIGNALING IN PLANT-MICROBE INTERACTIONS
Presenter(s): Lauren Kelly (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Imani Pascoe (College of Natural Science)

Ethylene is a gaseous plant hormone with important roles in the regulation of plant growth, development, and response to stress. The plant microbiome can influence those processes, and bacterial perception and response to ethylene may impact microbial colonization of plants and plant-microbe interactions. The purpose of this project is to characterize plant-growth-promoting traits in the lab isolate collection and focus on isolates that may influence plant-microbe interactions through ethylene. One bacterial strain, Pseudomonas sp. 48MFCvi1.1, contains a putative ethylene receptor. Further experiments were performed on this strain including microbe-microbe to detect antagonism. To investigate the function of ethylene sensing in bacteria and its potential effects on Arabidopsis thaliana we performed vertical plate assays. The genotypes utilized were ethylene insensitive (ein2-1), ethylene overproducer (eto1-1), and wild-type (Col-0). A. thaliana inoculated with Pseudomonas sp. 48MFCvi1.1. and uninoculated were grown for short time periods (up to 2 days) and 2 weeks. Colonization, plant biomass, and root growth of plants were measured. Understanding how bacteria sense and respond to ethylene may aid in the design of plant growth promoting microbial products that can sense stressed plants and increase plant resilience.

ENHANCING INTRACELLULAR UPTAKE: STATISTICAL MODELING OF TARGETED NANOPARTICLES IN CANCER CELLS VIA INTRAVITAL MICROSCOPY
Presenter(s): Alan Wang (Pomona College)
Microbiology, Immunology & Infectious Disease
Mentor(s): Bryan Smith (College of Engineering)

The utilization of nanoparticles in medical research has witnessed significant growth due to their potential to enhance disease diagnosis and therapy, particularly in the field of cancer. Unlike small-molecule agents, nanoparticles can transport larger payloads and be conjoined with therapeutics. As internalization is required, we try to answer whether targeting can increase internalization into cells and at what time. We explore the use of targeting agents, as many nanoparticle cancer studies use targeting ligands, but it is unclear what their relevance is. This study employs intravital microscopy (IVM), which is the use of advanced fluorescence microscopy to visualize within living subjects on the micro-nano scale. IVM is the exclusive method to shed light on the occurrences spatiotemporally involving nanomaterials within living organisms, and hundreds of images were acquired in tumor-bearing mice injected with targeted nanoparticles compared to mock-targeted nanoparticles. The primary objective of this research is to develop statistical models based on in vivo imaging data to elucidate the binding and internalization of nanoparticles in tumor cells over time. We want to identify if targeting nanoparticles increases the internalization of cancer cells over time. We also want to determine whether there exist temporal relationships between various phases of nanoparticle states (i.e. free in the tumor interstitium, bound to the surface, and internalized in cells). To achieve these objectives, the study will assess potential confounding factors and their impact on the observed phenomena. We hope this study can contribute by answering whether targeting is effective for internalization in tumor cells.

ECOLOGICAL DIVERGENCE AND SPECIATION OF THE CIT+ LINEAGE

Presenter(s): Claire Spender (Michigan State University), Max Halliday (Michigan State University)
Microbiology, Immunology & Infectious Disease
Mentor(s): Zachary Blount (College of Natural Science)

The reason for these competitions is to determine the fitness of the isolates that have been created via the Cit+ lineage. Using these Cit+ clones, Cit- revertants, Ara+ revertants, and dctA deletion constructions in various combinations test different aspects of ecological divergence and adaptation to different niches and metabolic capacities. Overall, we are looking to see if the Cit+ lineage is adapting to growth better in DM25 and or worse on glucose, therefore improving/reducing its fitness.

NEUROSCIENCE

ANDROGEN HORMONE REGULATES THE RESOLUTION OF INFLAMMATORY PAIN IN MICE

Presenter(s): Lizzy O'guin (Michigan State University)
Neuroscience
Mentor(s): Geoffroy Laumet (College of Natural Science), Jaewon Sim (College of Natural Science), Joseph Folger (College of Natural Science)

Women experience chronic pain at a 20% higher rate than men. Therefore, it is crucial to examine the mechanisms underlying this sexual dimorphism to narrow the discrepancy in pain-suffering. The immune system contributes to pain through its interactions with the nervous system. Immune responses vary by sex, suggesting that sex difference in pain may result from sex difference in the immune response. In a mouse model of inflammatory pain, males recovered faster than females. Preliminary data from the lab discovered that production of the molecule interleukin-10 is necessary for the resolution of pain. Additionally, we observed that the skin of males expresses higher levels of IL-10 compared to female mice. Given these sexual dimorphic effects on pain resolution and IL-10 production, we hypothesized that the androgen hormone testosterone is a key regulator of the resolution of pain and IL-10 production. To test this hypothesis, we compared male mice that underwent sham (control) or orchiectomy surgery to remove the testicles. Eight weeks after the surgery, mice were injected with Complete Freund's adjuvant into one hind paw to induce inflammatory pain. Pain sensitivity was monitored by von Frey filaments and expression of IL-10 was assessed by quantitative polymerase chain reaction. Pain testing showed that ORX procedures delayed the resolution of pain. PCR analysis of paw and spinal cord tissue samples showed that ORX surgery did not affect the expression of IL-10 in response to CFA. Our findings demonstrate that while sex hormones contribute to pain resolution, it is not through IL-10 signaling.

LY6G ANTIBODY ADMINISTRATION REINDUCES PAIN HYPERSENSITIVITY IN MICE

Presenter(s): Hari Ramakrishnan (Michigan State University)
Neuroscience
Mentor(s): Geoffroy Laumet (College of Natural Science), Jaewon Sim (College of Natural Science)

Chronic pain is a pervasive and debilitating health issue that affects millions of individuals globally, leading to decreased quality of life, reduced productivity, and significant economic costs. Despite the widespread impact of chronic pain, the underlying mechanisms behind its transformation from acute pain remain largely elusive. Chronic pain often manifests in cyclic patterns, with periods of heightened pain sensitivity followed by periods of relative pain relief and remission. However, the biological mechanisms underlying the recurrence of pain remain unknown. To better understand this phenomenon, we established a mouse model of chronic pain by administering cisplatin, a common chemotherapy drug, through intraperitoneal injection (2mg/kg) for three consecutive days to induce pain hypersensitivity and allowed time for remission. Von Frey filaments were used to measure pain sensitivity. Preliminary data from the lab indicate an increase in neutrophils in the spinal cord during pain remission, suggesting a potential role for neutrophils in the development of chronic pain. To further investigate the involvement of neutrophils, we depleted them in cisplatin pain remission by administering Ly6G antibody into the spinal cord. Our data showed that pain sensitivity can be reinduced in mice in remission through neutrophil depletion. Our findings offer novel insights into the mechanisms of chronic pain recurrence and the potential involvement of neutrophils, which may inform the development of new and effective treatments for chronic pain. However, further research is required to fully understand the implications of our findings and validate the role of neutrophils in the development of human chronic pain.

INVESTIGATING THE ROLE OF GCG IN THE VENTRAL TEGMENTAL AREA IN MORPHINE BEHAVIORS

Presenter(s): Olivia Dodson (Michigan State University)
Neuroscience
Mentor(s): Cristina Rivera Quiles (College of Natural Science), Michelle Mazei-Robison (College of Natural Science)

Although opioid dependence is a major health and economic burden, our limited understanding of the underlying neurobiology limits better interventions. Dysregulation of the mesocorticolimbic reward circuit contributes to addiction, with alteration in the activity and output of dopamine (DA) neurons in the ventral tegmental area (VTA) contributing to the rewarding aspects of drug use. However, the molecular mechanisms underlying changes in VTADA function remain relatively unexplored. Thus, we used translating ribosome affinity purification to identify gene expression changes in mice that occur in VTADA neurons following chronic morphine. We found that expression of glucagon-like peptide-1 (GCG) was enriched in VTADA neurons, and its expression was robustly increased following chronic morphine. Thus, we hypothesize that activity of VTA-GCG neurons contributes to morphine-elicited behaviors. To test this, we're using GCG-Cre mice and Cre-dependent viral vectors. Specifically, we're using DREADDs, designer receptors exclusively activated by designer drugs, to selectively activate or inhibit VTA-GCG neurons. We stereotaxically injected the excitatory DREADD hM3Dq into the VTA of male and female wild-type and GCG-Cre mice and found that acute activation of VTA-GCG neurons does not affect general locomotion or elicit conditioned place preference or aversion. We're now assessing whether activation of VTA-GCG neurons alters morphine-elicited behaviors. Our preliminary data suggest there's a decrease in morphine-induced locomotion and morphine CPP in animals whose VTA-GCG neurons were activated. Together, these studies will set the stage for future work investigating the role of specific VTA-DAGCG circuits, their activity during behavior, and their potential as targets for therapeutic intervention.

DEFINING THE EFFECTS OF ENDOGENOUS NEUROTENSIN FROM LHA NEURONS AND THEIR PROJECTIONS

Presenter(s): Penelope Hurtado-Stuart (The University of Arizona)
Neuroscience
Mentor(s): Gina Leinninger (College of Natural Science), Jariel Ramirez-Virella (College of Natural Science)

Obesity affects >40% of the US population and is characterized by excessive food consumption and a sedentary lifestyle that causes weight gain. Yet, incomplete understanding of how the brain controls feeding and movement behaviors has hindered development of weight loss therapies. Experimentally

activating lateral hypothalamic (LHA) neurons expressing neurotensin (LHANts neurons) transiently increases water intake and body weight, but over 24 hr it suppresses feeding and increases energy expenditure to promote weight loss. The weight reduction effects, but not the drinking, are mediated by Nts signaling via neurotensin receptor-1 (NtsR1), which is robustly expressed by dopamine neurons in the Ventral Tegmental Area (VTA). Intriguingly, there may be distinct subsets of LHANts neurons that project to different brain areas to mediate drinking vs. feeding suppression. We hypothesized that LHANts neurons projecting to the VTA promote weight loss but not drinking. To test this, we used optogenetics to activate all LHANts neurons or only the subset of neurons projecting from the LHA to the VTA and assessed how they modulate feeding, drinking, moving and body weight. We observed that acutely activating all LHANts neurons does not impact feeding, but increases drinking. Conversely, activating only the LHANts neurons that project to the VTA reduced feeding without invoking a drinking response. These data suggest that biasing LHANts neuronal signaling to the VTA may have potential to support weight loss behaviors. Going forward, understanding how central Nts signaling regulates feeding vs. drinking could suggest new strategies to support weight loss and address the obesity epidemic.

EMPLOYING BIOLOGICAL OLFACTION FOR NON-INVASIVE DETECTION OF BACTERIAL BIOFILMS

Presenter(s): Mariam Shahab (Michigan State University)
Neuroscience
Mentor(s): Michael Parnas (College of Engineering)

Staphylococcus aureus (SA) and Pseudomonas aeruginosa (PA) are pathogenic bacteria that harm human health. In particular, biofilm infections caused by SA and PA are more difficult to treat than infections caused by planktonic SA and PA. When a patient has a bacterial infection, the bacteria release unique mixtures of volatile organic compounds (VOCs), based on their metabolism, and these are exhibited in the patient's exhaled breath. The patient's VOC profile is altered with respect to a healthy individual. Biological olfaction can be used to detect VOCs. The neural output from adult locust olfactory systems were used to differentiate two states of bacteria, planktonic and biofilm, in both SA and PA. Surgery was performed on the insect to expose the antennal lobe (AL) and microelectrodes were placed in the AL to acquire the neural recordings. Spike sorting was performed on Igor software to find individual neurons for temporal pattern analysis. We hypothesized that the locust olfactory sensory circuit will be able to distinguish between the bacterial smells. Preliminary data shows that single neurons have unique firing patterns for different bacterial smells and a principal component analysis (PCA) showed differences in the population neural evolution for SA and PA during the transient stage of stimulus presentation. This brain-based VOC detection technique will be fast, producing output data within 250ms. This technique will pave the way for a quick, cheap, and non-invasive tool to detect bacterial biofilms.

DISRUPTING COCAINE-SEEKING BY DEVALUING MEMORIES OF COCAINE REWARD THROUGH MESOLIMBIC CIRCUITRY

Presenter(s): Toria Fex (Michigan State University)
Neuroscience
Mentor(s): Alexander Johnson (College of Social Science)

Cocaine is a readily abused psychoactive drug; deaths from overdosing have risen to ?20K/year and annual healthcare costs increased to over $700 million. Unfortunately, there is a lack of effective treatment strategies and accordingly many previous users display relapse to cocaine-taking behavior, particularly when exposed to drug-related cues or contextual stimuli, even after long periods of abstinence. Thus, there is a critical need to develop strategies to disrupt drug-related activities. We have developed an approach in which memories associated with cocaine-seeking are devalued by pairing these memories with gastric malaise. This approach results in a marked reduction (>50% reduction) in cocaine-seeking behavior. Furthermore, we have begun to isolate the brain circuitry underlying this phenomenon. This was achieved by a dual-viral intersectional strategy, in which a retrograde Cre-recombinase virus was placed into nucleus accumbens (NAc), and a Cre-dependent inhibitory DREADD, hM4Di, injected into the ventral tegmental area (VTA). This enabled silencing of VTA cells projecting to NAc when rats were injected with the actuator, clozapine-N-oxide (CNO). Thus, we will examine the necessity of VTA to NAc circuitry in underlying memory devaluation effects that disrupt cocaine-seeking. Overall, these studies lay the foundation to develop novel approaches to attenuate addictive behaviors.

CORTICAL CIRCUITS AND INCUBATION OF COCAINE CRAVING IN ADOLESCENT RATS

Presenter(s): Leo Pereira Sanabria (Michigan State University)
Neuroscience
Mentor(s): Amy Arguello (College of Social Science)

Rationale: Adolescence is a critical period when initiation of drug use intersects with brain development. Exposure to drug-associated stimuli can elicit craving for drug, despite long periods of abstinence (incubation of craving). However, few studies have examined the circuits that support craving during adolescence. Using an abbreviated cocaine self-administration (Coc-SA) procedure, we found that adolescent rats display incubation of craving in a cocaine-associated context, which correlated with activation of the prelimbic prefrontal cortex (PrL), a region important for decision making and relapse. Objectives and Methods:To determine if increased PrL activity in adolescent rats resulted from differences in projection density to the basolateral amygdala (BLA), an important region for associative learning and relapse, adolescent and adult rats received infusions of the retrograde tracer Cholera toxin B (CtB) into the BLA (Exp 1). To determine if activation of PrLàBLA projections correlates with age-dependent increases in incubation, rats received CtB into the BLA, followed by Coc-SA in a unique context and extinction training in a different context. After 1 or 15 days of abstinence, rats received Relapse Tests in the cocaine context (Exp 2). Tissue was processed for CtB and Cfos expression. Results & Conclusions: Preliminary results from Exp 1 show higher CtB+ cells in the PrL of adolescent rats compared to adults, suggesting that adolescent rats have higher density of PrLàBLA projections. For Exp 2, we predict that increased activation of PrL àBLA projection will correlate with incubation in adolescent rats.

ROLE OF VENTRAL TEGMENTAL AREA NEUROMEDIN S NEURONS ON NUCLEUS ACCUMBENS CELLULAR ACTIVITY

Presenter(s): Darynaisha Crawford (Dillard University)
Neuroscience
Mentor(s): Cristina Rivera Quiles (College of Natural Science), Michelle Mazei-Robison (College of Natural Science)

The opioid epidemic is still prevalent in the U.S., with more than 70% of overdose deaths caused by opioids. Studying the neurobiology underlying substance use disorder could lead to better treatments. The ventral tegmental area (VTA) of the brain is responsible for regulating reward behavior, which plays a major role in drug addiction. We are interested in Neuromedin S (NMS) expressing neurons in the VTA because we found that NMS expression is increased in DA neurons in mice following chronic morphine. We found that VTA-NMS neurons project to the nucleus accumbens (NAc), another structure in the brain's reward circuitry. We hypothesize that activation of VTA-NMS cells will increase the number of active cells in the NAc following morphine treatment. To explore this, we stereotaxically injected viral vectors into the VTA of mice to either activate or inhibit VTA-NMS neurons. We then treated mice with morphine or saline and collected their brains. VTA and NAc were sliced using a microtome and used for immunohistochemistry (IHC). We'll use cFos as a marker of cellular activation and mCherry to visualize NMS terminals via fluorescence microscopy. We expect to see an increase in the number of active cells in the NAc with the activation of VTA-NMS cells and with morphine treatment. We'll also conduct IHC to detect NMS terminals in the NAc and expect to see them in proximity of NMUR2, the NMS receptor. Collectively, the data will help to define the NMS-VTA -NAc circuit and its potential role in opioid responses.

ESTABLISH A MOUSE MODEL OF MIGRAINE TO INVESTIGATE PATHOPHYSIOLOGICAL MECHANISMS

Presenter(s): Amanda Hernandez (University of Puerto Rico, Rio Piedras Campus)
Neuroscience
Mentor(s): Geoffroy Laumet (College of Natural Science), Jaewon Sim (College of Natural Science)

Although migraine is one of the most prevalent neurological disorders, its underlying mechanisms remain unclear. The current understanding is that migraine is a result of dysregulation in meningeal blood vessels and following activation of trigeminal sensory neurons that innervate the meninges. Several molecules, including prostaglandin (PGE2), nitric oxide (NO), and calcitonin-gene related peptide (CGRP), have been identified as important players at the molecular level. However, how meningeal vessels and neurons interact and how these molecules mediate or regulate the interaction remain elusive. To gain a comprehensive understanding of migraine pathophysiology, we have established a migraine mouse model. Stress is known to be one of the most reported migraine triggers, so we subjected mice to three days of restraint stress. We validated the development of migraine in mice by measuring the expression of disease-associated genes such as Calca, Nos1, Nos2, Nos3, Ptgs2 (Cox2), and Il6 in meninges and trigeminal ganglions. Additionally, we assessed facial grimacing and sensitivity to light (photophobia) in the stressed mice to confirm the presence of migraine-like symptoms. The establishment and validation of this migraine mouse model will greatly facilitate further investigation into the pathophysiology of migraine.

EFFECTS OF AMYLOID, TAUOPATHY AND RAPAMYCIN TREATMENT ON TELOMERE LENGTH IN MICE

Presenter(s): Alejandra Isabel Pacheco Balzac (Pontifical Catholic University of Puerto Rico-Ponce)
Neuroscience
Mentor(s): Marcia Gordon (College of Human Medicine)

Alzheimer's disease is a neurodegenerative disorder that affects the ability to obtain new information and maintain a healthy cognitive state. Within the Alzheimer brain, amyloid and tau form aggregates that compromise neuron function. Aging is a major risk factor for Alzheimer's disease, so age-related brain changes may be important for Alzheimer's progression. The drug rapamycin increases longevity in yeast, flies, worms, mice, and possibly higher mammals. We hypothesized that slowing the rate of aging with rapamycin would slow the development of Alzheimer-like pathology in a mouse model. Rapamycin was administered to 5-month-old mice with amyloid deposition orally via their diet for twelve months. Mice were then injected with gene therapy to overexpress tau while remaining on the rapamycin diet, and subsequently euthanized at an age of 20 months. Thus, experimental animals showed accumulation of both amyloid and tau in the brain. Because aging is associated with a reduced length of telomeres (protective caps on the ends of chromosomes), we hypothesized that Rapamycin treatment would preserve telomere length, and the risk of developing Alzheimer-like pathology would be diminished. Average telomere length will be measured using a real-time PCR based method. If the findings indicate that there is a preservation of telomere length, this study could greatly contribute to the current body of research regarding viable treatments for Alzheimer's Disease. Furthermore, these findings could potentially improve the quality of life in patients affected by this disease, and provide a cost-effective means of treatment for affected families and the economy.

WHAT OUR MOTHERS WISH THEY KNEW: HOW PREGNANCY CHANGES PRIMARY CIRCADIAN FUNCTION IN THE SCN

Presenter(s): Aysha Smith (University of Arizona)
Neuroscience
Mentor(s): Hanne Hoffmann (College of Agriculture & Natural Resources)

The U.S. is the most dangerous country for mothers of color to give birth in, with Black maternal mortality rates more than double that of white and Hispanic women. One reason pregnancy outcomes remain poor is due to the limited understanding of how the body changes during pregnancy. The goal of this study is to examine pregnancy-associated changes in the brain. One contributing factor to poor pregnancy outcomes is a disruption to the body's 24-hour clock mechanism. The body's master 24-hour pacemaker is located within the brain's suprachiasmatic nucleus (SCN), from where it regulates activity-rest patterns (locomotor activity). I hypothesized that pregnancy changes the SCN by altering VIP expression and wheel-running behavior in mice. I used two techniques to document changes in SCN function during pregnancy. Wheel running behavior will measure the locomotor activity of the mice before and throughout pregnancy; and in order to confirm which peptides might drive the changes in SCN function, immunohistochemistry will establish the expression of VIP which are important for SCN synchronization and hormone release. I found that there were significant changes in wheel-running behavior for three post-mating conditions and that these changes are associated with increased expression of VIP. This study helped to gain insight into how the brain changes in pregnancy and increased our understanding of healthy pregnancy behavioral patterns. This study aids in providing foundational ideas to further examine the role of stress in adverse pregnancy outcomes and its relationship to circadian disruption.

LATERAL HYPOTHALAMIC AREA NEURONS EXPRESSING NEUROTENSIN ALLEVIATE OBESITY-INDUCED PAIN AND INFLAMMATORY PAIN IN OBESE MICE

Presenter(s): Hope Bemis (Michigan State University)
Neuroscience

Mentor(s): Rabail Khan (College of Natural Science)

Chronic pain and obesity frequently occur together. An ideal therapy would alleviate pain without weight gain, and most optimally, could promote weight loss. The neuropeptide neurotensin (Nts) is implicated in reducing weight and pain, but the endogenous mechanisms underlying this physiology were unknown. We previously showed that activating lateral hypothalamic area neurons expressing Nts (LHANts neurons) suppresses feeding and promotes weight loss. Here we hypothesized that activating LHANts neurons can also alleviate pain. To test this, we injected NtsCre mice in the LHA with AAVs to cre-dependently express either mCherry (Control) or excitatory Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) in LHANts neurons, permitting their activation after treatment with the DREADD ligand clozapine N-oxide (CNO, 0.3 mg/kg, i.p.). Excitingly, CNO-mediated activation of LHANts neurons in diet-induced obese mice alleviated obesity-induced pain hypersensitivity. However, pretreatment with the brain permeable Nts receptor pan-antagonist SR142948 (1mg/kg, i.p, 30 min before VEH/CNO) blocked CNO-mediated analgesia, indicating that LHANts neurons alleviate obesity-pain in an Nts-dependent manner. In mice treated with complete Freund's adjuvant (which induces inflammatory pain), activating LHANts neurons relieved inflammatory pain in Nts-dependent manner. Taken together these data suggest that augmenting signaling via LHANts neurons may be a common actionable target for both obesity-induced and inflammatory pain.

VIRAL-MEDIATED TRACING OF LATERAL HYPOTHALAMIC AREA CELLS PROJECTING TO THE DORSAL MOTOR NUCLEUS OF THE VAGUS

Presenter(s): Kailyn Butler (Michigan State University)
Neuroscience
Mentor(s): Alexander Johnson (College of Social Science), Jenna Lee (College of Social Science), Nathan Pence (College of Social Science)

When the body senses high glucose level in the blood insulin is secreted from beta cells to then start a phosphorylation cascade. When the cascade ends GLUT4s are released onto the cell membrane allowing glucose to then come into the cell, lowering blood glucose. Cephalic Phase Insulin Release (CPIR) is an insulin release that occurs prior to when food is eaten, an anticipatory effect. We wanted to know if there was a biological difference between anticipatory glucoregulation in male and female rats. The Lateral Hypothalamic Area (LHA) A serves as a control center for different types of neurons that has the key task of processes around energy regulation. Prior research in our laboratory has identified LHA neurons which project to the dorsal motor nucleus of the vagus (DMNV), a brain region critical for integrating parasympathetic information. To evaluate the role of LHA ® DMNV neurons we utilized a chemogentic approach to selectively inhibit this circuit during CPIR testing. In order to accurately identify cells that project to the DMNV, a dual-viral tracing approach was used. Male and female rats were injected with a retrograde AAV2 containing Cre recombinase transgene into the DMNV. Furthermore, a Cre-dependent virus containing an inhibitory DREADD and labeled with mCherry was injected throughout the rostral-caudal area of the LHA. Using this circuit-specific manipulation of LHA ® DMNV neurons, we evaluated if CNO administration would attenuate the anticipatory rise of insulin during a CPIR test. Blood glucose and insulin samples were collected at baseline, 3, 10, 20, 40, and 60 minute timepoints following sucrose consumption under control and CNO conditions. In order to analyze this possible phenomenon an Enzyme-Linked Immunoassay (ELISA) will be used inorder to see specific antibodies within the blood that was collected. Overall we want to know if there is a correlation between the neurons in the LHA which then project to the DMV and the initiation of CPIR.

LOCUS COERULEUS REGULATION OF FOREBRAIN MICROGLIAL ACTIVATION IN ALZHEIMER'S DISEASE

Presenter(s): Gian S. Correa (Pontifical Catholic University of Puerto Rico)
Neuroscience
Mentor(s): Mahsa Gifani (College of Human Medicine), Scott Counts (College of Human Medicine)

Neurodegeneration of noradrenergic locus coeruleus (LC) neurons that regulate attention, memory, and executive function is an early feature of Alzheimer's disease (AD). Notably, LC neurons innervate immune cells in the forebrain including microglia. In AD, microglia are activated to engage in the clearance of amyloid-β pathology. However, when microglia are overactivated, they induce neuroinflammation which can exacerbate existing pathology. Since LC noradrenergic signaling in microglia is postulated to promote homeostasis in order to prevent this pro-inflammatory response, we aim to determine if LC degeneration and subsequent loss of norepinephrine signaling increase microglial activation and inflammation in AD. To address this, we will perform immunohistochemistry using an antibody to the activated microglia marker MHC-II in order to identify and quantify the amount of microglia-related inflammation in forebrain tissue of transgenic Tg344-19 AD rats with or without an LC-specific immunotoxin lesion (n = 4/group), as well as control nontransgenic rats (n = 2). We anticipate quantifying an increased load of activated MCH-II-positive microglia in LC-lesioned compared to non-lesioned animals. If successful, this project will provide evidence from a translational AD rat model that LC degeneration promotes microglial dysfunction and inflammation during disease progression.

THE IMPACT OF LIGHT EXPOSURE ON COGNITIVE FUNCTION IN CLASSROOMS

Presenter(s): Alysha Szewczul (Michigan State University)
Neuroscience
Mentor(s): Hanne Hoffmann (College of Agriculture & Natural Resources)

Humans are constantly exposed to a variety of light types, created naturally or through artificial means. Light exposure to the body impacts physiological functions, including but not limited to cognitive output, fatigue levels, and mood regulation. The level of impact on cognitive learning from different types of light on undergraduate students remains unclear. This study has chosen to test light's impact on cognitive function from two different light types provided through light-enriched glasses. Recruitment of and cooperation by Michigan State University (MSU) professors, will be necessary in order to implement this study. he goal is to recruit 100 undergraduate MSU students spanning five separate classes, in order to have three testing groups; a control group (no light glasses), a type 1 light group, and a type 2 light group. I hypothesize that after wearing light-enriched type 1 glasses for one session (20 minutes), students will experience greater cognitive function. Cognitive data will be collected from all three groups, with two groups wearing light-enriched glasses, during MSU classroom hours between 8 am and 12:40 pm. This time frame has been chosen as it allows for a variety of class start times, and follows literature showing time-of-day dependent effects of light exposure. Students willing to participate must be 18 years or older, generally healthy, and without light sensitivity. Results of the study will be collected to provide feasibility to scale toward a larger randomized controlled trial.

CHRONIC COCAINE EFFECTS ON ER STRESS IN VENTRAL HIPPOCAMPUS

Presenter(s): Ashley Harlock (Michigan State University)
Neuroscience
Mentor(s): Alfred Robison (College of Natural Science), Andrew Eagle (College of Natural Science)

The ventral hippocampus is important in the drive to seek and take drugs. We have found that chronic cocaine produces changes in physiology and gene expression in ventral hippocampus neurons. These changes may underlie aberrant cocaine-seeking and reward. We recently found that chronic cocaine increases calreticulin mRNA and protein in ventral hippocampus neurons. Calreticulin is an endoplasmic reticulum (ER) chaperone protein important in binding to misfolded proteins and preventing them from being exported. Misfolded proteins can cause the unfolded protein response (UPR), a compensatory process initiated by ER stress. However, it is unknown whether cocaine-induced calreticulin is linked to ER stress or whether this alters ventral hippocampus function or drug responses. Thus, we hypothesized that cocaine induces calreticulin in ventral hippocampus neurons to alter the UPR and regulate ER stress. Initially, we examined whether chronic cocaine increases

UPR proteins, such as ATF6, phosphorylated IRE1, and PERK, in ventral hippocampus tissue from cocaine-treated mice using Western blotting and immunohistochemistry. Preliminary experiments suggest that cocaine may be increasing the expression of ATF6, PERK, and phosphorylated IRE1 in the ventral hippocampus. Ongoing experiments are also examining whether calreticulin mediates cocaine effects on UPR proteins, using conditional calreticulin knockout mice and viral-mediated overexpression of calreticulin in ventral hippocampus neurons to identify whether calreticulin is necessary and sufficient for cocaine-induced increases in UPR proteins. These preliminary findings suggest that chronic cocaine may be producing ER stress, which may underlie altered excitability and dysfunction in hippocampal neurons that could lead to aberrant drug seeking.

PROFILING AND PRIORITIZATION OF PLASMA BIOMARKERS ASSOCIATED WITH COGNITIVE IMPAIRMENT BASED ON SEX, RACE, AND ETHNICITY

Presenter(s): Emma Nicolaysen (Michigan State University)
Neuroscience
Mentor(s): Andrew Umstead (College of Human Medicine), Irving Vega (College of Human Medicine), Jared Lamp (College of Human Medicine)

Alzheimer's Disease (AD) is a complex neurodegenerative disorder whose pathophysiology causes irreversible cognitive decline. While many recent studies have searched for plasma biomarkers to facilitate early detection of cognitive impairment (CI), little is known about how race and sex can affect the detection of plasma biomarkers of CI. We hypothesize that there are plasma biomarkers that differentiate females from males with CI, as well as those that differentiate Black females with CI from Non-Hispanic White females with CI. To test this hypothesis, we applied a label-free quantitative proteomics approach using plasma samples obtained through the Michigan Alzheimer's Disease Research Center (MADRC). Individuals with CI were divided into two categories: those with amnestic multidomain dementia syndrome and those with amnestic MCI-multiple/single domains. Next, we compared changes in protein abundance in plasma from females and males, and between Black females and Non-Hispanic White females. Western Blot and targeted mass spectrometry were used to validate the identified proteins. Gene ontology and protein-protein interaction network analyses provided further information about the biological and molecular function of the identified plasma proteins associated with CI. The findings of this study would lead to a greater understanding of the effects of sex, race, and ethnicity on plasma biomarkers in CI.

MORPHOLOGICAL AND PHYSIOLOGICAL PROPERTIES OF THALAMOCORTICAL NEURONS IN THE MOUSE DORSAL LATERAL GENICULATE NUCLEUS

Presenter(s): Pedro Torres Morales (University of Puerto Rico in Cayey)

Neuroscience
Mentor(s): Charles Cox (College of Natural Science)

Visual information is relayed from the retina to the primary visual cortex via the dorsal lateral geniculate nucleus (dLGN) of the thalamus. In cat dLGN, at least three distinct classes of thalamocortical neurons (X, Y, and W) have been differentiated based on morphological and physiological features. One distinct feature of X-cells is that they possess dendrodendritic synapses from local inhibitory interneurons that can be activated with metabotropic glutamate receptor (mGluR) agonists. In contrast, Y- and W-cells do not have these synapses. Recent evidence suggests that mouse dLGN thalamocortical neurons can be differentiated into putative X-, Y-, and W-cells based on dendritic morphology; however, it is unclear whether these morphological subtypes have similar distributions of dendrodendritic synapses from interneurons as cats. To examine the morphology and physiological properties of mouse dLGN thalamocortical neurons, we performed whole-cell voltage clamp recordings in brain slices from mice (postnatal days 12 - 23). The presence of dendrodendritic synapses was confirmed by an increase in inhibitory postsynaptic currents following the application of a mGluR agonist. To identify the morphology of these thalamocortical neurons, a fluorescent dye was included in the recording pipette, and two-photon microscopy maximum projection images were obtained. Using Sholl analysis thalamocortical neurons were classified as X-, Y-, or W-like cells. We then determined the proportion of these specific dLGN cell types that had dendrodendritic synapses. Our results suggest that the distinct physiological characteristics of dendrodendritic synapses are not preserved in mouse dLGN and further studies are needed to understand visual information processing in mice.

EVALUATING MICROTUBULES BINDING PROPERTIES OF BIG TAU PROTEIN IN VITRO

Presenter(s): Sidney Retama-Candelario (North Carolina Central University)
Neuroscience
Mentor(s): Benjamin Combs (College of Human Medicine), Kelly DuBois (College of Human Medicine), Nicholas Kanaan (College of Human Medicine)

Tau is a microtubule-associated protein that is known for its role in regulating microtubule dynamics. This protein is most commonly thought to exist as six major isoforms in the brain. However, there is a seventh isoform called "Big tau", which is created by the inclusion of an additional exon and this form of tau is enriched in the peripheral nervous system. Since its discovery in the early 1990s, very little research was published on the Big tau isoform, leaving many gaps in our knowledge. Specifically, a clear understanding of big tau's physiological functions is lacking. The objective of this study is to determine whether there are differences in microtubule binding properties and effects on microtubule polymerization kinetics between big tau and full-length tau isoforms. To test our hypothesis, we created recombinant big tau and the hT40 full-length tau isoform in bacteria and purified them through a series of chromatography steps. We will determine protein concentrations using an SDS-Lowry protein assay. Then, we will compare the full-length and big tau using SDS-PAGE and western blotting. Next, we will measure the extent to which full-length and big tau bind microtubules using an in vitro assay. Finally, the purified proteins will be compared in an in vitro microtubule polymerization assay to measure the impact on kinetics. These studies should provide new insights into the differences between big tau and full-length tau in their interactions with microtubules in vitro and begin to establish some of the physiological properties of this understudied form of tau.

INVESTIGATING THE RELATIONSHIP BETWEEN SGK1 PHOSPHORYLATION AND CATALYTIC ACTIVITY IN NEURO 2A CELLS

Presenter(s): Valeria Clemente Quinones (University of Puerto Rico-Humacao)
Neuroscience
Mentor(s): Michelle Mazei-Robison (College of Natural Science), Samantha Caico (College of Osteopathic Medicine)

Despite the high health and economic costs from drug use, treatment options are inadequate. Lack of treatment options is driven by our incomplete understanding of the neurobiology underlying this disease. The ventral tegmental area (VTA) has a critical role in the rewarding aspects of drugs of abuse. Previous work in our laboratoryhas found that chronic cocaine and morphine administration increases both the activity and phosphorylation of serum and glucocorticoid inducible kinase 1 (SGK1) in the VTA and that reducing VTA SGK1 activity and phosphorylation decreases drug behavior in mice. These data implicate SGK1 as a novel target for treatment of drug addiction. Therefore, we hypothesize that pharmacological inhibition of SGK1 is sufficient to reduce drug responses. We will be using a commercially available SGK1 inhibitor, GSK650349, to first assess the ability of GSK650349 to inhibit SGK1 activity in a Neuro2A cell model. We will assess whether GSK650349 can decrease the phosphorylation of an exclusive SGK1 substrate, NDRG, and decrease phosphorylation of SGK1 at its N-terminus site, via western blot. We will also perform transfection experiments with mutant SGK1 constructs to determine the relationship between SGK1 phosphorylation and catalytic activity. Finally, we will determine if GSK650349 inhibits SGK1 activity in vivo and is capable of altering drug behavior. These experiments will increase our understanding of the role of SGK1 activity and phosphorylation in drug responses and investigate therapeutic potential of SGK1 inhibition in treatment of substance use disorders.

IMPACT OF THE BDNF RS6265 SNP ON NIGROSTRIATAL INNERVATION DENSITY

Presenter(s): Marivelisse Velazquez (Pontifical Catholic University of Puerto Rico)
Neuroscience
Mentor(s): Caryl Sortwell (College of Human Medicine)

Motor dysfunction in Parkinson's disease (PD) is caused by degeneration of the nigrostriatal dopamine system. Pharmacological treatments for PD primarily aim to replenish dopamine transmission in a number of ways including increasing presynaptic dopamine levels. For more than 50 years, levodopa, the rate limiting step in the production of tyrosine hydroxylase in dopaminergic neurons, remains the gold standard pharmacological treatment for PD due to its ability to increase presynaptic dopamine levels. Previous findings have shown an impact of the rs6265 SNP variant (Met/Met) in the gene BDNF on therapeutic response to levodopa in early stages of PD. While the rs6265 variant does not impact risk or response to medication in late stage PD, the rs6265 variant does impact levodopa-induced dyskinesias (LID) time development. We will investigate the impact of the BDNF rs6265 SNP on nigrostriatal neuron density and the dopaminergic neuronal innervation of the striatum. For the methodology, we used immunofluorescence for tyrosine hydroxylase (TH) and dopamine transporter (DAT) to quantify nigrostriatal innervation in 14 month old met/met (n=7) or wildtype (val/val, n=7) rats. The outcome of this research will determine whether rs6265 BDNF SNP impacts dopaminergic innervation of the striatum. Results may provide insight into the mechanism whereby levodopa treatment is suboptimal in rs6265 subjects.

TO PLAY OR NOT TO PLAY? UNDERSTANDING OPTIMAL CONDITIONS FOR STUDYING SOCIAL PLAY BEHAVIOR IN DIFFERENT LABORATORY RAT STRAINS

Presenter(s): Isabella Orsucci (Michigan State University), Kira Becker (Michigan State University)
Neuroscience
Mentor(s): Jessica Lee (College of Social Science), Samantha Bowden (College of Social Science)

Social play is a common social behavior observed in juveniles of many mammalian species. Social play is vital to the development of emotional, social, and cognitive skills, and contributes to appropriate social interactions and behaviors later in life. Children diagnosed with autism spectrum disorder or schizophrenia show decreased involvement in social play behaviors with their peers compared to typically developing children, and report that they find social interactions less pleasant than non-social interactions. Lack of social play can reduce the ability of autistic individuals to appropriately navigate social and emotional situations later in life. Despite the documented importance of social play, little is known about the brain mechanisms regulating this behavior. Since juvenile rats naturally show social play, rats are the model species to study social play in laboratories, however, there is limited comprehensive knowledge on how to best test social play for commonly used rat strains. Therefore, this study focused on optimizing procedures for studying social play in two common laboratory rat strains: Long Evans and Sprague Dawley. The behavioral paradigm used in our study was social play testing. We determined the effects of two factors on social play behavior, namely the familiarity of a stimulus rat (novel vs familiar) and length of time socially isolated before testing (2 or 24-hours). Overall, our goal is to provide recommendations for optimal conditions to measure social play behaviors in different rat strains, so researchers can more efficiently work toward the big-picture goal of understanding the brain mechanisms regulating social play behavior.

ESTROUS CYCLE INFLUENCE ON INCUBATION OF COCAINE CRAVING IN ADOLESCENT RATS

Presenter(s): Victoria Braman (Michigan State University)
Neuroscience
Mentor(s): Amy Arguello (College of Social Science)

Rationale: Drug use during adolescence results in increased risk to develop substance-use disorders (SUDs). Drug craving is often triggered by exposure to drug-associated stimuli and can increase with longer periods of abstinence (i.e. incubation of craving). Adult females suffering from SUDs display faster escalated intake or relapse in shorter time than adult and increased craving. In adult rat models of cocaine self-administration, it has also been shown that females display higher incubation of craving compared to males, during the estrus phase. However, much less is known about these processes in adolescent females. Objective & Methods: To examine sex differences in relapse behavior, we used an abbreviated cocaine self-administration and relapse model which allows for training, tests, and estrous cycle monitoring during the adolescence period. Adolescent male and female rats received cocaine self-administration training in a unique context (active lever = cocaine infusion), followed by extinction in a second context (no rewarded levers). Rats were re-exposed to the cocaine-paired context after 1 day or 15 days of abstinence and cocaine-seeking behavior examined. Vaginal swabs were collected daily to track estrous cycle during each phase of behavior. Results & Conclusions: We found that adolescent male and female rats display similar lever press behavior during cocaine self-administration, extinction and relapse tests that occurred after 1 day of abstinence. We observed a trend for increased cocaine-seeking behavior in female rats during estrus phase. Future directions will examine the estrous cycle and relapse after 15 days of abstinence in adult and adolescent female cocaine-exposed rats.

ELECTROPHYSIOLOGY RECORDINGS FROM OCTOPUS ARM TO UNDERSTAND SENSORIMOTOR CIRCUITS.

Presenter(s): Danesha Derima (University of The Virgin Islands)
Neuroscience
Mentor(s): Galit Pelled (College of Engineering)

Neuronal networks in the brain called sensorimotor circuits mediate the interplay between sensory inputs and motor outputs. Damage to the sensorimotor circuits can be caused by traumatic brain injuries, neurogenerative disease, and even birth defects, which can lead to impairment in movement and sensations. It is important to understand how the neural circuits control behavior, and this knowledge will be useful to design new devices to assist people who lost the ability to move. We aim to fill in the knowledge gap in sensorimotor processing and controlled movements by studying neurocircuits in octopus arm to further the advancement of artificial limbs. Octopuses have a highly developed nervous system with 500 million neurons in their brain and arms, which have exceptional flexibility that allows them to bend or rotate their arms in different directions. Sensorimotor circuits control movement through an intricate mechanism, enabling people to interact with their surroundings and accomplish motor objectives. We hypothesize that there are specific patterns in processing for sensory stimulations and movements. Neurophysiology data will be collected from the Octopus bimaculoides by extracellular electrophysiology. We will also be slicing and staining octopus tissue to determine the location of neurons and where the electrodes are recording from. For our statistical analysis, the signal analysis program of Plexon will analyze the frequency, latency, and duration of each reaction after each stimulation. Keywords: Octopus biamaculodies, electrophysiology, Plexon, sensorimotor circuits,

ACTIVATION OF LEC-NAC NEURONS DURING CONTEXTUAL MEMORY ENCODING OF POSITIVE AND NEGATIVE VALENCED STIMULI

Presenter(s): Brenique Dawson (University of the Virgin Islands)
Neuroscience
Mentor(s): Andrew Eagle (College of Natural Science)

Motivation regulates a variety of behaviors, including feeding, drinking, and sex, and is regulated by the nucleus accumbens (NAc), a brain region important in reward. The lateral entorhinal cortex (LEC) is a brain region important in associative memory, and there is a subpopulation of LEC neurons that send projections to NAc (LEC-NAc). However, the role of LEC-NAc neurons in motivated behavior has never been investigated. Our preliminary evidence shows that LEC-NAc neurons are necessary for the encoding of context and positive (cocaine) and negative (footshock) stimuli. This study will investigate whether LEC-NAc neurons are activated by the association of contexts with positive and negative stimuli across two experiments. In Experiment 1 we tested whether cocaine-context associations activate LEC-NAc neurons. Cre-dependent GFP mice (Rosa26eGFP-L10a strain) received intracranial infusions of a Cre-expressing retrograde virus (HSVrg-hEf1a-Cre) in NAc to label LEC-NAc neurons with GFP. 3 weeks later mice underwent cocaine context conditioning. 1 h after the task, brains were collected for c-fos immunohistochemistry, which is a marker for neuronal activity. In Experiment 2 we tested whether footshock-context associations activate LEC-NAc neurons using the same approach as Experiment 1. Mice underwent contextual fear conditioning and brains were collected 1 h later for c-fos immunohistochemistry. We hypothesized that cocaine- and footshock-context associations will increase c-fos in GFP-labeled LEC-NAc neurons. These findings will complement our evidence that LEC-NAc neurons are important in the encoding of a context and a valanced (positive or negative) stimulus and identify the role of a novel brain circuit in motivated behavior.

HIPPOCAMPAL NEUROPLASTICITY AND INCUBATION OF COCAINE-CRAVING IN ADOLESCENT RATS

Presenter(s): Shambhvi Ojha (Michigan State University)
Neuroscience
Mentor(s): Amy Arguello (College of Social Science)

Substance use disorders are characterized by repeated episodes of relapse which can be triggered by drug-associated stimuli. In adults, craving to take drug can increase even after a year of drug-free abstinence. Much less is known about craving during the critical period of adolescence. Using an adolescent rat model of cocaine self-administration (Coc-SA) and relapse, we found that cocaine exposure during adolescence led to higher relapse-like behavior in a cocaine-paired context during late abstinence, compared to adult rats. The goal of the current research is to examine whether synaptic plasticity related proteins contribute to the age-dependent difference observed in relapse. We focused on examining plasticity-related proteins within the dorsal hippocampus, a region known to facilitate contextual relapse. Adult and adolescent rats went through a Coc-SA-relapse procedure. During Coc-SA, all rats pressed a lever for cocaine infusions in a unique context (2 hr, 2x/day over 5 days). Then the rats underwent EXT training in a second context, where lever presses were not rewarded (2 hr, 2x/day over 4 days). Adult and adolescent-exposed rats were tested in the cocaine-paired context after 1 day or 15 days of abstinence. Thirty minutes after the relapse test, rats were sacrificed via live decapitation, brain punches were obtained from the dorsal hippocampus and western blotting conducted to examine markers of synaptic plasticity (i.e., phosphorylated NR2b and NR2a). Based on preliminary data from the prefrontal cortex, we hypothesize that levels of pNR2b within the dorsal hippocampus will be associated with the time-dependent relapse effects in adolescent-exposed rats.

DAILY RHYTHMS AND SLEEP IN RAI1 DEFICIENT NILE GRASS RAT, A DIURNAL RODENT MODEL OF SMITH-MAGENIS SYNDROME

Presenter(s): Jamie Shi (Michigan State University)
Neuroscience
Mentor(s): Lili Yan (College of Social Science)

The Retinoic-acid induced 1 (RAI1) gene is a major gene contributing to Smith-Magenis Syndrome (SMS), a rare neurodevelopmental disorder characterized by low intellectual quotient, obesity, behavioral problems, and disrupted circadian rhythms in sleep and melatonin secretion. Every reported individual with SMS experiences sleep disturbances including daytime sleepiness, frequent nighttime awakenings, and decreased total sleep time beginning in early childhood. Additionally, most of them display an inverted secretion pattern of melatonin. Multiple Rai1-mutant mouse lines exist, but these nocturnal mice are melatonin-deficient and lack circadian rhythm phenotype. There are striking differences between nocturnal and diurnal species in circadian rhythms and central responses to light and melatonin. A diurnal model with intact melatonin secretion is essential to understand the role of Rai1 in regulating circadian rhythms and sleep and offer better translations to humans. Using the Nile grass rat (Arvicanthis Niloticus), a well-established diurnal rodent model. We initiated a project and successfully generated grass rat founders carrying large deletions of the RAI1 gene using CRISPR-based genome-editing. Using offspring produced by these founders crossed with wild-type (WT), we compared daily rhythms and sleep between mutant animals and their WT littermates (Rai1+/- vs. Rai1+/+). Our preliminary data shows altered daily rhythms in locomotor activities and sleep in Rai1+/- grass rats. These results will guide future studies elucidating neural mechanisms underlying sleep rhythm disturbance and inverted melatonin rhythm in SMS.

FEMALE REPRODUCTION-INDUCED CHANGES IN CRFR2 EXPRESSION IN THE RAT CAUDAL DORSAL RAPHE

Presenter(s): Christina Xenos (Michigan State University)
Neuroscience
Mentor(s): Joseph Lonstein (College of Social Science)

The neurobiological changes induced by female reproduction play an essential role in mediating the postpartum behaviors necessary for the survival of offspring. This brain remodeling that occurs allows for typical maternal caregiving behaviors and a reduction in the behavioral and neuroendocrine responses to stress. However, prolonged stress experienced during pregnancy can disrupt these postpartum adjustments, hindering maternal caregiving along with increasing mothers' susceptibility to postpartum affective disorders like postpartum depression and anxiety. One neurochemical regulating postpartum maternal caregiving and stress responding is the neuropeptide, corticotropin-releasing-factor (CRF). CRF acts on two receptor subtypes, CRFR1 and CRFR2. One brain site where CRFRs may act for its postpartum effects is the midbrain dorsal raphe (DR), the main source of forebrain serotonin. Our lab previously found a reproduction-induced increase in the number of cells expressing CRFR2, but not CRFR1, mRNA within the rostral subregion of the DR. We have not yet investigated the caudal subregion (DRC), although it is known to express very high CRFR2 in rats. We predicted that female reproduction would also increase CRFR2 expression in the DRC, but that effect would be prevented by chronic pregnancy stress. Therefore, this experiment compared DRC CRFR2 mRNA expression among virgin female rats, pregnancy-stressed postpartum rats, and non-stressed postpartum rats via real-time quantitative polymerase chain reaction (RT-qPCR). This experiment is expected to provide significant insight on the neural mechanisms driving postpartum caregiving and affective behaviors, specifically in the midbrain dorsal raphe regions producing serotonin.

ROLE OF LATERAL ENTORHINAL CORTEX NEURONS PROJECTING TO NUCLEUS ACCUMBENS IN CONTEXTUAL ASSOCIATIVE MEMORY

Presenter(s): Luis Colon (Michigan State University)
Neuroscience
Mentor(s): Alfred Robison (College of Natural Science), Andrew Eagle (College of Natural Science)

The reward pathways/circuit is important in motivated behaviors such as drinking, social behavior, and escaping from painful stimuli, and drugs of abuse such as cocaine can hijack the brain's reward pathway. The nucleus accumbens (NAc) is important in modulating the reward pathway, and the lateral entorhinal cortex (LEC) is a region important for associative memory; however, it is unknown if LEC neurons projecting to the NAc (LEC-NAc) play a role in mediating motivated behaviors. We hypothesize LEC-NAc neurons, influence memory processing of a drug-context association underlying the motivation for cocaine. To investigate this, we used male and female C57BL6/J mice. A Retrograde HSV-Cre was injected bilaterally into the NAc, and a Cre-dependent AAV DREADD-Gi was bilaterally injected into the LEC, using AAV-mCherry for controls. After recovery, mice were tested for Cocaine Conditioned Place Preference (CPP, a test to measure preference for cocaine) and Contextual Fear Conditioning (CFC, a task to measure fear conditioned to a context). CPP data showed that the LEC is necessary for the encoding but not recall of a memory in a cocaine-context association. Likewise, CFC data also showed that the LEC-NAc circuit is required to encode contextual memory but not recall. These findings suggest that LEC-NAc neurons are necessary for encoding, but not recalling, an association between a context and the positive (cocaine) and negative (footshock) valenced stimuli that may occur in that context. The results of this study have revealed a novel role for LEC-NAc in motivated behavior.

PHARMACOLOGY & TOXICOLOGY

INHIBITION OF RHO/MRTF OVERCOMES DEVELOPMENT OF DRUG RESISTANCE IN MOUSE MELANOMA

Presenter(s): Annika Baker (Calvin University)
Pharmacology & Toxicology
Mentor(s): Bardees Foda (College of Osteopathic Medicine)

BRAFV600E is the most common driving mutation of malignant cutaneous melanoma, resulting in constitutive activity of the MAPK pathway and uncontrolled cell proliferation. Resistance to the most effective anti-melanoma agents, such as BRAF inhibitors (e.g., Vemurafenib), is a significant problem in achieving treatment with long-lasting effectiveness for metastatic melanomas. Previous studies identified upregulated Rho/MRTF pathway as a substantial partner in drug resistance in melanoma. Treating mouse melanoma cells from the YUMMER-1.7 line with a paired a Rho/MRTF pathway inhibitor, CCG-257081, and Vemurafenib (Vem) strongly inhibited the development of stably Vem-resistant melanoma cells. We hypothesized that inhibiting the Rho/MRTF pathway may enhance apoptotic events by targeting pre-resistant cell populations. To test our hypothesis, we co-treated Vem-sensitive YUMMER with Vem in the absence or the presence of CCG-257081. To monitor cell apoptosis, we concurrently treated the cells with a fluorescent Caspase 3/7 probe and used an Incucyte apparatus to obtain real-time data. Interestingly, we observed more apoptotic cells among the cells treated with CCG-257081 and Vem than cells treated only with Vem. We concluded that inhibiting the Rho/MRTF pathway may overcome the development of Vem-resistance by increasing apoptosis in pre-resistant cells. We recommend further analysis for CCG-257081 as a valuable anticancer agent.

PROMISING PPAR (PEROXISOME PROLIFERATOR ADVANCED RECEPTOR) MOLECULES AS TREATMENT FOR ALZHEIMER'S DISEASE AND DECREASED NEUROINFLAMMATION.

Presenter(s): Emma Korhorn (Ferris State University), Gabriella Brekke (Ferris State University), Kaylin Brown (Ferris State University), Paton Birely (Ferris State University)
Pharmacology & Toxicology
Mentor(s): Tracey Ward (Ferris State College of Pharmacy)

Alzheimer's disease, AD, is an age-associated neurodegenerative disorder characterized by progressive memory loss and cognitive impairment. Current medications include Memantine, NMDA antagonist, and 3 Cholinesterase inhibitors: Rivastigmine, Galantamine & Donepezil. All of these treatments only temporarily improve AD symptoms yet fail to treat the underlying pathophysiology of the disease. A promising class of selective athiazolidinedione (TZD) molecules have been designed and show significant promise as potential therapeutic benefit for AD. Traditional drug discovery techniques using MOE computational software and in silico methodologies were used in their initial creation before they were synthesized and tested in vitro and in vivo. These molecules bind within the AF-2 ligand binding domain (LBD) of human PPAR receptors to influence gene expression. The avoidance of any binding to tyrosine 473 within the AF-2 LBD was done to decrease lipid accumulation and any adverse cardiac side effects that are traditionally observed with g TZD molecules. These molecules were tested in vitro with neuroblastoma cells and found to decrease neuroinflammation, and improved memory via Y-Maze analysis. Western blot, ELISA technologies using polyclonal PPAR alpha antibodies were used in evaluation and analysis of TNF-alpha and b-actin expression. There is a significant need for newer drug treatments for AD, so these promising molecules may provide alternative options with treating AD.

MODIFYING THE LINKER OF SOLUBLE EPOXIDE HYDROLASE INHIBITORS IMPROVES BLOOD BRAIN BARRIER PENETRATION AND DRUG-LIKE PROPERTIES

Presenter(s): Megan Shuck (Michigan State University)
Pharmacology & Toxicology
Mentor(s): Kin Sing Lee (College of Osteopathic Medicine)

Alzheimer's Disease (AD) is a neurodegenerative disease that impairs patients' cognitive ability impacting their quality of life and negatively impacting their families. In AD patients' brains, the activity of the enzyme soluble epoxide hydrolase (sEH) is higher than healthy controls. SEH breaks down beneficial epoxy fatty acids into the corresponding diols contributing to the key biomarkers of AD, neuroinflammation, neurofibrillary tangles, and amyloid beta plaque. Previous research demonstrated a reduction of the key biomarkers in a mouse model of AD. However, the leading compound, TPPU, has a poor blood brain barrier (BBB) penetration (12-20%), low solubility, and a high melting point. These properties make TPPU an unideal compound for the central nervous system (CNS) and as a drug. Thus, modifying sEH inhibitors to improve those properties will create a better candidate for AD treatment in a mouse model. In this presentation, a novel series of sEH inhibitors will be presented. Some of these new inhibitors carry much improved CNS exposure and drug-like properties.

MODELING THYROID HORMONE DYNAMICS AND CHEMICAL DISRUPTION: INTEGRATING HIGH-THROUGHPUT METHODS WITH PRIMARY HUMAN HEPATOCYTES

Presenter(s): Sophia Caron (Michigan State University)
Pharmacology & Toxicology

Mentor(s): Brian Johnson (College of Veterinary Medicine), Keri Gardner (College of Engineering)

Thyroid hormones (TH) play a vital role in cellular energy regulation. Hormone production and feedback in the hypothalamic-pituitary-thyroid (HPT) axis, along with liver involvement, control TH levels. Chemicals from diverse classes disrupt TH balance by affecting molecular targets involved in TH synthesis, transport, reception, metabolism, recycling, and feedback. TH imbalance leads to various harms, including neurodevelopmental deficits, sensory impairments, metabolic disorders, and cancer. Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) disrupt TH balance, yet the underlying mechanism remains unclear. This project aims to investigate the effects of PCDD/F exposures on human thyroid kinetics, enhancing health risk assessment. To establish in vitro assays that accurately replicate thyroid catabolism and function, we employed hepatoma cells (HepG2) as an initial model. Our objective was to investigate the potential synergistic effects between PCDD/Fs and commonly co-occurring chemicals, acting through alternative molecular initiating events. This foundational investigation laid the groundwork for subsequent experiments utilizing primary human hepatocytes (PHH). By utilizing PHH-based models, we aim to comprehensively explore the chemical and microphysiological impacts of pollutants such as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and polychlorinated biphenyls (PCBs). This approach enables us to extend the scope of our assays, as PHH models better reflect the complexities and diversities of human physiology. The improved predictive potential of microphysiological in vitro chemical testing linked through computational modeling to population health outcomes is a critical step toward supporting PCDD/F risk-assessment. Improved risk-assessment can then guide targeted intervention strategies that prevent adverse health effects in sensitive populations.

HUMANIZED C-ELEGANS: STUDYING THE ROLE OF HOW SEH AFFECTS NEURODEGENERATION

Presenter(s): Briana Briggs (Michigan State University)
Pharmacology & Toxicology
Mentor(s): Jennifer Hinman (College of Natural Science), Kin Sing Lee (College of Osteopathic Medicine)

There is much about neurodegenerative diseases (ND), such as Alzheimer's disease (AD) that we don't know, such as how they form and how to treat/cure the disorders, as many of the mechanisms are currently left unknown. Studies show that soluble epoxide hydrolase (sEH), an enzyme that metabolizes lipid epoxides, and its downstream metabolites (dihydroxy-PUFAs) are upregulated in the brain of patients with Alzheimer's disease. We come to the question of what effect polyunsaturated fatty acids (PUFAs) have on ND. We hypothesize that dysregulation of cytochrome P450-EH metabolism plays a role in the pathogenesis of neurodegeneration. To test this hypothesis, we conducted studies on Caenorhabditis elegans (C. elegans). The nematodes are a good model for these experiments because they have short lifespans that are easy to measure, low maintenance beings, and are genetically malleable. Two homologs for epoxide hydrolase have been found in C. elegans which are very similar to sEH in humans. We will utilize genetically modified C. elegans containing human sEH in place of the more active C. elegans sEH homolog (KIN01) and replacing both C. elegans epoxide hydrolase homologs with human sEH (KIN02). These strains were analyzed for health and lifespan effects compared to wild-type C. elegans by analyzing these worms' longevity (lifespan), egg production, and locomotion. These assays are conducted frequently throughout their lifespan to effectively measure the activity and health of the nematodes. Overall, this sEH model would be valuable in the future to study effects of sEH inhibition in NDs. There is much about neurodegenerative diseases (ND), such as Alzheimer's disease (AD) that we don't know, such as how they form and how to treat/cure the disorders, as many of the mechanisms are currently left unknown.

EVALUATING THE GENE EXPRESSION OF CANNABINOID RECEPTORS 1 AND 2 IN MONOCYTES

Presenter(s): Cassandra Bryant (Michigan State University)
Pharmacology & Toxicology
Mentor(s): Norbert Kaminski (College of Agriculture & Natural Resources)

With the growing legalization of cannabis across the United States, cannabis use has increased 13.2% between 2011 and 2021 for adults aged 19-30 years. With this increase comes a need to understand the mechanisms and effects of cannabis use in the human body. When cannabis is ingested or inhaled the compounds that makeup the Cannabis sativa plant bind to various receptors, such as cannabinoid receptors (CB). Cannabis has over 110 chemicals that are defined as phytocannabinoids. Δ9 -Tetrahydrocannabinol (THC) is the main psychotropic compound and can bind to both CB1 and CB2 receptors. Some literature has suggested that when THC binds CB2 it can have immunomodulatory effects on immune cells such as monocytes. These monocytes will produce inflammatory cytokine IL-1β upon toll-like receptor (TLR) activation when a pathogen is detected. Previous studies in the Kaminski laboratory have shown that THC can suppress the production of IL-1β in a concentration dependent manner in TLR activated monocytes. To understand potential mechanisms by which THC may be mediating this effect, the Kaminski laboratory is interested in determining the expression of CB1 and CB2 receptors in vitro on primary human pan monocytes, CD16+ monocytes and CD16- monocytes. CB2 is more highly expressed on white blood cells than CB1 including by CD16+ and CD16- monocytes according to PCR analysis of

TLR-activated primary human immune cells from blood. The Kaminski lab is specifically interested in the CB2 receptor and how it can be targeted to suppress inflammation in individuals with inflammatory ailments in the absence of psychotropic effects.

THE USE OF GAP JUNCTION INTERCELLULAR COMMUNICATION BIOASSAYS TO ASSESS THE POTENTIAL TUMORIGENIC EFFECTS OF ENVIRONMENTAL CONTAMINANTS.

Presenter(s): Abdikeni Sharif (Grand Valley State University)
Pharmacology & Toxicology
Mentor(s): Brad Upham (College of Human Medicine)

Intercellular communication through gap junction channels plays a vital role in maintaining tissue homeostasis. Disruption of intercellular communication is a common phenotype of many tissue growth and development disorders, including cancer. For tumors to successfully form, they need to stop normal communication with their neighboring cells. This project had two components. The first determined the effects of GenX, a per-and polyfluoroalkyl substance (PFAS) that manufactures state "it's a safer PFAS", on gap junctional intercellular communication (GJIC). The second began validating a new high throughput bioassay of GJIC. This high throughput assay uses the bipotent rat liver stem cell line that has two subsets of cells, one with a transfected yellow fluorescent protein (YFP) gene and the other transfected with an iodide transporter (IT) gene. Cells are grown together in 96 well plates and the assay initiated with the addition of iodide. Cells with the IT will take up the iodide and if the channels are open, then the dye will migrate to the YFP cells and partially quench the fluorescence. The scalpel load - dye transfer (SL-DT) assay was used in the IT and YFP cells. to compare the dose responses to the iodide-dependent high throughput assay. The GenX results were contradictory in which data collected this summer showed high cytotoxicity and no inhibition of GJIC whereas data collected by Ms. Liebold last summer showed low cytotoxicity and inhibition of GJIC. Upon closer scrutiny last summer GenX stock solutions were prepared in dimethyl dioxide (DMSO) and this summer in phosphate buffered saline. A literature search indicates that GenX is decarboxylated in aprotic solvents such as DMSO while GenX does not appreciably decarboxylate in aqueous solutions. Thus, we conclude GenX is cytotoxic at low doses and does not dysregulate GJIC while the decarboxylated form is not very cytotoxic and inhibits GJIC and is dose dependent. For the high throughput assay of GJIC, we determined the dose response of GJIC to the environmental contaminant, phenanthrene, is similar to the SL-DT assay in both the iodide transporter and YFP transfected cells.

THE IMPACT OF TBHQ ON DENDRITIC CELL FUNCTION IN THE CONTEXT OF INFLUENZA A VIRUS (IAV)

Presenter(s): Taylor Godfrey (Prairie View A&M University)

Pharmacology & Toxicology
Mentor(s): Cheryl Rockwell (College of Human Medicine), Saamera Awali (College of Human Medicine)

Influenza is a recurring, ever-evolving viral infection that can have long lasting effects on overall immune health and function. When an individual is stricken with Influenza A virus (IAV), dendritic cells, a key component of the immune system, work in overtime by presenting viral antigens to other immune cells for viral clearance. However, research shows that the consumption of certain food additives may hinder immune cell function and capabilities. For example, tert-butylhydroquinone (tBHQ), anadditive widely used to delay rancidification, or oxidation of fats, has been shown to hinders the relationship between Nrf2, a transcription factor associated with cellular homeostasis, and its regulator KEAP1. The purpose of this study is to determine the effect of tBHQ on dendritic cell function after exposure to IAV, specifically on cytokine secretion. To date, the relationship between tBHQ and immune cells such as T cells, NK cells, and B cells have been evaluated, but its association with dendritic cells have yet to be investigated. Therefore, this study aims to shed light on the tBHQ-mediated immunomodulatory role of Nrf2 and how it impairs clearance of the persistent and infectious virus, influenza. To do this, an enzyme-linked immunosorbent assays (ELISAs) will be used to measure IL-12 and IL-6 secretion levels in cells treated with tBHQ. Data analysis will provide exact measurements of these secretion levels with the usage of a standard curve model to illustrate how the secretion levels relate to it.

PERIVASCULAR ADIPOCYTE PROGENITORS ADIPOGENESIS IS MODULATED BY ECM STIFFNESS AND ANATOMICAL LOCATION

Presenter(s): Alanis Torres (University of Puerto Rico - Mayaguez)
Pharmacology & Toxicology
Mentor(s): Andres Contreras (College of Veterinary Medicine)

The pathogenesis of hypertension involves changes in the anatomical structure of the vasculature. Mechanical forces on the vessels promote collagen deposition in the tunicas media and adventitia, changing vascular structural properties and enhancing their deleterious impact. This process remains poorly understood in the outermost layer: the perivascular adipose tissue (PVAT). During hypertension, mechanical forces limit adipogenic potential of PVAT adipocyte progenitors (AP), which may drive AP to a fibroblastic fate, affecting their vasoactive functions and promoting vascular stiffness. Thoracic aortic PVAT (aPVAT) contains 3 long strip fat depots: one anterior to the aorta (A-aPVAT), and two lateral to the posterior wall (L-aPVAT). Previous research indicates L-aPVAT adipocytes arise from progenitors different than those in A-aPVAT, we hypothesized that ECM stiffness and anatomical location influences the adipogenic potential of AP. L-aPVAT and A-aPVAT were collected from 10-week-old male Sprague Dawley rats by outgrowth expansion. To determine the effects of ECM stiffness on adipogenic potential, progenitors were cultured in a collagen matrix at different stiffness degrees. Adipogenesis and lipogenesis were quantified based on lipid droplet accumulation using IncuCyte Live-Cell® imaging and triglyceride quantification. Proliferation was evaluated with EdU staining. RNA from progenitors and adipocytes were sequenced in Illumina NextSeqData, and differentially expressed genes identified. We expect that with higher ECM stiffness, adipogenic capacity of AP will be reduced, and that L-aPVAT will have higher adipogenic potential. These results will help us understand the remodeling process of PVAT during hypertension.

LONG-TERM INFLAMMATION AND FIBROSIS IN MICE SKIN EXPOSED TO NITROGEN MUSTARD

Presenter(s): Dara Villa (Universidad Ana G. Mendez)
Pharmacology & Toxicology
Mentor(s): Neera Tewari-Singh (College of Osteopathic Medicine)

Chemical emergencies due to industrial accidents, terrorism attacks, warfare, transport etc. are a serious threat to the health of humans. Among chemical threat agents, vesicants cause blistering and debilitating injuries to the skin tissue, and injury symptoms could take few hours to days to appear and can last for years. Sulfur mustard (SM) is the most extensively used warfare agent in various conflicts since World War I to recent Syrian conflicts. SM remains a potential threat and highlights the need to increase research efforts to understand the injury mechanisms and to develop effective therapies. Nitrogen mustard (NM), an SM analog and chemotherapeutic agent has been used to study vesicant toxicity and associated mechanisms. The goal of our study is to test the hypothesis that a single exposure to NM will result in long-term inflammation and fibrosis in mice. C57BL/6 mice were topically exposed to acetone alone or to 0.5 mg NM dissolved in acetone. Mouse skin sections showed long-term injury post 12 weeks of exposure with inflammation and fibrosis. Skin samples from mice at 1, 2, 4, and 12 weeks after exposure are being analyzed using trichrome staining for collagen deposition and RT-PCR for inflammatory and fibrotic markers. Trichrome staining showed an increase in collagen deposition post-exposure, which is being quantified. Inflammatory and fibrotic markers IL17 and IL23, and TGFβ and αSMA are being evaluated in the skin tissues. The results from this study will be useful in evaluating the long-term toxic effects and mechanism of NM toxicity.

DOES COMPOUND 48/80 INCREASE URINARY BLADDER SMOOTH MUSCLE CONTRACTILITY TO MUSCARINIC AGONISTS?

Presenter(s): Johnae Walker (Fayetteville State University)
Pharmacology & Toxicology

Mentor(s): Nathan Tykocki (College of Osteopathic Medicine)

During voiding, bladder filling causes sensory outflow that ultimately causes the release of acetylcholine from both the parasympathetic nerves to drive urinary bladder smooth muscle contraction. Recently, we discovered that the pro-inflammatory basic secretagogue Compound 48/80 caused bladder dysfunction and increased smooth muscle contractions to nerve stimulation. However, it is unclear if the altered smooth muscle responsiveness was due to increased acetylcholine release from parasympathetic nerves or increased smooth muscle sensitivity to acetylcholine. Thus, we hypothesize that Compound 48/80 increases urinary bladder smooth muscle contractility in response to acetylcholine. To test this hypothesis, tissue bath studies were conducted using urinary bladder smooth muscle strips from male C57BL/6 mice to measure isometric contractility. Cumulative concentration-response curves were performed using the nonhydrolyzable acetylcholine mimetic carbachol (10nM - 30μM). These experiments were then repeated in the presence or absence of Compound 48/80. Through this work, we will better characterize how Compound 48/80 impacts bladder contractility and provide a basis for using Compound 48/80 as a therapy to regulate bladder dysfunction.

UNVEILING THE EFFECTS OF TICAGRELOR ON BLEEDING: A STUDY IN P2Y12-DEFICIENT MICE

Presenter(s): Maira Marroquin (Northeastern Illinois University)
Pharmacology & Toxicology
Mentor(s): Adam Lauver (College of Veterinary Medicine)

Arterial thrombosis remains a leading cause of mortality globally, emphasizing the importance of effective preventative strategies. Antiplatelet medications, including clopidogrel and ticagrelor, serve as vital prophylactic agents through their selective inhibition of the P2Y12 receptor, reducing platelet reactivity, and thereby, risk of thrombotic events. Despite their benefits, bleeding complications persist, raising questions about the mechanisms behind such adverse effects. Previous work in our lab revealed clopidogrel-induced bleeding complications were not solely associated with antiplatelet activity, but also tied to vascular interactions. Building upon this, our study investigates whether ticagrelor, another widely used P2Y12 inhibitor, also induces bleeding beyond its P2Y12 inhibition. Using P2Y12 deficient mice, we conducted tail bleeding assays and hemoglobin concentration analysis to evaluate bleeding outcomes following ticagrelor administration. Our hypothesis is that ticagrelor, due to its fewer metabolites compared to clopidogrel, specifically inhibits P2Y12 without inducing excess bleeding. The results of our study could significantly impact clinical management of antiplatelet therapy.

EVALUATING THE BLEEDING EFFECTS OF SPECIFIC CLOPIDOGREL METABOLITES

Presenter(s): Vanessa Martinez (Pontifical Catholic University of Parana)
Pharmacology & Toxicology
Mentor(s): Adam Lauver (College of Veterinary Medicine)

Clopidogrel is an antiplatelet medication prescribed for the prevention of heart attack or stroke in patients with acute coronary syndrome (ACS). ACS is a common heart disease in the United States, affecting millions of people each year. The syndrome involves the pathological formation of blood clots in the coronary or cerebral arteries, an event called thrombosis. Occlusive clot formation leads to poor blood flow and inadequate oxygen delivery to the body cells. Clopidogrel acts as a purinergic P2Y12 receptor antagonist, thereby inhibiting ADP-induced platelet aggregation, and has been demonstrated to be effective in inhibiting thrombosis. However, clinical studies have demonstrated that long-term use of clopidogrel induces a high risk of bleeding. A recent study from our laboratory suggested that non-platelet mechanisms are responsible for unfavorable bleeding events. Therefore, we hypothesized that specific clopidogrel metabolites directly disrupt the normal hemostatic balance through platelet-independent mechanisms. To test this hypothesis, we evaluated the effects of clopidogrel metabolites on platelet function and bleeding in P2Y12 deficient mice to evaluate their platelet-independent effects. P2Y12 knockout mice and their wild-type littermates were treated orally with clopidogrel, or the M1, M2, and M15 metabolites for five days. Blood samples were collected, and platelet function was evaluated by flow cytometry. Bleeding effects were evaluated using a tail bleeding assay and measuring blood volume loss. The results suggest that the clopidogrel metabolite M15 possesses non-platelet effects. Together with our previous work, these findings demonstrate that specific clopidogrel metabolites may impair vasoconstriction and potentiate bleeding.

CONVERSION OF PRO-FIBROTIC MONOCYTES TO MATRIX METALLOPROTEINASE-PRODUCING MACROPHAGES IS MODULATED BY 19, 20-EPOXYDOCOSAPENTAENOIC ACID IN THE LIVER

Presenter(s): Ladymar Rodriguez Torres (Michigan State University)
Pharmacology & Toxicology
Mentor(s): Bryan Copple (College of Human Medicine)

Chronic liver injury (CLI) can progress to liver fibrosis (LF), a life-threatening condition characterized by excess deposition of extracellular matrix in the liver. Currently, there are no treatments for this disease. As a result, LF is the 14th leading cause of death worldwide underscoring the importance of identifying new treatments. During CLI, monocytes are recruited to the liver where they release proinflammatory cytokines and growth factors that

stimulate the deposition of fibrotic matrix in the liver. Experimental studies have shown that during spontaneous fibrosis reversal, these monocytes differentiate into macrophages that produce matrix metalloproteinases (MMPs), including MMP-13, that degrade the extracellular matrix. Prior studies have demonstrated that 19, 20-Epoxydocosapentaenoic acid (19,20-EDP) modifies the phenotype of myeloid cells such as monocytes. However, the mechanism is unknown. In the current studies, we hypothesized that 19,20-EDP stimulates the conversion of monocytes into MMP-producing macrophages. To test this hypothesis, monocytes were purified from the livers of mice with fibrosis and treated with 19,20-EDP. mRNA levels of MMPs and proinflammatory cytokines were quantified by real-time PCR. Treatment of pro-fibrotic monocytes with 19,20-EDP produced a change in cell morphology consistent with the conversion into macrophages. Moreover, 19,20-EDP treatment increased mRNA levels of MMP-9 and MMP-13, while decreasing levels of tumor necrosis factor-alpha and interleukin-6. It was concluded that 19,20-EDP may be an important mediator of monocyte differentiation during fibrosis reversal. Further identification of the mechanism by which 19,20-EDP stimulates this process may lead to a novel treatment for LF.

SERUM 25-HYDROXYVITAMIN D AND C-3 EPIMER CONCENTRATIONS THROUGHOUT GESTATION IN A BOVINE DAIRY HERD

Presenter(s): Samantha Velasquez Rivertte (Michigan State University)
Pharmacology & Toxicology
Mentor(s): John Buchweitz (College of Veterinary Medicine), Justin Zyskowski (College of Veterinary Medicine)

Hypovitaminosis D is highly prevalent in pregnant women and infants worldwide. Serum 25-hydroxyvitamin D (25(OH)D) serves as an indicator of vitamin D status in most animal species. The recent identification of its C-3 epimer, 3-epi-25-hydroxyvitamin D3 (3-epi-25(OH)D3), in blood serum has been reported for both pregnant women and infants; however, because of its recent discovery an overall biologic importance have yet to be fully elucidated. Given its prevalence in pregnant women, it was hypothesized that 3-epi-25(OH)D3 may serve as a predictive biomarker of pregnancy in dairy cattle. In the current study, we validated an LC-MS/MS method to measure the mono-hydroxyvitamin D metabolites 25-hydroxyvitamin D2 (25(OH)D2), 25-hydroxyvitamin D3 (25(OH)D3), and 3-epi-25(OH)D3, in bovine serum and then analyzed serum collected from dairy cows at six stages of pregnancy. The 25(OH)D metabolites were extracted from serum by supported liquid extraction and the eluate was derivatized with 2-Nitrosopyridine. Pre-bred heifers had serum concentrations ranging from 65-85 ng/mL with trends toward non-significant increases with mean values approaching 100 ng/mL during pregnancy. Interestingly, 3-epi-25(OH)D3 remained near baseline (1.3 - 1.9 ng/mL) for the first 90 days and elevated 3- to 4-fold thereafter. While not predictive of pregnancy during the early phases of gestation, the elevation in

3-epi-25(OH)D3 is consistent and appears to mimic previous observations with mid- to late-gestational increases in estrogen concentration found in dairy cattle. This study confirms that the epimerization of 25(OH)D3 is conserved in pregnant dairy cattle. Future studies will need to explore the potential link between increases in gestational estrogen and epimerization.

DEVELOPING AN ULTRASOUND-GUIDED ORTHOTOPIC ALLOGRAFT MOUSE MODEL TO REDUCE LUNG TUMOR BURDEN USING CDDO-ME

Presenter(s): Karenna Collins-Thompson (Smith College)
Pharmacology & Toxicology
Mentor(s): Jess Moerland (College of Natural Science), Karen Liby (College of Natural Science)

Lung cancer remains the deadliest form of cancer, with a 5-year survival rate of around 25%. The majority of cases are non-small cell lung cancer (NSCLC). Up to 30% of NSCLCs have mutations in the cytoprotective Keap1-Nrf2 pathway, resulting in constitutive activation of Nrf2. The inactivation of Keap1, a negative regulator of Nrf2, is a commonly found mutation. High Nrf2 expression leads to tumor protection, chemo-resistance, and a lower patient survival rate. Previous studies have shown that the triterpenoid CDDO-Me reduces lung tumor burden in a Nrf2 dependent manner. To develop a novel orthotopic allograft mouse model for constitutive Nrf2 activity within the tumor, a mouse lung cancer cell line was injected orthotopically. An ultrasound was used to guide cell placement. Tumors were imaged after 3, 5, 10, 15, and 20 days to track development. To determine the effects of CDDO-Me on tumors with overactive Nrf2 expression, WT or Keap1 KO cells were injected. 5 days post injection mice began vehicle diet or CDDO-Me 100 mg/kg of diet. Weight loss observed when the drug was fed continuously was eliminated when CDDO-Me diet was fed 4 days on and 3 days off. Using the ultrasound ultimately resulted in shallow injections and cell migration from the lung. Within the mice that developed tumors, WT vehicle mice had heavier lung weights than WT CDDO-Me and Keap1 KO mice. Further alterations to the orthotopic allograft model are necessary to increase the rate of successful tumors and continue investigating the effects of CDDO-Me.

PHYSICAL & MATHEMATICAL SCIENCES

EXAMINING GALAXY EVOLUTION THROUGH THE LENS OF THE THERMAL SUNYAEV ZEL’DOVICH EFFECT IN MILKY WAY-LIKE GALAXIES

Presenter(s): Jason Williams (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Brian OShea (College of Natural Science)

Understanding galaxy evolution is crucial for comprehending the formation of the universe. One of the main ways of studying galaxies in our own sky is by observing the various wavelengths of light emitted from them. Advancements in observational equipment have facilitated the detection of microwaves with finer resolution in galaxies at increasingly greater distances. Photons passing through galaxies and their environments undergo inverse Compton scattering, resulting in noticeable increases in their energy. This phenomenon is known as the Sunyaev Zel'dovich effect (SZE). By studying the interaction between the cosmic microwave background and galaxies through the thermal SZE, we enhance our ability to detect and measure various quantities such as mass, pressure, and temperature in these distant objects. Examining galaxies at ever-increasing distances and comparing them to nearby galaxies provides insights into their appearance and behavior, enabling us to observe their evolutionary patterns. In this study, we investigate the degree to which we can understand galactic evolution by analyzing their SZE using cosmological simulations. By making synthetic SZE observations of galaxies and their environments, we extract information about how this aspect of galaxies varies over time in relation to other observational properties such as galaxy mass, temperature, and physical extent.

PLANET-PLANET SCATTERING: A POTENTIAL EXPLANATION FOR UNUSUAL A(LI) VALUES IN EXOPLANETARY HOT JUPITER SYSTEMS

Presenter(s): Olivia Maynard (Ohio State University)
Physical & Mathematical Sciences
Mentor(s): Seth Jacobson (College of Natural Science)

In exoplanetary systems, dynamical instabilities can cause significant impacts on the interaction of planets and their orbital paths around a star. One such impact is planet-planet scattering, where unstable gravitational interactions between the planets drastically change their orbits; this can force one of the planets to be engulfed by its host star. The surviving planet typically has an eccentric orbit due to the instability of these interactions. We aim to discover if planet-planet scattering occurred in several exoplanet systems with eccentrically orbiting planets, specifically main sequence Hot Jupiter planets with high lithium abundance (A(Li)) in their stars' stellar envelope. These A(Li) values are highly uncharacteristic for the age of the stars and indicate a recent mass addition. To test the hypothesis, we analyze the orbital parameters of several Hot Jupiter exoplanets identified in the TESS survey while simulating smaller exoplanets in the system that could potentially trigger dynamical instability and planet-planet scattering. In these systems, planet-planet scattering could provide an explanation for the high abundance of lithium in the stellar envelope, if planetary engulfment occurred. Understanding the mechanisms behind the interesting composition of these stars allows us to deepen our comprehension of our overall knowledge of the Universe outside of the Solar system.

A COMPREHENSIVE SURVEY OF RADIO EMISSION FROM 1-100 YEAR OLD TYPE IA SUPERNOVAE

Presenter(s): Grace Showerman (Michigan State University), Matthew Bartnik (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Laura Chomiuk (College of Natural Science), Sumit Sarbadhicary (Ohio State University)

It is still unclear which models of white dwarf binaries fit the general population of Type Ia supernovae (SNe Ia), and this affects many applications of astrophysics and cosmology. A unique way to analyze SNe Ia progenitors is with radio observations, where radio traces the presence of material around the progenitor as a result of interaction with the supernova ejecta. The amount and extent of material depends on the mass-loss from the progenitor before explosion, and can be measured by radio detections (or lack thereof). Radio observations of SNe Ia exist, but very few for supernovae older than one year. So, while we have constraints on circumbinary material within 600 AU (10^{16} cm) of progenitors, our knowledge of more distant material (which is possible in some progenitor models) is lacking, and this project aims to fill that crucial gap.

FAST RADIO BURSTS FROM X-RAY BINARY SYSTEMS

Presenter(s): Emma Dugan (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Esha Kundu (College of Natural Science)

It is well known that globular clusters are abundant in X-ray binaries (XRBs). XRBs consist of a compact object accreting material from a nearby donor star. Observations of these systems have shown X-ray and radio emission. Soft X-rays are produced mainly in the accretion disk, hard X-rays come primarily from the corona, and the radio emissions are thought to be produced by the jets emanating from the compact object. Another form of radio emission has been detected in the universe in the form of fast radio bursts (FRBs), which are millisecond duration bursts of radio waves that mainly come from unknown extragalactic sources.These bursts do not appear to be periodic, as there have been recorded instances of multiple fast radio bursts occurring in one day, and then no more are detected for days, weeks, or months afterwards. Some of the FRB sources are found to be associated with persistent radio sources. Recently an FRB was discovered in a globular cluster which motivates us to study XRBs containing white dwarfs, neutron stars, and black holes as the accreting object and examine if there exists a population of likely-to-produce FRB XRBs in the local universe.

COLLISIONLESS ENCOUNTERS: INFLUENTIAL FLYBY STUDIES ON LUNAR RETENTION FOR PLANETARY MOONS

Presenter(s): Allison Perez-Bermudez (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Seth Jacobson (College of Natural Science)

Why do certain planets like our Earth possess a moon, while others, in this case, Venus, lack one? Our objective is to understand the influence of collisionless encounters on planetary systems similar to Earth's, observing how these impact the planets' ability to retain their moon(s). This study will attempt to extrapolate patterns consistent with the previous understandings of tidal evolution and popular planet formation scenarios on planetary moons by evaluating these scenarios by running various simulations. Planets may have different flyby histories and starting tidal strengths. Therefore testing the diverse potential identities are crucial. The results will shed light on planets, like Venus, that currently do not have a natural satellite and could give a reason for it. Analyzing the different simulations will provide more insight into how a planetary system could lose its moon(s) and the effects it will consequently cause.

APPLICATION OF THE DISRUPTIVE PROBING METHOD TO INVESTIGATE THE REACTION DYNAMICS OF THE MCLAFFERTY REARRANGEMENT

Presenter(s): Bradley Curenton (University of Alabama)
Physical & Mathematical Sciences
Mentor(s): Jacob Stamm (College of Natural Science), Marcos Dantus (College of Natural Science), Sung Taik Kwon (College of Natural Science)

Understanding the ultrafast timescales of competing fragmentation channels following strong-field ionization is key to learning more about how compounds fragment as well as the mechanistic pathways by which these product fragments are formed. This project seeks to measure the ultrafast timescales associated with the McLafferty rearrangement of 4-methyl-2-pentanone for the purpose of classifying whether the mechanism is stepwise or concerted. For these experiments, a solid-state femtosecond laser was paired with a Wiley McLaren time-of-flight (TOF) mass spectrometer to study the reaction dynamics of 4-methyl-2-pentanone by applying the disruptive probing method. This method involves splitting a pulse into a pump and probe pulse using a beam splitter so that the higher intensity pump pulse can ionize the sample and the lower intensity probe pulse can disrupt the reaction as it proceeds. To control when the probe pulse reaches the molecules in the TOF chamber, a variable delay stage is employed so that the probe pulse can disrupt and monitor ion yields of different reaction pathways as the time delay is varied between the pump and probe pulses. By analyzing how individual ion yields changed with time, a bi-exponential fit was used to measure the timescales associated with the McLafferty rearrangement. In this presentation, I will discuss the disruptive probing method and the processes used to classify the McLafferty rearrangement, which exhibited a stepwise mechanism with a short molecular rotation and proton transfer step followed by a longer bond cleavage step.

SYNTHESIS AND CHARACTERIZATION OF A COPPER-BASED REDOX SHUTTLE FOR DYE SENSITIZED SOLAR CELLS

Presenter(s): Cady Hale (Willamette University)
Physical & Mathematical Sciences
Mentor(s): Samhita Kaushik (College of Natural Science), Thomas Hamann (College of Natural Science)

Dye sensitized solar cells (DSSCs) are a compelling subset of solar cells because of their efficiencies in diffuse light environments and potential to be low cost. A redox shuttle (RS) is an essential component of these cells as they carry out the process of dye regeneration in which they return electrons to the oxidized dye from the counter electrode. Regeneration allows the dye to absorb additional photons. In a process called recombination, oxidized RSs can also contribute to efficiency losses by accepting electrons after they are injected into the semiconductor. Copper RSs have been shown to have good balance between dye regeneration and recombination. In response to these previous findings, the focus of this project was to synthesize and characterize bis(2,9-diisopropyl-1,10-phenanthroline) copper (I) hexafluorophosphate and begin to evaluate it in terms of utilization in DSSCs as a RS. This study of bis(2,9-diisopropyl-1,10-phenanthroline) copper (I) hexafluorophosphate will add to the body of knowledge surrounding electrochemical properties of copper complexes with substituted phenanthroline-based ligands. Data collected on this complex during the characterization process included H1 NMR, UV-Vis, and cyclic voltammetry data. In future work, these data points will be compared to that of other complexes with phenanthroline-based ligands, giving insight into how substitution of ligands contributes to the electrochemical properties of these complexes in the context of DSSCs.

DETERMINING THE ORBITAL PERIOD OF THE AM CANUM VENATICORUM (AM CVN) SYSTEM ASASSN-21BR

Presenter(s): Shane Painter (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Elias Aydi (College of Natural Science)

In a AM CVn system called ASASSN-21br, we have spectra from it from over four nights. The photometry of this system estimates roughly a 37 minute orbital period. With the spectra, we intend on determining the orbital period through spectral analysis using a program called IRAF and confirming the orbital period from the photometric analysis.

PREPARATION OF LEAD HALIDE PEROVSKITE THIN FILMS FOR ELLIPSOMETRIC DETERMINATION OF COMPLEX DIELECTRIC FUNCTIONS

Presenter(s): Henry Thomas (Iowa State University)
Physical & Mathematical Sciences
Mentor(s): Kyeongdeuk Moon (College of Natural Science), Seokhyoung Kim (College of Natural Science)

Lead halide perovskites (LHPs) with three- and two-dimensional crystal structures have garnered significant interest in recent years as promising materials for optoelectronic devices such as solar cells and nanowire lasers. While the bulk properties of these materials, such as tunable bandgaps, have been widely studied, there still are a range of detailed properties that need to be further identified to allow for the investigation of targeted properties. Examples of these properties include frequency-dependent complex dielectric functions and refractive indices for perovskites containing different halide compositions and crystal structures. Once identified, these parameters will enable numerical calculations of photonic effects in well-defined nanostructures, providing design principles for technological applications in light-emitting devices (LEDs) and nanolasers. The primary goals of my research are twofold: 1) The preparation of uniform thin films of various halide perovskites of which the complex dielectric functions are currently unknown, and 2) determination of their functions using spectroscopic ellipsometry. Various synthetic methods were tested, including one-step spin coating, two-step spin coating, and hybrid methods of spin-coating and dipping. Thin films were characterized via optical microscopy and scanning electron microscopy (SEM). X-Ray diffraction (XRD) and energy-dispersive X-Ray spectroscopy (EDS) were used to confirm the identity of the thin film. Future work will include performing SE on the prepared thin films to find the experimental dielectric function of CsPbBr3, a prototypical all-inorganic 3D perovskite. Subsequently, other perovskites, including inorganic (CsPbI3,CsPbCl3) and organic-inorganic hybrid (MAPbBr3,BAPbBr3) will be studied.

CHLORIDE ION EFFECT ON THE PITTING OF SELECTIVE LASER MELTED ALSI10MG DURING CYCLIC POLARIZATION TESTING

Presenter(s): Kolton Mehalko (Penn State Erie, the Behrend College)
Physical & Mathematical Sciences
Mentor(s): Greg Swain (College of Natural Science), Jack Walton (College of Natural Science)

Selective laser melting (SLM) is an additive manufacturing method used to fabricate metal parts from the bottom up. SLM employs a high-power laser beam to raster scan and melt metal powder particles preplaced on a build platform. The melting of the regions of interest in a layer-by-layer manner fuses the molten metal into the desired structure upon solidification. One such alloy produced using SLM is AlSi10Mg. There is a scientific need to understand how the material's mechanical properties and electrochemical behavior/corrosion susceptibility are affected by the surface texture, microstructure, and elemental composition. In this work, the effect of the chloride anion on the electrochemical properties and corrosion susceptibility of AlSi10Mg alloys prepared using SLM was investigated. Specifically, cyclic potentiodynamic polarization was used to measure the open circuit potential, pitting potential, and repassivation potential of the alloy in naturally aerated 0.5 M Na2SO4 + different chloride anion concentrations. The results reveal that with increasing chloride concentration, generally the open circuit potential shifts negative, the pitting potential shifts to less positive potentials, and the repassivation potential shifts to less positive potentials, which is consistent with greater corrosion susceptibility. Additionally, 14-day full immersion degradation testing was performed on the alloys in 0.01 M NaCl at 55˚C to learn about the early-stage corrosion/degradation of this alloy. This presentation will report on both the electrochemical measurements and the microscopy analysis of the alloy surfaces before and after the full immersion test.

DEVELOPMENT OF AN EFFICIENT SAMPLE PREPARATION METHOD FOR BOTTOM-UP PROTEOMICS OF SMALL NUMBERS OF MAMMALIAN CELLS

Presenter(s): Warren Jacobs (Saginaw Valley State University)
Physical & Mathematical Sciences
Mentor(s): Liangliang Sun (College of Natural Science)

Advances in bottom-up proteomics (BUP) for Mass Spectrometric applications have allowed for more complete analysis of complex cell protein mixtures in order to better determine the proteomes of cells. However, a significant bottleneck for future research is the loss of peptides or peptide signal dilution during the cell lysing and the subsequent protein digestion steps. In this research, a standard digestion process was evaluated for isolating proteins from cell lysate using bottom-up proteomics. The procedure was optimized by evaluating the effect of 4 different digestion parameters on peptide expression. Samples were analyzed via Liquid Chromatography Tandem Mass Spectrometry (LC-MS2), using an EASY-nLC 1200 LC interface using an electrospray ionization with a Thermoscientific Exploris 480 Q-HF extractive Mass Spectrum with a 90-min separation window, with both peptide and potential protein counts being determined using Proteome Discoverer 2.2 and MaxQuant software. Samples were then evaluated for both peptide and protein yield, as well as the ratio of peptide signal to total mass signal. It was identified that separation of the reduction and proteolysis steps, with addition of Iodoacetamide (IAA) following reduction does improve both protein and peptide yield while simultaneously increasing the percentage of peptide-related mass spectra analyzed, with Mass Spectra identifying almost twice peptides with a 9% increase in peptide signal identification when compared to reference preparations. Addition of IAA was able to produce similar effects in smaller loading volumes of proteins, indicating the utility of

IAA for an increase in digestion efficiency through the alkylation of cysteine residues.

UNDERSTANDING COLLECTIVE MOTION INSIDE A NUCLEUS

Presenter(s): Mickey Mumby (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Vladimir Zelevinsky (College of Natural Science)

The goal of this project is to predict the shapes and dynamical properties of the excited states of specific nuclei based on known data for low-energy states. Using previously documented measurements of the 2+ lowest energy states (quadrupole vibrations with positive parity and angular momentum 2) of various nuclei and an equation derived by V. Zelevinsky in 1995 (updated and applied to limited experimental data in 2006), a mathematical model to predict energies of 3- states (octupole vibrations with negative parity and angular momentum 3) is made. We sought to determine the best constants in the equation for various even-even nuclei. The constants were generated by taking the nuclei with known 2+ and 3- energy values and finding the value where the average difference between the experimental and the predicted value was smallest. This model has significantly improved accuracy over the previous version, and still has room for improvement without changing its general methodology or structure. The model can be used in predictions of collective motion for incoming experiments with unstable nuclei.

STUDYING NUCLEI AT FINITE TEMPERATURE WITH THE IN-MEDIUM SIMILARITY RENORMALIZATION GROUP

Presenter(s): Isaac Smith (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Heiko Hergert (Facility for Rare Isotope Beams)

Nearly all elements in the universe were formed in the cores of stars and supernovae. The exact details of how the elements were formed, however, have yet to be worked out. A key step in learning about these processes is understanding properties of nuclei at finite temperature (the temperatures present in stellar cores) as determined from solutions to the Schrodinger equation. We expand the In-Medium Similarity Renormalization Group (IMSRG) method, a method for approximating solutions to the Schrodinger equation at zero temperature, to finite temperature. Using an exactly-solvable toy model, we demonstrate that the finite-temperature IMSRG method can accurately determine properties of nuclei at finite temperature. In future work, we will apply the finite-temperature IMSRG to realistic models of nuclei to determine quantities such as free energy and decay rates, which will help paint a picture of how the elements in the universe formed.

EDGE COVERS ON JOINED CYCLE GRAPHS

Presenter(s): Evan Calderon (Yale University)
Physical & Mathematical Sciences
Mentor(s): Brian Drake (Grand Valley State University), Feryal Alayont (Grand Valley State University)

An edge covering of a graph is a set of edges such that every vertex in the graph is adjacent to one edge in the set. Some graphs such as P_n (the path graph on n vertices) and C_n (the cycle graph on n vertices) have well established edge cover recurrence relations consisting of the Fibonacci and Lucas numbers, respectively. In this paper, we use these established relations to examine the edge cover recurrence relations on joined cycle graphs, which we differentiate by cases depending on their structure. We then use that to determine the general formulas for the graphs before ending with an examination of their edge cover polynomials.

INSIGHT INTO THE ADSORPTION OF PER- AND POLYFLUOROALKYL SULFONATES IN CLAY MATERIALS

Presenter(s): Mary O'Reilly (Truman State University)
Physical & Mathematical Sciences
Mentor(s): Angela Wilson (College of Natural Science), Chrissy Schumm (College of Natural Science), Narasimhan Loganathan (College of Natural Science)

Per- and polyfluoroalkyl substances (PFAS) are contaminants that are known to persist in the environment for decades. The high stability of these molecules is due to the presence of multiple C-F bonds, which increases resistance to natural forms of degradation. The unique amphiphilic properties of PFAS make them highly desirable for a myriad of industrial and consumer applications - such as firefighting foams, cosmetics, and non-stick cookware - resulting in numerous potential sources for environmental contamination. Consequently, the U.S. Environmental Protection Agency (EPA) has imposed restrictions on "legacy" PFAS molecules which have been replaced with "new-age" PFAS. Most information on PFAS is limited to having a qualitative understanding of their adsorption in soil components. However, in order to effectively design remediation processes, it is extremely important to have a quantitative understanding of the adsorption strength. Unfortunately, such information is scarce even for legacy PFAS. This work is focused on providing quantitative understanding of the adsorption for emerging PFAS molecules, namely fluorotelomer sulfonate (FTS), using potential of mean force (PMF) calculations at the surface of smectite clays. In addition, classical molecular dynamics (MD) simulations have been employed to examine the interactions between varying concentrations of two legacy PFAS molecules - perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS) - and kaolinite clay. These simulations are representative of the concentrations of PFAS sulfonates and soil samples at contaminated sites. Insight from this work can be applied to the development of commercial techniques for the removal and remediation of site-specific PFAS contamination.

AN X-RAY ANALYSIS OF THE MORPHOLOGIES AND DYNAMICS OF THE LOCAL VOLUME COMPLETE CLUSTER SURVEY

Presenter(s): McKenna Leichty (University of Notre Dame)
Physical & Mathematical Sciences
Mentor(s): David Turner (College of Natural Science), Megan Donahue (College of Natural Science)

The Local Volume Complete Cluster Survey (LoVoCCS) is a weak gravitational lensing survey that observed 144 nearby and X-ray bright galaxy clusters. In this project, I used the data obtained from LoVoCCS to conduct an X-ray analysis, using an open source X-ray analysis Python package called XGA, of these clusters by creating contours at specific X-ray emission levels and fitting 2D ellipses to those contours. After fitting an ellipse to the overall shape of the clusters, I assessed their morphological and dynamical parameters, and then determined how relaxed they are. Relaxed clusters are better suited to calculate cosmological constants that tell us how much dark matter, dark energy and ordinary matter there are in our universe. Along with the contour fitting method, I am assessing low-order moments of the surface brightness distribution of these clusters, which relate to their morphologies, and exploring the possibility of background galaxy clusters interfering with the X-ray brightness of the LoVoCCS clusters. After matching possible background sources from a catalog of 600,000+ entries to within twice the R500 of each LoVoCCS cluster, I manually identified these X-ray emissions using NED and Legacy Sky Viewer databases and classified them as either foreground, part of the cluster, or background objects.

CHARACTERIZING SIPM FOR NEXT GENERATION NEUTRON DETECTORS

Presenter(s): Rodrigo Garcia (Northeastern Illinois University)
Physical & Mathematical Sciences
Mentor(s): Thomas Baumann (Facility for Rare Isotope Beams)

Over the past century, photon detectors have played an increasingly important role in radiation detection in medical diagnostics and nuclear physics research. Since the 1930s, we have used photomultiplier tubes (PMT) that have been pivotal in obtaining scientific knowledge. However, the PMT, with its bulky design, sensitivity to magnetic fields, and high operating bias voltage of 1-2 kV limits their viability when quantifying and or time stamping light signals are important (high energy physics,biophotonics,and LiDAR). The silicon photomultiplier (SiPM) has recently become a valid alternative for many applications requiring photodetection. SiPMs are less expensive and require a much lower bias voltage than PMTs. When detecting scintillation light (photons emitted when a scintillator absorbs energetic radiation, for our purposes from scattered neutrons), SiPMs allow for more freedom to arrange the sensors in optimal locations to maximize the detection of light around the scintillator. The added flexibility that SiPMs bring to designing neutron detectors will allow us to make higher resolution measurements of nuclear decays that will allow us to further study the nuclear structure of unstable isotopes that exist in neutron stars. With the use of a multichannel analyzer (MCA) and an analog to digital converter (ADC) the breakdown voltage and dark count rate will be found for a wide variety of SiPM types.

PLANETARY EJECTA EMPLACEMENT IN THE MAIN ASTEROID BELT

Presenter(s): Sanskruti Admane (Ohio State University)
Physical & Mathematical Sciences
Mentor(s): Seth Jacobson (College of Natural Science)

Terrestrial planet formation models have been studied in detail for several decades. The final stages of these models are dominated by giant impacts between embryos, during which the final accretion of inner planets occurred. Different scenarios have invoked different mechanisms to satisfy the constraints of successful planet formation. However, prior exploration of these scenarios have not considered imperfect accretion extensively. Debris created by violent collisions can be lost from the Solar System, or survive after terrestrial planet formation. In general, giant impact debris is scattered everywhere. The surviving debris will be geologically distinct from the surviving primordial planetesimals already in orbit or in our current meteorite collections. We investigate whether the debris created by giant impacts during terrestrial planet formation significantly changes the results compared to previously published work that assumes perfect merging. Specifically, we investigate how much of this debris may survive from the giant impact era of planet formation in the asteroid belt today. We simulated planet formation using three common models meant to be representative of debris outcomes of all imperfect accretion models. We conclude that debris from giant impacts is emplaced in the asteroid belt, after interactions with the Mars embryo. We also find that the mass of the debris emplaced is too large, even after collisional evolution, to satisfy the small mass of the current Main Asteroid Belt.

SIMPLIFYING COMPLEX MODELS OF CARDIAC METABOLISM USING REGRESSION-BASED NEURAL NETWORKS

Presenter(s): Cindy Zhuang (Texas A&M University)
Physical & Mathematical Sciences
Mentor(s): Jason Bazil (College of Osteopathic Medicine)

The physiology of cardiovascular disease is complicated by metabolic derangements that make causal inference challenging. To address this, we combine experiments with computational approaches to elucidate the bioenergetics of cardiac mitochondria in disease states. From empirical data and first principles, we can systems of ordinary differential equations (ODEs) and partial differential equations (PDEs) that highlight the physiological and pathological complexities of these systems. We approach this complexity using regression neural nets (RNNs), which can be adapted more easily to large numbers of ODEs. Since RNNs can include many nodes and layers with a relatively small computational burden, they can simplify the computational problem and reduce the time needed to solve it. Applying RNNs to models of the biochemical reaction network of the cardiac mitochondria will help us assess the computational efficacy and accuracy of the method. In the future, we will integrate this simpler model into other processes in the whole heart, such as blood flow, electrophysiology, mechanics, and metabolism.

AGN PHOTOMETRY: UV-IR COLOR RELATIONS & AUTOMATION

Presenter(s): Agrim Gupta (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Megan Donahue (College of Natural Science)

This research project involves the analysis of 27 Active Galactic Nuclei (AGN) sources with Ultraviolet (UV) data obtained from a pipeline in various filters. The primary objective was to reproduce the pipeline data using the Swift UVOT software and its diverse methods. However, discrepancies between the measured magnitudes and the original pipeline data were observed, indicating potential differences in aperture sizes. To address this issue, a Curve of Growth model was employed, where magnitudes were measured for various aperture sizes to study how the magnitude changes with aperture radius. The count rates increased with the aperture radius until reaching a plateau, signifying the inclusion of more background and less of the source beyond a certain radius. Comparison of the Curve of Growth model with the pipeline data demonstrated that the pipeline magnitude values were approached with an increase in aperture radius. The project further involved comparing the UV data with the Infrared (IR) magnitudes obtained from the Two Micron All Sky Survey for all aperture radii. This comparison provided valuable insights into the star formation rates of galaxies. The difference between the UV and IR magnitudes, along with the corresponding color, served as an indicator of star formation rates. An ultimate goal of this project was to automate the entire photometry process to streamline data analysis and ensure more consistent and reliable results. Automating the photometry process would enhance efficiency and reproducibility, allowing for larger sample sizes to be analyzed systematically.

VALIDATION OF CONVOLUTION TECHNIQUE FOR EXTRACTING HADRONIC FORM FACTORS

Presenter(s): Jean Paul Sadia (Rutgers University)
Physical & Mathematical Sciences

Mentor(s): Paul Gueye (Facility for Rare Isotope Beams)

The standard model is an exceptional theory, in the sense that it provides a consistent description of the existence and interactions of sub-atomic particles. However, this theory is still not able to solve the missing mass problem (e.g., more than 90% of the visible mass of the universe cannot be accounted for). In addition, it has long been postulated that neutron stars are strange stars, a phenomenon that could also explain the observance of exceptionally small sizes of some white dwarfs. Our study is on the validity of using the mathematical convolution technique to extract the K-meson form factor. This quantity is critical in the estimation of the production of the strange quark content in the universe with an impact on the existence of strange stars. We aim to establish this convolution's validity by conducting sensitivity analysis on the independent variables of the cross section for kaon photoproduction. These are the energy transfer to the nucleon Q2, the invariant mass s and the energy transfer to the kaon t. The work to be done will allow us to model the probability of creating strangeness with three separate functions that depend on the Mandelstam variables. If our convolution technique is successful, it could be applied elsewhere such as extracting physics quantities from experimental measurements or image processing.

CHEMICAL CHARACTERIZATION OF ADULT BLOWFLIES TO IMPROVE POSTMORTEM INTERVAL ESTIMATION

Presenter(s): Kritzia Rosado (Inter American University of Puerto Rico)
Physical & Mathematical Sciences
Mentor(s): Ruth Smith (College of Natural Science), William Shirley (College of Natural Science)

Postmortem interval is currently estimated based on the lifecycle of blowflies that invade the body upon death. This method requires that the species of blowfly present are identified; however, identification can be difficult due to visual similarities among species throughout the lifecycle. The main body of the blowfly consists of a cuticle, which is present through all life stages and contains hydrocarbons and fatty acids. Previous research demonstrated differences in chemical composition of the cuticle to distinguish blowfly species in specific life stages. However, these studies are limited to an evaluation of one or two species and a single developmental stage. The overall objective in our work is to evaluate changes in chemical profile of multiple species throughout all developmental stages to provide more objective PMI estimations. The first step was to evaluate differences in chemical profiles of adult blowflies representing five different species. Female flies from each species were extracted with hexane and all extracts were analyzed by gas chromatography-mass spectrometry (GC-MS). The resulting chromatograms were subjected to principal component analysis (PCA) to evaluate the association and discrimination of the blowflies based on their chemical composition. Flies from each species were grouped closely and distinction among the five species was observed in the scores plot. Extracts from each of three species were projected onto the scores plot and each extract grouped closely with the corresponding species, demonstrating potential to identify species based on cuticular chemical profiles.

ELECTROCHEMICAL DETECTION OF PHARMACEUTICALS IN WATER SAMPLES USING BORON-DOPED DIAMOND ELECTRODES

Presenter(s): Marissa Zamora (Fort Lewis College)
Physical & Mathematical Sciences
Mentor(s): Aaron Jacobs (College of Natural Science), Greg Swain (College of Natural Science)

Thousands of pharmaceuticals are being used today to treat various diseases. Pharmaceuticals and related metabolites are contaminants of emerging concern, because of their potential adverse effects on human health and the ecosystem. For instance, antibiotics can give rise to antibiotic-resistant bacteria, which can bring about irreparable harm to humans.(1) There is a need for inexpensive and in some cases, field deployable, analytical methods for detecting low concentrations of these emerging pollutants. Electrochemical methods with carbon electrodes are routinely used in electrochemical detectors and sensors to quantify electroactive analytes in solution. By electroactive, one refers to molecules that are easily oxidized or reduced at an electrode surface. Electrochemical measurements often involve application of a potential to an electrode and measuring the current that flows in response to the potential perturbation, which is reflective of the local analyte concentration. In this presentation, research results will be reported on the voltammetric characterization of two electroactive pharmaceutical pollutants, diclofenac (a non-steroidal anti-inflammatory) and carbamazepine (anticonvulsant), using boron-doped diamond thin-film electrodes. Flow injection analysis with amperometric detection was used to quantify both drugs in water samples and in a urine simulant. For both drugs, diamond electrodes provide a linear dynamic range from 0.1 to 100 μM and a limit of detection near 0.1 μM (S/N=3). (1) A. Satinder, Chapter 11 - Current status of pharmaceutical contamination in water, in Handbook of Water Purity and Quality (Second Edition), Editor(s): A. Satinder, Academic Press, 2021, pp. 255-270

DELINEATING THE REACTION ENERGY PROFILE OF THE ENANTIOSELECTIVE SYNTHESIS OF DIHYDRO-BETA-CARBOLINES BY TANDEM C-H ACTIVATION AND AZA-MICHAEL ADDITION

Presenter(s): Syed Wasiuddin (Eastern Michigan University)
Physical & Mathematical Sciences
Mentor(s): Maria Milletti (Eastern Michigan University)

β-carbolines are substituted indoles that serve as the basic structures of common pharmaceutical drugs that have anti-cancer and neuroprotective properties. In 2019, Rajasekar and Anbarasan suggested a novel one-pot synthesis for dihydro-β-carbolines involving more than one catalytic system: a rhodium acetate dimer for C-H insertion on the indole and a basic organo-catalyst for the subsequent aza-Michael addition. Use of the chiral squaramide as the organo-catalyst affords excellent stereoselectivity. The proposed reaction mechanism has not been explored by either experimental or computational methods and identifying the rate-determining step would offer insight on how to improve reaction conditions, including lower reaction temperatures. The goal of this work is to determine the structure of all intermediates and transition states and calculate relative activation barriers using density functional theory (DFT) methods as implemented in the Gaussian suite of programs. We will model triethylamine, as well as squaramide, as the organo-catalyst, to explore the role of chirality in determining enantioselectivity.

REVISITING KEPLER-74 B: A HIGHLY ECCENTRIC HOT JUPITER

Presenter(s): Shaniylah Welch (State University of New York at Fredonia)
Physical & Mathematical Sciences
Mentor(s): Noah Vowell (College of Natural Science)

We will present the reanalysis of Kepler-74 b, a hot Jupiter discovered by NASA's Kepler mission. Kepler-74 b was originally discovered in 2013 as an eccentric hot Jupiter on a 7.34 days orbit. Follow-up studies find a wide range of eccentricities from circular (e=0) to highly eccentric (e=0.287). We reanalyze the radial velocities of Kepler-74 in order to measure the eccentricity and refuse to enforce a circular solution. From this analysis we measure an eccentricity of e=0.45 highlighting the need for a comprehensive reanalysis of hot Jupiter eccentricities in order to assemble a homogeneous sample to probe hot Jupiter migration.

EXPERIMENTAL MEASUREMENTS OF STRUCTURE OF LIQUID IRON-NITROGEN ALLOYS

Presenter(s): Jack Piper (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Allison Pease (College of Natural Science), Susannah Dorfman (College of Natural Science)

In experimental mineralogy, in order to obtain data about the structure of liquids under high pressures and temperatures, the Paris-Edinburgh Cell (PEC) is often used in conjunction with X-Ray diffraction (XRD) to generate said data. PECs achieve high pressures through anvils on the top and bottom of the cell, and the temperature is generated from graphite heaters within the cell. This study focuses on iron nitride (Fe-N), and because of this a change was made to the standard PEC assembly. Typically, a capsule of boron nitride would surround the sample, but in order to avoid nitrogen contamination, this capsule was substituted for one made out of magnesium oxide instead. The PEC was used to put Fe-N under extreme pressures and temperatures, and XRD patterns were obtained at the Argonne National Laboratory, the advanced photon source, 16 BMB. Data analysis is still ongoing, but we aim to constrain the correlation between structure and pressure / temperature and compare results to literature values on the Fe-C system (Shibazaki et al, 2015).

EDGE COVERS OF MODIFIED PATH AND CYCLE GRAPHS

Presenter(s): Mallory Price (Grand Valley State University)
Physical & Mathematical Sciences
Mentor(s): Brian Drake (Grand Valley State University), Feryal Alayont (Grand Valley State University)

A graph is a mathematical structure consisting of vertices (dots) and edges (lines) that connect pairs of vertices. Graphs are used in modeling relationships between discrete objects. When a specific graph structure can be extended in a consistent pattern, we get graph families such as path and cycle graphs. An edge cover of a graph is a subset of the graph's edges chosen so that each vertex is an endpoint of at least one edge in this subset. In this project, we studied the sequences formed by counting the total number of edge covers in a graph family. It is known that the edge cover totals of certain graph families, such as the path and cycle graphs, give rise to known sequences, the Fibonacci and Lucas numbers, respectively. This allows us to obtain new combinatorial interpretations of known sequences or to generate new sequences from edge cover totals. In this presentation, we will report on our results on the edge cover sequences for graphs obtained by attaching 3-vertex path and cycle graphs.

UNCERTAINTY QUANTIFICATION AT THE EDGE OF STABILITY

Presenter(s): Andrew Yeomans-Stephenson (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Kyle Godbey (Facility for Rare Isotope Beams), Pablo Giuliani (College of Natural Science)

The properties of exotic nuclei are a vital importance to understand the origin of elements. However, studying the properties experimentally can pose great challenges. In this work we use cutting edge quantified theoretical models to study reactions between exotic oxygen isotopes and stable calcium targets to predict fusion cross sections in an effort to guide future experiments at the Facility for Rare Isotope Beams.

ELECTRON DETECTING DEVICE

Presenter(s): Claire Ardelean (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Wolfgang Mittig (Facility for Rare Isotope Beams)

The purpose of my research was to design and build an electron detector. The device will produce secondary electrons by sending alpha particles through a foil. We will then study the paths of these electrons.

USING RADIOACTIVE MOLECULES TO STUDY THE ORIGIN OF VISIBLE UNIVERSE

Presenter(s): Meyhar Dudeja (Michigan State University)
Physical & Mathematical Sciences
Mentor(s): Jaideep Singh (Facility for Rare Isotope Beams), Jochen Ballof (Facility for Rare Isotope Beams)

Ever wondered why there is something rather than nothing? More precisely, why there is only matter in visible universe and no antimatter? An anti-matter is like matter with opposite charge and when matter and anti-matter collide, they burst into energy in form of light. It is believed that matter and anti-matter were created in equal quantities at the dawn of universe. The question now is how did all the anti-matter disappear? The answer might lie in forces between sub-atomic particles that are not the same when arrow of time is reversed. Although these forces have been observed in rare instances, they are not enough to justify the missing anti-matter. We are designing an experiment with radioactive molecules to search for these new exotic forces to unravel the mystery of disappeared anti-matter. Radioactive "pear"-shaped(like the fruit) atomic nuclei might enhance the observability of new exotic forces by a thousand times will be produced at FRIB at MSU. Molecules, when aligned with an external electric field, increase sensitivity to new exotic forces by factor of 100x compared to atoms. Therefore, radioactive molecules have a sensitivity to new exotic forces that is over 100,000x more than stable atoms which were used to search for these forces in past. We are constructing an instrument, called the EDM3 instrument, that will create these radioactive molecules. I will describe the fabrication, assembly, and testing of the EDM3 instrument. This work (EDM3) is supported the U.S. DOE, Office of Science, Office of Nuclear Physics, under contract DE-SC0019015.

CHARACTERIZING THE MORITA EQUIVALENCE FOR INVERSE HULLS OF MARKOV SHIFTS

Presenter(s): Lucas Vega (The University of Texas Tyler), Zach Duah (The University of Michigan)
Physical & Mathematical Sciences
Mentor(s): David Milan (The University of Texas Tyler)

The inverse hull of a Markov shift is an inverse semigroup constructed from the language generated by a Markov transition matrix. We provide a characterization to determine when two inverse hulls are Morita equivalent.

PLANT SCIENCE

COMPUTATIONAL EXPLORATION OF BIASES WHEN PREDICTING BINDING POCKETS IN PROTEINS

Presenter(s): Israel Davidson (Cornell University)
Plant Science
Mentor(s): Duncan Boren (College of Natural Science), Josh Vermaas (College of Natural Science)

lants need to respond to environmental stresses, such as drought, heat, herbivory, and often do so through the action of small molecules. How these small molecule signals trigger plant responses is known in part, but many small molecules have not been explored. In this study, we develop a computational biology pipeline to predict binding sites for small molecules with potential biological activity, such as isoprene, ethylene, and auxin across multiple plant species to look for broad differences in responses. The pipeline uses Alphafold, molecular simulation, DeepSurf, and Autodock Vina to help create a computational pipeline that uses amino acid sequences and lignand structure to quickly screen across large amount small compounds that affect a plants development along with what is considered to be to good binding pocket. From our experiment we learned that aromatic residues are overrepresented in the predicted pockets using DeepSurf, while residues that are classified as special cases are underrepresented in the DeepSurf processing. From the experiment we also see that that proportion of the status of the residues were also consistent among all tested species. Again the proportions of structured and unstructured content is similar in all species. The protein sizes distributions were different amongst all of the species with Douglas Fir having the lowest size distribution while Arabidopis has the highest size distribution .Now in the end using these methods to carry out future experiments will prove to be biased in some form. However we hope that it can be used as a guide of some sort to guide future experiment using these same technologies.

DIFFERENTIATING TRICHOME PATTERNS BETWEEN URBAN POPULATIONS OF CAPSELLA BURSA PASTORIS

Presenter(s): Evan Adamski (Michigan State University)
Plant Science
Mentor(s): Asia Hightower (College of Natural Science)

All gardeners know to be wary of insects that could destroy the plant. Fortunately, plants come with some protection. Trichomes, small spiky structures that extend from the surface of the leaf, protect the plant from predators, radiation, and water loss. Different populations of the same species have different densities of trichomes, however we do not know what is causing this. Using Capsella bursa-pastoris as our model organism, we will explore why populations in New York City contain lower trichome densities than in Lansing, Michigan. This study grows different New York and Lansing samples to identify current levels in variation. We will then cross-pollinate the plants between the populations to identify how much variation is genetic. Our experiment will determine how much of the variation is due to genotypic variation, gene expression, and environmental factors. We expect a combination of genetic, environmental, and gene expression factors causing the different trichome densities. Because trichomes play an important role in dealing with environmental stressors, this study will demonstrate how different populations will adapt to insect predation with increasing levels of urbanization.

ANALYSIS OF LEAF SHAPE VARIATIONS IN CAPSELLA BURSA-PASTORIS POPULATIONS

Presenter(s): Claudia Colligan (Michigan State University), Tianyi Xia (Michigan State University)
Plant Science
Mentor(s): Asia Hightower (College of Natural Science)

Capsella bursa-pastoris is one of the most abundant invasive plant species, with populations growing worldwide. Unlike other species in the family, this species shows a high level of diversity in the shape of its leaves. Leaf shape is responsible for heat dissipation, water transport, and photosynthesis. Species such as C. grandiflora and C. rubella show very little variation in leaf shape throughout populations due to the gene REDUCED COMPLEXITY (RCO) controlling growth. However, the underlying genetic basis for leaf variation in C. bursa-pastoris is not known. It is unknown if leaf shape phenotypes vary by population, as well as the gene responsible for the variety. In order to determine this, seeds from 83 different genotypes were collected from Times Square, New York, and grown under the same conditions. Phenotypic data such as leaf number, plant width, and longest leaf length was collected multiple times per week. 2D scans were made in order to determine circularity and aspect ratio. If the results show a pattern, then it is likely that there is an interaction between genotypes and the environment, because individuals within those populations would have similar leaf shapes. If the results show no pattern, which indicates that genotype has a strong effect on phenotype regardless of environment due to the phenotypic differences within the population. In the future, this work will expand to include a Genome Wide

Association Study (GWAS) as well as QTL Mapping to find the genes responsible for leaf shape in Capsella bursa-pastoris.

THE IMPACTS AND TRADE-OFFS ASSOCIATED WITH HEAT STRESS IN CAPSELLA BURSA-PASTORIS

Presenter(s): Kennedy Barnes (Michigan State University)
Plant Science
Mentor(s): Asia Hightower (College of Natural Science)

As temperatures continue to climb and the environments start to shift climate change is no longer in the future but our reality and it is important that we understand how heat stress will impact arable and non arable land. Capsella bursa-pastoris (CBP) is a model plant in the Brassicaceae family that allows for deeper understanding of plant morphology, fitness, evolutionary and developmental genetics of plants. Flowering time is a vital component of plant fitness and development that can show us how well a plant is adapting to its environment. Our research focused on finding known heat stress genes associated with flowering phenotypes in CBP that affected different elements of its plant fitness by amplifying and isolating genes using qPCR and gel electrophoresis. As our research continues we will utilize QTL mapping to link genotype and phenotype to unravel genetic architecture of complex traits and tradeoffs within CBP. The family of Brassicaceae are important economically, agriculturally and nutritionally. Understanding the genetic and physical exchanges between CBP and a warmer environment,will allow farmers and agriculturalists to make the best decisions to ensure the longevity of crops in the Brassicaceae family to combat rising temperatures.

GENOMIC SIGNATURES OF URBAN ADAPTATIONS IN ARABIDOPSIS THALIANA

Presenter(s): Athena Dila (University of Michigan - Ann Arbor)
Plant Science
Mentor(s): Emily Josephs (College of Natural Science), Sophie Buysse (College of Natural Science)

As urbanization increases globally, plants face novel challenges in adapting to city environments. Yet, little is understood about the genetics underlying urban adaptation. We propose to identify genomic signatures of urban adaptation in Arabidopsis thaliana by comparing the genes of plants from a gradient of urban and non-urban areas. In order to determine this, we will run a Genome-Wide Association Study (GWAS) of A. thaliana to identify genomic regions that are associated with urban environments. We used the model organism A. thaliana because it is abundant in both urban and non-urban environments globally. Our first aim of this project is to effectively quantify urbanization, as different papers have used multiple definitions such as population size, distance from the urban core, or percent of impervious surfaces. Then, we used publicly available geographic and genomic data to run a GWAS to identify genomic changes common to plants from urban areas. Our results showed that there are regions of the genome associated with urban environments throughout Europe. Of particular interest is a gene on chromosome 3 involved in responding to environmental stressors. Overall, we are excited to see evidence of urban adaptation!

EXPRESSION LANDSCAPE OF CONSERVED DROUGHT RESPONSIVE GENE AND ORTHOLOGS ACROSS SPECIES IN RESPONSE TO ABIOTIC STRESSES

Presenter(s): Austin Jensen (University of Wisconsin-Stevens Point)
Plant Science
Mentor(s): Hannah Cushman (College of Natural Science)

Abiotic factors such as drought and cold stress can be major environmental factors affecting crop growth and productivity. Understanding the genetic basis for plant responses to abiotic stresses and what processes are conserved throughout different species is necessary for developing strategies to improve plant growth. Recent strategies have used genome analysis to determine genes that are associated with stress responses in plants. A gene with a conserved response to drought in Arabidopsis thaliana and switchgrass (Panicum virgatum) has been identified and is temporarily being called 'Conserved Drought Responsive' (CDR). Arabidopsis mutants of this gene show improved drought tolerance. Here, we investigate the expression patterns of CDR and its orthologs in a range of plant species (Arabidopsis, soybeans, rice, maize, and cotton plants) in response to abiotic stresses by analyzing publicly available RNA-seq data from NCBI to identify conserved and divergent patterns in gene expression in response to drought, cold, and salt stresses. We also searched for conserved regulatory expression patterns in promoter and terminator sequences of CDR and its orthologs. A conserved response to abiotic stresses demonstrates that manipulation of CDR orthologs in heavily water dependent crops, such as rice, may prove effective strategies to improve drought resistance in these crops.

USING YEAST ONE-HYBRID TO IDENTIFY TRANSCRIPTION FACTORS REGULATING ACYLSUGAR BIOSYNTHESIS IN CULTIVATED TOMATO

Presenter(s): Alora Sundbeck (Michigan Technological University)
Plant Science
Mentor(s): Rachel Kerwin (College of Natural Science)

Acylsugars are specialized defense metabolites produced in the leaf trichomes of Solanaceae plants. Biosynthesis of acylsugars in cultivated tomato (Solanum lycopersicum) trichomes is mediated by four acylsugar acyltransferase (ASAT) enzymes, ASAT1, ASAT2, ASAT3, and ASAT4. The genes encoding ASAT1-ASAT4 are expressed exclusively in trichomes, but the factors regulating their transcription are unknown. Transcription factors are

proteins that bind to specific regulatory DNA sequences in the promoters of target genes, thereby activating or repressing their expression. To gain insight into how acylsugar biosynthesis is regulated in cultivated tomato, we screened 21 candidate acylsugar transcription factors derived from tomatoes using yeast one-hybrid assays. These transcription factor candidates, along with the promoter of the trichome-expressed ASAT1 acylsugar pathway gene, were cloned into separate yeast one-hybrid vectors. We detected interactions between TF06 (Solyc07g054220.1), TF07 (Solyc01g107960.4), and TF14 (Solyc05g053330.3) and the ASAT1 promoter, suggesting these transcription factors may directly regulate acylsugar biosynthesis. These results provide insight into how acylsugar biosynthesis is regulated in tomato trichomes. This will advance our understanding of spatial gene expression regulation important in specialized metabolite production. This knowledge could ultimately be applied to breed tomato crops with higher pest resistance.

EVALUATING TRANSCRIPTION FACTOR MYBR87 AS A BIOMARKER FOR NITROGEN RESPONSE IN MAIZE SEEDLINGS

Presenter(s): Juan Naasko (University of Michigan)
Plant Science
Mentor(s): Addie Thompson (College of Agriculture & Natural Resources), Robert Shrote (College of Agriculture & Natural Resources)

Maize is among the most globally cultivated crops with the use of nitrogen (N) fertilizer being common for its cultivation. N-supplementation ensures high yields and fast growth; however, much of what is applied is not used by plants, instead leeching into the ground and ecosystems. This negatively impacts the environment and is an economic cost to farmers, making the optimization of N-supplementation a priority. This is difficult for maize cultivation because different varieties have unique N-responsiveness and needs. Our research aims to validate the gene mybr87, a transcription factor, as a biomarker for N-response in vegetative stage 3 (V3) maize. Six hybrid and six inbred lines were grown under conditions either with or without N-supplementation. RNA was extracted from leaf tissue collected at V3, and reverse-transcriptase quantitative PCR was used to quantify mybr87 expression across the maize lines and treatments. We looked at B73xPHZ51 and its inbred parents for expression levels of mybr87 in +/- N conditions. Across all three lines, mybr87 expression was significantly repressed under +N conditions. This was consistent with +N expression found in later-growth maize, validating the gene. The main takeaway from this project was the protocol developed for testing other candidate genes as N-response biomarkers. Future work would be SNP analysis on N-response biomarkers to find specific SNP variations tied to specific N-response types. That way we could assess N-responsiveness in hybrids to aid farmers in optimizing N-supplementation, helping both to produce high yields while saving costs and limiting N runoff into the environment.

GENOMIC CHARACTERIZATION OF MICRO ANIMAL SYMBIONTS IN RESURRECTION PLANTS: INSIGHTS FROM A SYSTEMS PERSPECTIVE

Presenter(s): Margaret Mattson (Scripps College)
Plant Science
Mentor(s): Robert VanBuren (College of Agriculture & Natural Resources), Rose Marks (College of Agriculture & Natural Resources)

Drought stress poses a significant threat to global agriculture and ecosystem stability. Resurrection plants have evolved unique adaptive strategies to cope with this abiotic stressor, enabling them to tolerate extreme desiccation and rapidly recover upon rehydration. Tardigrades have been shown to be similarly stress tolerant; this adaptive strategy works in conjunction with resurrection plants to form desiccation tolerant symbiotic communities able to survive anhydrobiosis. However, the association between resurrection plants and desiccation tolerant tardigrades present in drought tolerant systems is ill defined. This study seeks to characterize the microbiota present in desiccation tolerant bryophytes, differentiate gene expression levels of known drought tolerant associated genes, and compare genetic pathways conferring anhydrobiosis between symbiont and host. Utilizing a meta analyses of publicly available sequencing data, we analyzed RNAseq data of Bryum argentum, Selaginella lepidophylla, and Syntrichia caninervis to identify the presence of tardigrades and their gene expression across desiccation timepoints. Tardigrade specific genes were then annotated and expression levels of genes associated with desiccation tolerance were assessed. Our results provide insight into the diverse community of desiccation tolerant organisms and the degree to which their respective evolutionary histories are entwined. As climate pressures intensify, it becomes increasingly vital to explore the unique adaptive strategies utilized for anhydrobiosis from a community perspective for both agricultural innovation and informed conservation efforts. Describing the relationship between microbiota and resurrection plants provides insight into the coevolutionary dynamics of drought survival, developing evolutionary understanding of the ecological context that desiccation tolerant life evolved.

EFFECT OF PHOTORESPIRATION ON PEROXISOME MOTILITY AND DISTRIBUTION IN ARABIDOPSIS THALIANA

Presenter(s): Krishen Patel (Michigan State University)
Plant Science
Mentor(s): Amanda Koenig (College of Natural Science), Jianping Hu (College of Natural Science)

Peroxisomes, small organelles with a single membrane, are responsible for processes such as oxidative reactions and fatty acid breakdown. They collaborate with other organelles like chloroplasts and mitochondria to facilitate many metabolic pathways necessary for plant growth. For example, peroxisomes are critical during photorespiration. Although photorespiration decreases photosynthetic efficiency and is therefore often considered wasteful, it is important for plant development, including nitrogen allocation and plant immunity. To carry out photorespiration, peroxisomes, chloroplasts, and mitochondria must be in close proximity, which requires organelle movement. Organelles interact with myosin motors to traverse the cytoplasm along actin, however the components and assembly of organelle-specific motor complexes are not well understood. Here, I worked to discover recruitment proteins that connect myosin to peroxisomes. Furthermore, I investigated how photorespiration impacts actin-dependent peroxisome dynamics. Candidate adaptor proteins were previously identified from Myosin XI interaction proteins. Mutant and wild-type Arabidopsis thaliana were transformed with fluorescent markers for actin and peroxisomes, then actin-dependent peroxisome motility was evaluated using confocal fluorescence microscopy. We initially observed no significant movement reduction in the recruitment protein and photorespiration mutants; quantitative analyses are underway. Future experiments will assess these plants as well as the more severe PR mutant plgg1 under photorespiratory conditions such as heat, high O2:CO2, and pathogens, which may reveal changes to organelle dynamics. Insights into peroxisome motility and distribution during critical metabolism in plants, such as photorespiration, has the potential to optimize plant development and resilience for agriculture and food security.

ISOPRENE PROTECTION AGAINST HIGH TEMPERATURE AND HIGH LIGHT STRESS

Presenter(s): Makayla Ritko (Illinois Valley Community College)
Plant Science
Mentor(s): Mohammad Mostofa (College of Natural Science), Thomas Sharkey (College of Natural Science)

Isoprene is a volatile hydrocarbon emitted by many plant species. The methylerythritol 4-phosphate (MEP) pathway supplies dimethylallyl diphosphate (DMADP) for producing isoprene by isoprene synthase. Isoprene emitted by plants is estimated to be around 600 Tg annually, which can contribute to harmful ozone production and aerosol formation. Conversely, isoprene can protect plants from various abiotic stresses, including temperature. However, the function of isoprene against the combined effects of high temperature and high light is unknown. Using isoprene emitting (IE) and non-emitting (EV) tobacco plants, we assessed important features, such as photosynthesis, stomatal conductance (gsw), internal carbon dioxide (Ci), and isoprene emission, under high temperature (38˚) and high light (3000 µmol m-2 sec-1) conditions. Results showed that IE plants maintained a higher level of photosynthesis and gsw than EV plants during exposure to high light and high temperature for two hours. Photosynthesis and gsw continued to be

higher in IE plants than EV plants during half an hour of recovery, but photosynthesis becomes more similar in the plants after twenty-four hours of recovery. Ci remained similar in both lines throughout the stress, though EV plants had higher Ci than IE plants after twenty-four hours of recovery. Isoprene emission was evident in IE plants during high temperature and high light stress, illustrating the responsiveness of isoprene. Collectively, these results highlight the likely function of isoprene in protecting plants, which can be used in further work to improve stress tolerance in plants.

VALIDATION OF INTERNATIONAL WEED GENOMICS CONSORTIUM PIPELINE USING TWO MODEL SPECIES

Presenter(s): Jessica Matheson (University of Massachusetts Amherst)
Plant Science
Mentor(s): Luan Cutti (College of Agriculture & Natural Resources)

The International Weed Genomics Consortium (IWGC) aims to generate genomic resources for dozens of weedy species across the world. This study focuses on validating the IWGC annotation pipeline by re-annotating the genomes of model species and comparing them to the currently accepted annotations. Publicly available reference genome sequences and ISOseq data (mRNA long reads) from different tissues and stresses for Arabidopsis thaliana and Oryza sativa were utilized. The IWGC annotation pipeline involves identifying and masking repetitive regions (RepeatModeler and RepeatMasker), aligning ISOseq reads (pbmm2) and obtaining the longest isoform (isoseq3), predicting real genes (Maker), filtering, and generating 'structural' annotation files (i.e. gene models). The pipeline successfully annotated 90% of A. thaliana and 72% of O. sativa genes when combined ISOseq reads and a protein file from a closely related species in the step to predict the real genes. The annotation without any protein file from a closely related species to support the gene model prediction decreased the total number of genes annotated. The number of ISOseq reads and tissue type used in the annotation influenced the final number of genes annotated, particularly when a protein file was not used to support gene model prediction. Files with a higher number of reads better supported the gene model prediction. This validation process increases confidence in the pipeline for non-model species and provides insights into potentially overlooked genes in weedy species genomes.

CLASSIFICATION OF TERRESTRIAL INVASIVE PLANT SPECIES BASED ON MORPHOLOGY AND DNA

Presenter(s): Sneha Nath (Western Michigan University)
Plant Science
Mentor(s): Yan Lu (Western Michigan University)

Terrestrial invasive plant species (TIPS; e.g., garlic mustard and tree of heaven) grow and reproduce quickly and have the potential to harm the environment, the economy, and/or human health. Some TIPS produce large amounts of seeds; some TIPS have a very aggressive root systems capable of spreading a long distance; some TIPS produce chemicals that inhibit the growth of other plants or are toxic to humans and animals. To help the State of Michigan manage and control TIPS, we surveyed 5 natural preserves in Southwest Michigan (~800 acres total) and identified ~90 TIPS based on morphology. We also developed a DNA barcoding systems for TIPS, which involves: (1) genomic DNA extraction; (2) PCR amplification of target genomic loci; (3) purification and sequencing of PCR products; (4) analysis and public release of reliable nucleotide sequences. We selected four genomic loci for PCR amplification: internal transcribed spacer (ITS), rubisco large subunit (rbcL), maturase K (matK), and trnH-psbA. ITS is the spacer DNA between the small- and large-subunit ribosomal RNA genes in the nuclear genome. rbcL, matK, and trnH-psbA are located on the plastid genome. trnH-psbA is the spacer DNA between trnH and psbA genes, which encode transfer RNA-histidine and photosystem II protein D1, respectively. We found that the combined use of morphology-based and DNA-based approaches had much higher species identification rates. We also participated in the Garlic Mustard Contest organized by Portage Parks and Recreations in May 2023 and removed a total of 144 pounds of garlic mustard plants.

DETERMINING THE EFFECTIVENESS OF AN UNIVERSAL FUSARIUM ROOT ROT RESISTANT CHECK OF PHASEOLUS VULGARIS

Presenter(s): Alondra Vega Ayala (University of Puerto Rico at Mayaguez)
Plant Science
Mentor(s): Sophia Harlow (College of Agriculture & Natural Resources)

Fusarium spp. are the most common fungal pathogens causing Fusarium root rot (FRR) in dry beans (Phaseolus vulgaris), driving major loss worldwide. Dry beans have little resistance to FRR. Vax3 and Vax1 dry bean cultivars were initially selected for resistance to common bacterial blight, but only Vax1 was reported for resistance to FRR. Although Vax1 was reported resistant for FRR, Vax3 is the most used FRR resistant check in the global dry bean community (DBC), however shows conflicting results across the DBC. In MSU community, Vax3 is not consistently resistant, but reports from NDSU show Vax3 as very resistant across multiple studies. Given the inconsistency in FRR response, should Vax3 be considered the resistant check for FRR? To evaluate the continued use of Vax3 as FRR resistant, we obtained seedstock of Vax1 and Vax3 from the major breeding programs within the USA; Michigan, North Dakota, and Washington, as well as USDA-GRIN germplasm database. Seeds from the cultivars were assessed visually and had genotype-specific characteristics across all locations, so seed stocks weren't interchanged. Seedlings from each location were inoculated with F. cuneirostrum and scored for disease severity (1-9). No significant difference was identified between location/genotype. Because each cultivar was released at the F4/F5 stage, we evaluated genetic similarity across locations using Sanger sequencing of markers SAP6 and SU91. Vax1 had high sequence homology (homozygous), while Vax3 similarity was only 82-96% across locations (heterozygous). Based on these findings, we do not recommend Vax3 or Vax1 as resistant checks to FRR.

MANAGING POWDERY MILDEW IN WHEAT

Presenter(s): Bella Lichtenstein (Michigan State University)
Plant Science
Mentor(s): Martin Chilvers (College of Agriculture & Natural Resources)

This study looks at the effects of powdery mildew on wheat fields. This is a common fungus of wheat fields in Michigan caused by Blumeria graminis f.sp. tritici. It is a particular problem in the beginning of the season as this fungus grows best in cooler temperatures, preferably around 16 to 21 degrees Celsius. This disease, if left unmanaged, can stunt the growth of wheat and reduce yield significantly by reducing the amount of leaf area that is available to perform photosynthesis. In order to gain a better understanding of how this disease affects wheat yield, a plant disease management report will be written. The report will look at the applied fungicides, the variety of wheat, the yield, and the severity of the disease. After the data is compiled, the differences between the severity of the disease and the final yield will be compared.

CHARACTERIZING REGULATORY ELEMENTS

Presenter(s): Amayrani Olvera (Montana State University)
Plant Science
Mentor(s): Angel McKay Whiteman (College of Natural Science)

My project, Characterizing Regulatory Elements, explores the cloning of regulatory elements in Sorghum. More specifically, characterizing tissue specific promoters for synthetic biological purposes and establishing methods for transient expression via infiltration. The characterization of regulatory elements permits the ability to engineer optimized metabolic pathways. As a result, plant specialized metabolites can be produced and used for a variety of purposes. Terpenes, for example, are used by plants for protection against harmful pathogens and insects while humans may use terpenes for pharmaceuticals and dyes. This project also focuses on regulatory elements which target expression of the leaf epidermis. In characterizing regulatory elements, methods of terpene purification can be greatly improved with an increase in ease of extraction. Essentially, allowing synthetic biological blocks to be shared among labs for a large variety of purposes. Consequentially, Great Lakes Bioenergy Research Center (GLBRC) is then able to further improve the use of Sorghum for biofuels.

HOW DOES STOMATAL CONDUCTANCE VARY BETWEEN CROP SPECIES AND LAND USE HISTORIES?

Presenter(s): Julia Seay (Washington and Lee University)
Plant Science
Mentor(s): Jiquan Chen (College of Social Science)

There is a current debate between whether corn or switchgrass will be the better choice as potential crops for bioenergy production. The scientific community is in favor of switchgrass as a perennial grass since it requires low nitrogen, its longevity, its positive contribution to nitrate pollution, etc. his project is looking to contribute to this scholarly discussion by providing the stomatal onductance of the two crops in understanding the underlying mechanisms for carbon uptake, coupled with essential biophysical characteristics of the crops such as LAI (Leaf Area Index) and foliar nitrogen content, and microclimate in modeling photosynthesis. My primary study objective is to discover whether corn or switchgrass is more efficient at photosynthesis to help sequester more atmospheric carbon. This will be comparing the stomatal conductance of the two plants since it's an indication of the efficiency of gas/carbon sequestration between the plant and the atmosphere. The yhpothesis is that corn will have the higher stomatal conductance, because switchgrass sequesters more carbon when there is low soil organic carbon content (SOC) initially. As of now, the soil is high in SOC because of the previous Conservation Reserve Program (CRP) land management; it will decrease SOC and switchgrass' capacity for sequestering carbon. The efficiency for sequestration will be higher for corn, because the land use history of the CRP and the Agricultural Land Reserve AGR) work in the corn's favor, despite the corn having more agricultural needs than switchgrass. The goal behind the project is to better understand whether the mass production of one of these crops will positively or negatively contribute to the release of carbon into the atmosphere through their tomatas.

WHAT MAKES A WEED A WEED?

Presenter(s): Sebastian Lee (Pomona College)
Plant Science
Mentor(s): Nick Johnson (College of Natural Science)

Weedy plants often outcompete crops and pose significant challenges to agricultural productivity and yield worldwide. In this study, we leveraged the chromosome-level genome assemblies of various weed, crop, and wild crop relative species to elucidate the genetic factors that underlie weediness. We characterized variations in genome architecture and gene function associated with this quality using evolutionary and functional analyses. First, we processed genome data into amino acid sequences and used OrthoFinder to cluster orthologous genes and generate rooted phylogenetic trees that characterize the evolutionary history of our plant species of interest and their gene families. Then, we used the program CAFE5 to analyze the evolution of gene family size and to reveal how the gene families in different weed and crop species have expanded and contracted. We successfully calculated the number of gene family expansions and contractions in weeds, and found that there are intrafamilial patterns of gene family contraction and expansion in but no overarching pattern shared by all weeds. This lays the foundation for future research, as what is most important will be characterizing the function of these gene families to determine what at a genetic level makes a weed a weed.

DETERMINATION OF FRAUDULENT ADULTERATION OF VANILLA EXTRACT: ADVANCED STABLE ISOTOPE ANALYSIS

Presenter(s): Isabela Freitas (Western Michigan University)
Plant Science
Mentor(s): James Moran (College of Natural Science)

Vanillin is the main ingredient of vanilla extract, a common food flavoring valued at over $4 billion annually. Vanillin is typically produced by either extracted from vanilla beans derived from a specialized orchid plant or synthetically produced as a byproduct of the wood pulp industry. These two approaches produce vanillin with different relative carbon-13 abundances with that extracted from the vanilla bean being slightly enriched in carbon-13 relative to vanillin from wood pulp lignin. The focus of the project was to test the abundance of carbon-13 in the vanillin samples and to identify any traces of lignin vanillin. Testing the limits of the C13/C12 ratios that are expected for natural vanillin, and C13/C12 ratios falling outside these limits are considered evidence of fraudulent adulteration. The instrumentation used to achieve this was an Orbitrap-IRMS. Orbitrap- IRMS can better determine these isotope ratios since it does not have to combust the sample, therefore not losing any information about the molecule and permitting position-specific isotope evaluation. In determining fraudulent adulteration of vanilla extract, this methodology could potentially be applied to a wider range of food.

EFFECTS OF CONTROLLED DROUGHT ON SWITCHGRASS PHYSIOLOGY

Presenter(s): Veronica Pargulski (Michigan State University)
Plant Science
Mentor(s): Berkley Walker (College of Natural Science), Binod Basyal (College of Natural Science)

Switchgrass is a perennial plant that the Great Lakes Bioenergy Research Center is conducting research on for its potential as a biofuel crop. Previous research has been done with droughted switchgrass analyzing genomics and gene expression, however, we are interested in how the plants respond to drought at different phenological stages, including vegetative, flowering, and senescence. We conducted the experiment in the greenhouse with an automated irrigation system and 80 switchgrass plants. Throughout the experiment, data was collected on the tiller and leaf count as the plants grew, stomatal conductance using LI-600, photosynthetic rate and the efficiency of Photosystem II using LI-6800, we also determined which genes were regulating responses using RNA sequencing, and at the end of the experiment, the biomass and quality of ethanol produced from each treatment will be assessed. The importance of this work was to gather robust drought data to help predict how drought at different growth stages will impact biofuel production and quality in the future, as climate change worsens.

THE DELETION OF A PUTATIVE CHITINASE-CONTROLLING ENHANCER IN ARABIDOPSIS THALIANA

Presenter(s): Serena Perry (Elizabeth City State University)
Plant Science
Mentor(s): Brandon Beall (College of Natural Science), Jiming Jiang (College of Natural Science)

Climate change is increasing the prevalence of plant fungal pathogens, posing risks to plant health and crop yield. Plant defense mechanisms, including chitinase genes, play a crucial role in protecting plants against these pathogens. Chitinases enhance resistance to both biotic and abiotic stressors, increasing plant defense, development, and overall crop yield. Enhancers are genetic sequences that increase transcript levels of a gene. A large enhancer was located upstream of nine homologous chitinase genes. This project aims to investigate the functional significance of a specific enhancer region in Arabidopsis, utilizing the CRISPR-Cas9 genome editing system. The Cas9 nuclease, known as the "molecular scissors," is employed alongside specific guide RNAs (gRNAs) to induce targeted cuts within the identified chromatin region. The resulting construct is introduced into Agrobacterium tumefaciens, a bacterium that facilitates plant transformation via a technique called floral dip. This process yields transgenic Arabidopsis plants lacking the putative chitinase enhancer region. Future experiments will validate differential chitinase gene expression and provide the foundation for a comprehensive chitinase network; enabling researchers to develop plants with enhanced abiotic and biotic resistances.

SOCIAL SCIENCES

IDENTIFYING STRATEGIES FOR EVENT PROFESSIONALS TO INCORPORATE DIVERSITY, EQUITY, AND INCLUSION (DEI)

Presenter(s): Brennan Haugen (Michigan State University), James Hager (Michigan State University)
Social Sciences
Mentor(s): John Waller (College of Social Science)

In today's increasingly diverse and connected world, promoting diversity, equity, and inclusion (DEI) has become an essential aspect of event planning and management. Event professionals play a key role in creating an inclusive environment in which people with diverse backgrounds and experiences can participate. This overview examines strategies an event professional can employ to incorporate DEI principles into practice effectively. The Event Professional should prioritize DEI from the start of the event. This includes conducting in-depth research and understanding the target audience's demographics, cultural nuances, and preferences. Armed with this knowledge, organizers can design events that meet the needs and expectations of different attendees. Event professionals should be proactive in continuing education and training to enhance their cultural competencies and perceptions. This includes learning about current DEI trends, attending diversity workshops, and gaining diverse perspectives in the decision-making process. By participating in continued education, the event professional can stay abreast of the evolving DEI landscape and adapt strategies effectively. Finally, a feedback mechanism should be set up so that event management can adjust in the future and identify areas of improvement. This system would not only collect feedback from participants but also from stakeholders in the DEI effort. Adopting these strategies will allow the event professional to take an important step towards incorporating DEI principles into her practice, ultimately delivering an innovative and inclusive experience for all event attendees.

THE IMPACT OF RELEVANCE-SUPPORTIVE STRATEGIES ON MOTIVATION AND ENGAGEMENT IN MIDDLE SCHOOL SCIENCE CLASSROOMS

Presenter(s): Nayana Turner (Northeastern Illinois University)
Social Sciences
Mentor(s): Jennifer Schmidt (College of Education), Lauren Cabrera (College of Education), Samuela Mouzaoir (College of Education)

The ability of children to feel connected to the content they are learning is essential for their academic motivation. A construct that has been used to describe students' connection to content is relevance. One of teachers' roles in the classroom should be to make content as relevant to students' interests and experiences as possible. Beyond that, teachers can endeavor to make content culturally relevant and sustaining (Linnenbrink-Garcia, L., Patall, E. A., & Pekrun, R. 2016). Relevance emphasizes how crucial it is for educators to authentically engage with students' interests and perspectives within course content. This is a strategy that can guarantee that all students achieve academic, social, cultural, and civic success via the framework of Culturally Relevant Pedagogy(CRP). CRP is "a way of teaching that fosters student achievement while helping students to accept and affirm their cultural identity, as well as develop critical perspectives that challenge societal inequities." (Paris,2012). The aim of the present research is to examine how teachers engage in relevant pedagogical practices in the classroom and how those interactions are culturally relevant/sustaining within their classrooms specifically. Using classroom surveys and video data, we examine the number of instances when middle school educators enact relevance in diverse classrooms to gauge how often or if teachers apply relevance-supportive strategies throughout their lessons. Students deserve classrooms that highlight their identities to promote the connection between students and what they are learning, and that the use of relevant content supports that. The study design for this project is a modified secondary thematic analysis. Through watching and thematically coding videos of middle school science lectures, we investigate the practices of two teachers in two different lessons in order to identify and analyze specific instances of relevant interactions and strategies used in the classroom.

DE'ANDRE VAUGHN, DR. TERRY FLENNAUGH, NAVIGATING MASCULINITY AND SOCIAL INFLUENCE: BLACK MEN AND THEIR ACADEMIC ENDEAVORS

Presenter(s): De'Andre Vaughn (Morehouse College)
Social Sciences
Mentor(s): Terry Flennaugh (College of Education)

Despite ongoing efforts to increase African American male graduation rates, this demographic still possesses one of the lowest rates across all demographic categories. Previous researchers have examined the effects of variables such as support from loved ones, a sense of belonging within one's institution, responsibilities outside of schooling, and an overall lack of financial, institutional, or informational resources. However, little research has been done to evaluate the effects of masculinity and the pressures of social influence on the academic endeavors of African American men. Prior literature has found a negative correlation between men possessing traditional masculine ideals and engaging in help-seeking behaviors. The research is designed to answer how black male college and university students can navigate notions of masculinity and social influence to succeed. For this study, masculinity is defined as the performative demonstration of what men believe it means to be a man in society. Social influence encompasses pressure to meet expectations from peers, the opposite sex, and respected authorities. The researcher will conduct a qualitative analysis of students on track to graduate from secondary and postsecondary institutions through an interview process. Currently, 18 students can be reached for interviews. The students attend Historically Black Colleges and Universities (HBCUs) and Predominantly White Institutions (PWIs), respectively. Data will be collected through brief in-person interviews (approximately 30 minutes), which will be recorded and transcripted for further analysis. Keywords: Masculinity, social influence, African American men, graduation rates

AN ANALYSIS OF UNUSUAL CASE ASSIGNMENT IN PRONOUNS

Presenter(s): Olivia Ziemelis (Eastern Michigan University)
Social Sciences
Mentor(s): Daniel Seely (Eastern Michigan Univeristy)

In English, Case is a grammatical feature that is almost exclusively overtly expressed through the pronominal system. These are the different forms of pronouns, such as the first-person singular I, me, and my. Cross-linguistic studies of Case have given rise to Case Theory, a foundational component of a wide range of linguistic study, and particularly within the generative tradition of the work of Noam Chomsky. However, the Case realized on pronouns in certain syntactic structures seem to be unaccounted for via predictions set by Case Theory. Consider, for example, "The old me never did that". Here, the Noun Phrase the old me is in the subject position, receiving the assignment of Nominative Case according to Case Theory. However, the pronoun me arises in the Accusative form. This study utilizes the notion of default Case (Schütze 2001) to propose hypotheses to account for the challenging data. Critically, one hypothesis is that these pronouns are shielded from receiving abstract Case due to the internal structure of examples such as these, resulting in the default Case. In addition to providing further analysis to the default Case, this study explores the implications of the challenging data on Case Theory and the wider field of linguistic study.

THE SELF-REGULATION OF CHILDREN ENROLLED IN A TRANSITIONAL KINDERGARTEN CLASSROOM

Presenter(s): Alaina Johns (Oakland University)
Social Sciences
Mentor(s): Julie Ricks-Doneen (Oakland University)

The development of self-regulation (the ability to understand and manage one's behaviors and reactions) is essential for 4 to 5-year-old children's success in active social situations. This research aimed to answer two related questions: How do students in transitional kindergarten perform on the Preschool Self-Regulation Assessment (PSRA)? What are transitional kindergarten teachers' perceptions of students' self-regulation skills? It is valuable to note that through this present study, it can be concluded that self-regulation skills are still continuing to develop in children 4 to 5 years of age. Teachers interviewed in this study made several comments regarding components of self-regulation. Executive functioning skills and effortful control were equally discussed among interviewees.

GASLIGHTING IN THE WORKPLACE: PERCEPTIONS, PROCESSES AND OUTCOMES

Presenter(s): Jas Banks (Michigan State University)
Social Sciences
Mentor(s): Quinetta Connally (Eli Broad College of Business), Victor Blocker (Eli Broad College of Business)

Microaggressions are a nuanced form of discrimination experienced by members of marginalized groups, including women, racial minorities, and members of the LGBTQ community. Primarily rooted in identity, microaggressions represent verbal, behavioral and environmental humiliations that communicate negative, derogatory or hostile sentiments toward a person or group. While such behavior can range on continua from subtle-to-overt and unintentional-to-intentional, research has identified micro-invalidation as a unique category of microaggressions, as it typically occurs in response to prior micro-aggressive behavior (Sue, 2010). It represents a reaction that invalidates or denies a target's experience of microaggressions and subsequently, serves to exacerbate the situation and the target's experienced harm. Gaslighting is a secondary form of microaggression and a specific type of micro-invalidation - specifically, behavior that conveys blaming people for their own hardships (Johnson, Nadal, Sissoko & King, 2021). Although research has highlighted a need to understand and address microaggressions in the workplace (Fattoracci & King, 2022), little attention has been given to the occurrence and impact of gaslighting. Accordingly, our primary research question is: What is gaslighting behavior at work and are its subsequent effects in and on organizations? In this project, we integrate literatures on psychology, communication and health to develop a theoretical model of gaslighting that articulates its conceptualization in the workplace, the mechanisms through which it affects employees and organizations, and the subsequent impact on employee health and well-being.

PIRATES AND THEIR PRIVATES: AN EXAMINATION OF EMOTIONS IN THE PERFORMANCE OF GENDER THROUGH THE GOLDEN AGE OF PIRACY (1550-1700)

Presenter(s): Kaya Wilske (Michigan State University)
Social Sciences
Mentor(s): Ronen Steinberg (College of Social Science)

This research explores the mid 1500s to 1700s following the post-years of the Anglo-Spanish War and the consequential development of pirate communities after privateering fell out of use and ceased to exist as a profession. This scholarship features the culture of Early Modern England, piracy, and the ways that Anne Bonny and Mary Read impacted the foundations of gender ideology produced during this time. Through a combination of gender theory and the theory of emotions, the case of Early Modern piracy created a unique situation for the differing expression of gender through performance. This research enables communities today to connect concepts of gender and how Judith Butler's concept of "doing gender" is tied to emotions.

THE EFFECTS OF BLUE LIGHT EXPOSURE ON COGNITION AFTER NIGHT OF SLEEP DEPRIVATION

Presenter(s): Manvir Bamrah (Michigan State University)
Social Sciences
Mentor(s): Kimberly Fenn (College of Social Science)

Sleep is vital for optimal cognitive performance, but instances arise where sleep-deprivation is inevitable. One night of deprivation hinders cognition, particularly, vigilant-attention and placekeeping, or the ability to follow a sequence of steps without skipping or repeating steps. Placekeeping facilitates performance in daily tasks, from making coffee to performing surgery. Thus, strategies that support cognitive performance following sleep-deprivation are necessary. Blue spectrum light is shown to increase alertness and brain activation, hence we assess the ability of blue-light to reduce cognitive deficits from sleep-deprivation. In the evening, participants completed two tasks in our lab: a vigilant-attention task (Psychomotor Vigilance Task [PVT]) and a placekeeping task (UNRAVEL). They then randomly drew conditions to determine whether they remain awake, Deprivation group, or sleep for the night, Sleep group. The Deprivation group remained in the laboratory, monitored by research assistants, only prohibited from activities activating the autonomic nervous system. The Sleep group slept in their habitual sleeping environment and returned in the morning. Only half of the participants received 30-minutes of blue-light exposure. Two factors were present in our design, sleep (Deprivation, Sleep) and blue-light exposure (Present, Absent). After light exposure, all participants again completed UNRAVEL and PVT. Data collection is ongoing but sleep-deprived participants are expected to perform worse on both tasks with blue-light exposure improving performance across both groups. As sleep-deprivation becomes increasingly prevalent, blue-light therapy may show efficacy in reducing associated negative cognitive effects. Although results may show interventional promise, performance deficits are expected, suggesting no replacement for adequate sleep.

ANALYZING PRESIDENTIAL-CONGRESSIONAL COMMUNICATIONS UNDER TRUMP

Presenter(s): Josh Taft (Michigan State University), Rebekah Batu (Michigan State University)
Social Sciences
Mentor(s): Ian Ostrander (College of Social Science), Joshua Koss (College of Social Science)

While the President of the United States of America has long been at the apex of political attention in American politics, the eccentricities of Donald Trump's administration heightened this privileged position. Trump's always-online status particularly his heavy usage of Twitter, placed virtually all of his political whims in the public spotlight. What may have remained behind closed doors in meetings with select cabinet officials and members of Congress, was thus frequently thrust into the public by way of Trump tweeting. We code all of President Trump's tweets to examine the political content of his messages. Of particular interest for this research project is the way Trump utilized this social media tool to communicate with Congress by discussing its members or pending legislation.

PERSONALITY AND P-E FIT: THE POTENTIAL CONTRIBUTION OF MACHINE LEARNING TO PREDICTION

Presenter(s): Joshua Grant (North Carolina Central University)
Social Sciences
Mentor(s): Christopher Nye (College of Social Science)

Personality and personal environment fit are complex ideas that have been gaining influence in various fields of psychology, organizational behavior, and human resources. Personality, defined as the distinct and long-lasting patterns of thoughts, feelings, and behaviors that identify people, includes characteristics such as extraversion, agreeability, conscientiousness, emotional stability, and openness to new experiences. The correspondence or connection between a person's personality and the needs, values, and assets that are present in his or her own environments, such as job settings, relationships, or educational environments, can be described as person-environment fit (P-E fit). A substantial amount of P-E fit frequently leads to beneficial results, such as increased work satisfaction, better academic performance, stronger interpersonal connections, and increased well-being. A lack of fit, on the other hand, can lead to tension, discontent, and poor performance. Examining the relationship between a person's personality and his or her work may help us better comprehend the validity of personality.

THE RELATIONSHIP BETWEEN MATERNAL STRESS AND THE IMMUNE SPECIFICITY OF MILK

Presenter(s): Aditi Sharma (Michigan State University)

Social Sciences
Mentor(s): Masako Fujita (College of Social Science)

The benefits of breastfeeding in building up an infant's immune system have been widely accepted. While various immunological molecules in mothers' milk and their variation with maternal malnutrition, infections, and psychological stress have been researched, we know little about how stress affects the immune system of milk, particularly its activities. The coordinated immune response in whole milk has just recently become an area of research with a new in-vitro stimulation technique, consisting of stimulating milk with bacteria and monitoring the change in immunological molecules, like a pro-inflammatory cytokine interleukin-6 (IL-6). In our forthcoming research, we investigate whether a relationship exists between mother's stress levels and milk immune specificity, measured as the immune response to pathogenic bacteria (Salmonella enterica) vs. benign bacteria (Bifidobacterium breve). We will recruit ~100 breastfeeding mothers in Michigan and collect nutritional, environmental, and psychosocial stress data via anthropometry, finger-stick blood, and questionnaire. Using in-vitro milk stimulation with each bacteria strain to milk samples, we will characterize the immune response as the ratio post-: pre-stimulation IL-6 concentration, quantified through ELISA. Multivariate regression models will evaluate the relationship between maternal stress and milk variables, adjusted for covariates. We predict that as stress levels increase, the immune specificity will decrease, meaning the milk either underreact to pathogenic bacteria or overreact to benign bacteria, or both. Since mothers face varying levels of stress from multiple sources, uncovering any correlation between maternal stress and milk's immune specificity can shed further insight on the way that stress and health are intertwined.

EXECUTIVE FUNCTIONING AND SCHOOL CLIMATE

Presenter(s): Shannon Smith (Fort Valley State University)
Social Sciences
Mentor(s): Yijie Wang (College of Social Science)

A positive school climate is largely contingent upon specific learning environment factors such as the quality and character of daily life. This relates to school safety, child-teacher relationship, and extracurricular activities. In return, these school climate factors can be linked to enhanced executive functioning of students' working memory, cognitive flexibility, and inhibition. This construct helps to encourage academic success and the development of life-long skills. There has been limited research done on school climate when it comes to how it affects executive function. This study seeks to expand the research in this area and lend support to why this variable should be given greater observation by education professionals. We use the Adolescent Brain and Cognitive Development (ABCD) data set to conduct a multiple linear regression analysis on SPSS. The ABCD data set will possibly lend support to school climate being a predictor of the development of executive functioning in adolescents. Our explanatory variable of interest is school climate and our main dependent variable is executive functioning. Keywords: school climate, executive functioning, ABCD, regression

DEFICIENT EMPATHY IN SCHOOL SHOOTING PERPETRATORS
Presenter(s): Alexandra Boyce (Chaminade University of Honolulu)
Social Sciences
Mentor(s): Steven Chermak (College of Social Science)

The perspective of school being an unsafe place for children is spreading as school shootings appear to be rising and reported in the media. There were 51 school shootings in 2022 and 23 as of June 2023. The incidents can be categorized as rampage (mass) shootings or targeted shootings. Empathy is the capability to feel and understand others' emotions, often leading to compassionate behavior. The lack of empathy has been linked to capacities for violence and aggression in adolescents, which may be significant in school shooting perpetrators' ability to commit such acts. This study will examine the differences in empathy between rampage shooters and shooters that targeted a specific individual. Open-source data has informed comprehensive case studies of media, individual accounts, reports, and legal documents of each perpetrator. The 40-question EQ (Empathy Quotient) will be used to report an empathy score for each perpetrator, and a phenomenological approach will be used for qualitative analysis of intricacies in each case study. Descriptive statistics, a t-test, and regression analysis will be used for quantitative analysis. Empathy is expected to be more deficient in perpetrators of rampage shootings. Qualitative analysis is expected to expose intricate commonalities between perpetrators that have not yet been standardized in measures or discussed in previous studies. This study would further the understanding of individuals capable of such violence and allow for early primary or secondary prevention of violent behavior manifesting.

IDENTITY THREAT AND ITS REALATION TO CRITICAL RACE THEORY AND ITS IMPACT IN K-12 EDUCATION
Presenter(s): Cedric Evans (Northern Kentucky University)
Social Sciences
Mentor(s): Marisa Smith (College of Communication Arts Sciences)

Critical Race Theory (CRT), a powerful analytical tool, seeks to examine policies and address societal challenges. Originally developed on how the United States legal system maintains inequality and oppression, CRT has faces both influence and misinterpretation. The interpretation of CRT is sometimes mischaracterized which leads to opinions, debates, and controversies around the topic. In recent years, CRT is often the main topic when discussing equality, race, and opportunity in education. Recent trends indicate an attack against critical race theory, resulting in the creation and enactment of anti-CRT laws and regulations. Florida's Governor, Ron DeSantis, recently signed a bill prohibiting the teaching of CRT in the state's public schools. This action has inspired seven other states to consider similar bans. If CRT is to be banned, it is important to highlight that there will be no diversity and inclusion initiatives, teachings on cultural practices, and equity in education. In this abstract, we aim to investigate the impact of critical race theory legislation on its media coverage, focusing on our research question: How much attention does critical race theory receive overtime in local news? How is critical race theory covered overtime? Our research methodology involves utilizing a dictionary to analyze the themes of "threat" and "identity" within the context of CRT bans. Additionally, we will examine data from all 67 counties in Florida to explore local media sentiments and public opinion regarding the banning of CRT. The data that we will collect will allow us to better understand the terminology around CRT and its use in the context of race.

PLUG-IN PROBLEMS: THE FEASIBILITY OF EV CHARGING NETWORKS IN LOW-INCOME COMMUNITIES

Presenter(s): David Burean (Purdue University), Isaac Gabriel (West Chester University), Kendrick Xuan (Georgia Institute of Technology)
Social Sciences
Mentor(s): Mark Wilson (College of Social Science)

The transportation sector is one of the largest contributors to urban air pollution and is responsible for a quarter of all energy-related greenhouse gas (GHG) emissions. Tailpipe emissions from internal combustion engine (ICE) vehicles are especially detrimental to the well-being of low-income and marginalized communities. Transport decarbonization represents a significant factor in mitigating environmental and social equity consequences. With the advent of battery electric vehicles (BEVs) in the mainstream automotive industry, manufacturers have rushed to get products to market under pressure from the federal government (e.g. EV mandates). However, EVs will only be useful if users have sufficient resources to charge them. Although the deployment of EVs is on the rise, there remains significant ambiguity surrounding the charging market; these do not bode well for disadvantaged communities since the market tends to skew toward early adopters and higher wealth brackets. Previous studies have indicated disparities in EV charger placement and discussion on topics of EV equity have become increasingly common, yet there is still a lack of studies consolidating these problems. Research into best practices and stakeholder opinions have illustrated examples of financial incentives and other policy implications which could help or hinder consumer uptake. In this study, we aim to better synthesize these complexities regarding the equitable aspects of EV charging infrastructure with a particular focus on the city of Detroit and hope to bring social equity to the forefront of the discussion while informing future electrification decisions to facilitate EV adoption across all populations.

THE POLITICAL EFFECTS OF EXPOSURE TO EVIDENCE ABOUT RACIAL DISCRIMINATION

Presenter(s): Cesar Gonzalez (Roosevelt University)
Social Sciences
Mentor(s): Daniel Bergan (College of Communication Arts Sciences)

Racial resentment and denial or downplaying of discrimination against African Americans have become increasingly salient in recent elections. However, this belief runs counter to the fact that evidence of discrimination against racial minorities has become easier to communicate and, as a result, more accessible to discourage. According to the literature, 80% of African Americans in America experience discrimination compared to other racial minorities. More so is the fact that this evidence is clear among other racial minorities who agree that African Americans are targets of minorities more than themselves. However, this information does not seem to be echoed in any manner among the majority. Racial resentment and denying racial discrimination became prevalent in former president Trump's campaign in 2016. It also played a role in lurking into former presidents Obama's years of presidency and significantly impacting his image as the first Black president of the United States. Even today, this belief is influencing American politics to this day. For instance, recent aggressive racial policies in Florida, which ultimately bar schools from teaching subjects about race, can be attributed to racial resentment and the denying/downplaying racial discrimination. This study, therefore, seeks to test whether exposure to evidence about discrimination against African Americans influences Whites' political and racial attitudes and beliefs through an online survey. Through a large sample we gathered across America, this sample hopes to change the attitudes and views of the subjects in this study and other perspectives. That being the evidence presented can also influence their opinions on how they perceive political candidates, parties, policies, and even their voting behavior/choice.

MARKETPLACE OF OPPORTUNITY: FARMER'S MARKETS AND THEIR IMPACT ON THE LOCAL COMMUNITY

Presenter(s): Jalexis Williams (Dillard University)
Social Sciences
Mentor(s): Phillip Warsaw (College of Agriculture & Natural Resources)

Farmers' markets are typical gathering places for farmers and ranchers where they directly sell a variety of fresh fruits, vegetables, and other locally grown farm products to consumers. Regardless of the advantages of supplying natural fresh fruit and being easily accessible. There are concerns about Framers Markets' long-term viability and profitability. This study is an offshoot of a wider project to construct a database that farmers markets may use to analyze their "success" and develop improvement ideas. The objective of this study is to investigate and analyze farmers' market managers' and vendors' viewpoints of the economic, social, and environmental implications of markets on their local communities, as well as how those impacts are tracked and communicated to market participants and the local community. Interviews with market managers and local community members at agricultural markets, both those who already buy at their local market and those who do not, were fundamental to our approach. Thematic analysis was utilized to analyze interview data collected from vendors, market managers, consumers, and non-consumers. The research team identified major themes and subthemes within the interviews, allowing for a comprehensive understanding of the challenges and strategies related to food access and racial equity. The findings from this analysis were used to develop comprehensive strategies aimed at improving traffic flow in farmers markets. By examining the intersection of food access, racial equity, and impact tracking, this study offers insights and actionable recommendations for farmers markets to enhance their effectiveness in promoting equitable and accessible local food systems.

CULTURAL VARIATION IN AGE PERCEPTIONS ACROSS CULTURES

Presenter(s): Michelle Vargas (Northeastern Illinois University)
Social Sciences
Mentor(s): William Chopik (College of Social Science)

As people age, they report feeling younger than their actual age and "push off" when they think older adulthood starts. The age dissociation effect suggests people create and maintain psychological distance from stigmatized groups (e.g., older adults). However, such age perceptions and attitudes have mostly been studied in Western cultures (e.g., the United States and Europe). We hypothesize that older adults, across cultures, report feeling younger than their actual age and "push off" when they think older adulthood starts. However, cultures are complex, with different values and perspectives on older adults. Thus, we also expect cultures to differ in the degree to which they report feeling younger and when older adulthood starts. The current study examined age perceptions across the lifespan in 13 countries worldwide (N = 764.328). People were asked how old they felt, what age they wanted to be, how old they hope to live until, and how old other people think they are (in addition to when various life transitions, like older adulthood). As part of our methods, linear regressions were recorded and predicted variations in age perceptions by age, gender, education, and country. Forest plots will show variation across countries. Results are expected to show different responses in age perception across cultures. This study will quantify how attitudes about older adulthood differ across cultures, which might affect how older adults are treated and how people age themselves (e.g., if they engage in preventative health care).

ETHNIC STUDIES IN THE MIDWEST: A CONTENT ANALYSIS OF STATE LEGISLATION

Presenter(s): Nadia Valles (Oklahoma State University)
Social Sciences
Mentor(s): Maria Isabel Ayala (College of Social Science)

In 2020, the United States' population was at its most racially and ethnically diverse. Specifically, the Midwest region of the country saw this rise in almost every county in each state. Yet, the history and contributions of these communities have been lacking in educational curriculum nationwide. In the late 1960s, ethnic studies curriculums began to be developed to address this gap after protests and demands from students who belonged to these minority communities. Recently, there has been a growing rise against ethnic studies through state legislation. While the majority of literature focuses on the importance of ethnic studies and its effects, there is a gap in studies that focus on the legislation that allows this curriculum to happen nationwide. In this study, we analyze all legislation regarding ethnic studies curriculum in the Midwest states since 2016 to identify relationships with their enactment and framing. The data collected will stem from Legiscan datasets and the Comprehensive Center Network for each Midwest state. A grounded theory framework informs our inductive approach to conduct a content analysis to find themes in each piece, along with identifying why legislation was or was not enacted in one state. Governors and legislators' political affiliation impact on a legislation's progress is also identified. Results will lay the foundation for a focus on legislation and policy in regards to ethnic studies research because policies are the starting point in what is being taught in a growing, diverse society.

MORAL HUMILITY IS ASSOCIATED WITH LESSER RELIGIOSITY AND LESSER RELIGIOUS EXCLUSIVISM

Presenter(s): Jolie Kretzschmar (Michigan State University), Shub Ranjan (Michigan State University)
Social Sciences
Mentor(s): Mark Brandt (College of Social Science), Shree Vallabha (College of Social Science)

Moral humility is described as having an understanding that one may be fallible regarding matters of morality, along with an interest in and openness to others' moral views and strengths. Moral humility may be tied to how people think about religion, as people often attribute their moral codes to their religious faiths. We tested if moral humility is associated with (a) having a strong religious faith, and (b) high religious exclusivism. Religious exclusivism is the belief that only one religion is true. In a survey study of US American adults (N = 491), we found that there was a significant negative correlation between a person's level of religiosity and moral humility (r = -.22) and a significant negative correlation between their levels of religious exclusivism and moral humility (r = -.47). Religiosity was positively associated with religious exclusivism (r = .62). These results suggest that higher religiosity may inhibit openness to different moral viewpoints and foster religious exclusivism, but higher moral humility may instead foster acceptance and learning from religious differences.

SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

DOMAIN-SPECIFIC ANTI-CRIPTO-1 ANTIBODIES IDENTIFICATION VIA SPR, NODAL-CRIPTO-1 BINDING BLOCKADE ANALYSIS, AND ANTI-CANCER POTENTIAL

Presenter(s): Nina Aitas (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Alice Chu (College of Natural Science), Erik Martinez Hackert (College of Osteopathic Medicine)

Transforming Growth Factor (TGF)-β family signaling pathways play key roles in various cellular functions in animals, including embryogenesis and stem cell differentiation. Nodal and Cripto-1, integral components of this family, have been implicated in stem cell differentiation and tumorigenesis due to their expression in stem cells and tumor tissues. The overactivation of the TGF-β signaling pathway by Nodal and Cripto is considered a contributing factor to tumor formation, highlighting the potential for inhibiting these molecules as a strategy for cancer therapeutics. The objective of this research project is to identify monoclonal antibodies capable of inhibiting this pathway. Surface Plasmon Resonance (SPR) was employed to measure the association and dissociation rates of Nodal and Cripto, enabling the quantification of their binding affinity. Additionally, various Cripto constructs with different domain combinations were utilized to determine the Nodal binding domain. Monoclonal antibodies specifically binding to individual Cripto-1 domains were isolated and tested for their ability to inhibit Nodal binding to Cripto. Experimental procedures involved immobilizing Cripto constructs on an SPR plate and exposing them to Nodal alone, the antibodies alone, and Nodal in combination with the antibodies. The results demonstrate that the presence of anti-Cripto antibodies reduces the binding affinity of Nodal, effectively blocking the interaction between Nodal and Cripto and neutralizing Cripto's activity. These findings offer promising prospects for future studies focused on reducing Nodal activation of the TGF-β pathway via Cripto, potentially contributing to the prevention of cancer progression.

MOLECULAR CLONING OF PLASMID PIN-M8E2HR-ML39SCFV EXPRESSING HER2 ANTIBODIES

Presenter(s): Quynh Tong (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Masako Harada (College of Engineering)

Human epidermal growth factor receptor (Her2) is a protein that regulates breast cell growth. However, overexpression of Her2 led to abnormal breast cell growth, and thus makes Her2-positive breast cancer more aggressive. As such, any treatment that target this receptor can significantly improve the survival chance of this cancer type. With its high affinity for the Her2 receptor, the ML39 single chain fragment variable (ML39scFv) has been identified as a promising drug carrier. The aim of the project is to create a plasmid construct containing the gene that codes for the ML39scFv using molecular cloning techniques. More specifically, the desirable parts of the plasmid construct pIn-M8e2HR-E626 and(pcS-ML39scFv-G4SPAS-C1C2 were amplified through PCR and ligated using Seamless Ligation Cloning Extract (SLiCE) cloning method. Techniques such as gel electrophoresis, transformation, and colony PCR were used to ensure the successful cloning of the desired construct. Since extracellular vesicles produced by the cell line with this DNA would be able to target the Her2+ receptor accurately, future directions can include using these EVs to deliver therapeutics into Her2-positive breast cancer cells without producing substantial side effects.

EXPLORING THE ROLE OF NUSA ON GLYCINE TANDEM RIBOSWITCH AND CO-TRANSCRIPTIONAL REGULATION

Presenter(s): Alex Reed (University of Michigan)
Science, Technology, Engineering & Mathematics
Mentor(s): Nils Walter (University of Michigan)

Riboswitches are RNA secondary structural motifs typically found in the 5′ untranslated regions of bacterial mRNA transcripts and are crucial for gene regulation in response to dynamic cellular conditions. They contain two structural domains: the aptamer, which binds a specific ligand, and the expression platform, which controls gene expression via structural rearrangements. This study examines how the Bacillus subtilis glycine tandem riboswitch (GTR) regulates transcription of the glycine cleavage system operon and interacts with the transcription factor NusA. The Bacillus subtilis GTR is an ″on″ switch, and upon two glycine molecules binding, its expression platform conformationally shifts to favor downstream gene expression. Additionally, riboswitches can induce pausing at specific sites and recruit transcription factors such as NusA. We have identified three novel transcriptional pause sites within the GTR using radioactive biochemical assays in the presence and absence of both glycine and NusA. We found that pausing half-lives increased at these sites when both NusA and glycine were present. To examine this interaction, we performed single-molecule assays using Total Internal Reflection Fluorescence (TIRF) Microscopy with Cy5-labeled NusA and Cy3-labeled Pause-Elongation Complex (PEC). This revealed a significant increase in Cy5-NusA colocalization to the PEC in the presence of glycine at pause site U130. This suggests that the GTR may recruit NusA to this pause site for co-transcriptional regulation. Future work will investigate NusA interactions at the other two pause sites, as well as how the GTR uses NusA for co-transcriptional regulation.

VISUALIZING THE SGT2-GET4/5 COMPLEX THAT PLAYS A CRITICAL ROLE IN TAIL-ANCHORED PROTEIN BIOGENESIS USING CRYO-ELECTRON MICROSCOPY

Presenter(s): Tuan Kiet Trinh (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Hyojin Kim (College of Natural Science)

Tail-anchored (TAs) proteins belong to a class of functionally diverse integral membrane proteins required for many important cellular processes including electron transport chain, vesicular traffic, and apoptosis. Accurately targeting TAs to appropriate membranes is a critical process, as mislocalized and aggregated TAs could lead to diabetes, cancer, and cardiovascular diseases. The most well-studied ER-targeting pathway for TAs is the yeast "Guided-entry of TA" (GET) pathway, which involves an intricate cascade of protein interactions. The current model suggests that the Get4-Get5 (Get4/5) complex facilitates capture of nascent TA by Sgt2 chaperone and subsequent TA transfer to Get3. The spatial arrangements of Sgt2, Get4/5, and Get3 allows protected transfer of hydrophobic transmembrane domains of TAs, but they are not clearly understood. The study aims to determine the structure of the Sgt2-Get4/5 complex to gain insights into TA targeting mechanisms. We purified, biochemically characterized, and initiated a structural study of the Sgt2-Get4/5 complex using cryo-electron microscopy (cryo-EM). His-tagged Saccharomyces cerevisiae Sgt2 and Get4/5 were each successfully overexpressed in Escherichia coli using a T7 promoter expression system and purified using Ni-NTA affinity chromatography. Incubation of purified Sgt2 and Get4/5 led to a stable assembly of the Sgt2-Get4/5 complex. By size-exclusion chromatography and multi-angle light scattering, we confirmed that Sgt2-Get4/5 preparation was relatively homogeneous, with well-established oligomeric states. That is, Sgt2 was as a 66-kDa homodimer, and Get4/5 as a 140-kDa heterotetramer. Initial cryo-EM analysis suggested Sgt2-Get4/5 exhibits conformational heterogeneity, but chemically crosslinking the complex reduced structural heterogeneity. The initial 3D models signified an overall fibrous architecture of the Sgt2-Get4/5 complex but further optimization is required to achieve a higher resolution structure. This study shed more light on the interaction between Sgt2 and Get4/5 and potentially guide the development of novel therapeutic agents to treat diseases caused by defects in TA biogenesis.

SINGLE CELL DATA ANALYSIS

Presenter(s): Zhaoying Wang (University of Michigan - Ann Arbor)
Science, Technology, Engineering & Mathematics
Mentor(s): Yuying Xie (College of Natural Science)

The advent of ATAC-seq has revolutionized the understanding of chromatin accessibility, offering insights into gene regulation and cellular processes. However, analyzing ATAC-seq data presents many challenges, particularly in the normalization of high-dimensional, sparse datasets. Existing methods often assume dense or continuous data, failing to account for the presence of numerous zero counts and extreme skewness. Though some popular normalization methods such as TF-IDF (Term frequency-inverse document frequency) address sparsity, they may compromise the biological meaning of the original data, hindering interpretation. Hence, our research aims to shed light on the critical role of normalization in accurately deciphering chromatin accessibility patterns from ATAC-seq data. We investigate the implications of normalization on downstream analyses and highlight the significance of a biologically-meaningful normalization strategy for robust and interpretable results. In this conference presentation, we will delve into a comprehensive exploration of different normalization methods for ATAC-seq data and possibly introduce a novel approach that addresses the limitations of current methodologies.

CHARACTERIZING EFFECTOR-METAEFFECTOR PAIRS IN LEGIONELLA PNEUMOPHILA

Presenter(s): Ethan Wolfe (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Janani Ravi (College of Natural Science)

Bacterial effector proteins are virulence factors critical for parasitism in eukaryotic hosts. Metaeffectors - effectors that bind to and regulate the activity of cognate effectors - were recently discovered exclusively in Legionella pneumophila (Lp). Lp, which has co-evolved extensively with its natural host amoebae, is the etiological agent of Legionnaires' disease in humans. Upon infection, Lp injects ~330 effector proteins into its host cell through a Dot/Icm type IV secretion system (T4SS). In this project, we aim to functionally characterize 26 understudied effector-metaeffector (EM) pairs critical to bacterial virulence through the lens of evolution. We first characterize these proteins using their sequence-structural features, such as domain architectures, and delineate their evolution using MolEvolvR (doi.org/10.1101/2022.02.18.461833; jravilab.org/molevolvr). We also quantify the coevolution of all EM pairs across 102 Lp genomes to discover lone effectors (occurring without cognate metaeffectors) that could be cytotoxic to Lp itself. The domain/motif building blocks constituting these EM pairs will populate the first comprehensive EM feature repository that will enable the discovery of novel EM pairs in Lp and other understudied, emerging pathogens.

INVESTIGATION INTO THE EFFECT OF COLUMN SLENDERNESS ON 3D PRINTED RE-ENTRANT HONEYCOMBS

Presenter(s): Zachary Ahmed (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Weiyi Lu (College of Engineering)

Auxetic structures have shown advantageous mechanical properties that benefit multiple engineering fields such as auto and aerospace industries. The introduction of hierarchical spatial reconfiguration inspired by nature has the potential to further improve the mechanical performance. Recent developments in additive manufacturing have allowed the prototyping and investigation of complex hierarchical structures. This study focuses on the effect of column slenderness on pre- and post- buckling loading behaviors of one type of auxetic structure, the re-entrant honeycomb. From literature, it has been demonstrated that the column slenderness is one of the dominant structural parameters to engineer the mechanical properties of the resulted structures. Both regular re-entrant honeycombs(R-ReH) and hierarchical re-entrant honeycombs (H-ReH) with various column slenderness values have been 3D printed and investigated. Digital image correlation (DIC) technique has been configured to reveal the strain field evolution in structural members and elucidate the deformation mechanisms of the overall structures. Our experimental results validate the existing Gibson-Ashby model. With constant density, lower values of column slenderness ratio lead to improved mechanical performance by optimizing the spatial reconfiguration of the material. This finding will guide future engineering of lightweight but strong structures.

DEEP LEARNING BASED PIPELINE TO BENCHMARK THE PREPROCESSING OF SINGLE CELL DATA

Presenter(s): Divyalakshmi Varadha Rajan Prem Sudha (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Yuying Xie (College of Natural Science)

Several advances in the domain of single-cell transcriptomics have paved the pathway for the discovery of new cell types and a more comprehensive understanding of human diseases. However, one of the central challenges to

be confronted with when handling scRNA-seq data is its significant noisy nature stemming from several technical factors, such as amplification bias, cell cycle effects, library size differences, and notably, a low RNA capture rate. Therefore, preprocessing of the training and testing datasets is a crucial first step in the analysis of scRNA-seq data. Not to mention that different downstream tasks require specific types of preprocessing methods, namely, Quality Control of datasets, Normalization of count matrices, Selection of Highly Variable genes, and Dimensionality Reduction. To ensure a seamless and resource-efficient experience for researchers while utilizing computational models to perform experiments on scRNA-seq data, we propose an extension to our current Python toolkit - DANCE: A Deep Learning Library and Benchmark Platform for Single-Cell Analysis - aimed at supporting deep learning models for analyzing single-cell gene expression at scale. This pipeline, currently in its developmental stage, serves as a culmination of the most widely utilized and crucial preprocessing functions/methods that would aid researchers in selecting the optimum combination of the aforementioned preprocessing functions to suit their computational models. This would be achieved by numerous iterations of the collected benchmark datasets and different available preprocessing methods that would analyze the performance of the user's single-cell analysis model.

ASSOCIATIONS OF REMOTE HEALTH CARE WITH BETTER OR SIMILAR HEALTH OUTCOMES COMPARED TO IN-PERSON VISITS AMONG CHILDREN AND ADOLESCENTS LIVING WITH DISABILITIES

Presenter(s): Saman Amin (University of Michigan - Flint)
Science, Technology, Engineering & Mathematics
Mentor(s): Gergana Kodjebacheva (University of Michigan Flint)

Telehealth includes virtual appointments, phone visits, and e-mail/text exchanges. Telehealth use greatly increased during the COVID-19 pandemic. Research on telehealth use among children living with disabilities during the COVID-19 pandemic is limited. This systematic review analyzed the influence of telehealth use on health and quality of care among children living with disabilities during the COVID-19 pandemic. The databases PubMed, ScienceDirect, PsycINFO, and CINAHL were searched, with 12 articles meeting the inclusion criteria. Telehealth use had a positive influence on both physical and mental health among children living with disabilities in clinical and at-home settings. Specifically, telehealth services improved the quality of life as measured by greater family function, shorter hospital stays, and decreased anxiety for patients. Across care types, telehealth allowed children in rural areas to receive the necessary medical, behavioral, or psychological care they needed that would otherwise have been inaccessible. This also allowed medical providers to assess home environments to ensure that children living with disabilities could meet their health goals. Telehealth may have positive influences not only on the convenience factors but also on the health and quality of care among children living with disabilities. Future research may explore the influence of longitudinal use of telehealth beyond the COVID-19 pandemic on the health of children living with disabilities.

MENSTRUAL PHASES ARE NOT ASSOCIATED WITH FLUCTUATIONS IN OCD SYMPTOMS

Presenter(s): Nupur Huria (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Grace Anderson (College of Social Science), Jason Moser (College of Social Science)

The menstrual cycle is characterized by changes in ovarian hormones estrogen and progesterone, which influence fluctuations in psychological and physiological symptoms. Although research surrounding the relationship between menstrual cycle phases and anxiety symptoms is becoming increasingly prevalent, there is less investigation regarding obsessive-compulsive disorder (OCD). OCD is an anxiety disorder consisting of patterns of uncontrollable, time-consuming obsessions and behaviors aiming to decrease anxiety. The drop in ovarian hormones during the pre-menstrual phase of the menstrual cycle often correlates with prominent mood changes, including anxiety, difficulty concentrating, irritability, and feeling easily overwhelmed, which align with OCD characteristics. I hypothesized that the pre-menstrual phase would reflect an amplification of OCD symptoms. This study measured OCD symptoms in naturally-cycling menstruating participants ($n = 124$) across the menstrual cycle through the 18-item Obsessional Compulsive Inventory - Revised (OCI-R). The OCI-R is a self-report questionnaire measuring OCD symptoms, with higher scores reflecting a higher likelihood of an OCD diagnosis. Multilevel modeling was completed to compare the total number of OCD symptoms present at 5 points in the menstrual cycle. There was no significant change in OCD symptoms across the menstrual cycle phases ($F = 1.10$). However, the total average OCI-R score of 14.80 ($SD = 10.67$) indicates symptoms consistent with clinical levels of OCD symptoms. Interestingly, the ovulation phase had the highest average score (16.44; $SD = 13.06$). Future work should investigate the relationship between OCD symptoms and physiological indices of anxiety (like Error-Related Negativity or hormone levels) across the menstrual cycle, especially during ovulation.

EFFECTS OF SHORT RANGE ORDERING ON THE MECHANICAL PROPERTIES OF HFNBTATIZR HIGH-ENTROPY ALLOY

Presenter(s): Johnathan Kowalski (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Adib Samin (Air Force Institute of Technology)

One of the largest areas of research in the aerospace and defense industry is studying high-entropy alloys (HEAs) in the fabrication of various aircraft components. Due to enduring improvements in aerospace technologies and the increasingly harsh conditions experienced by modern aircraft, presently-adopted Ni-based alloys are operating at their thermal and mechanical limits. Initial studies show, however, that HEAs (metal alloys consisting of five or more elements) may offer improved thermal stability and mechanical performance, as well as better oxidation resistance, which prevents corrosion. If shown to be a viable replacement, HEAs could enable desired advancements in many aerospace technologies, such as more capable aircraft. In this work, the effects of chemical short-range ordering on the mechanical properties of the HEA HfNbTaTiZr were studied using atomistic simulation. Both stress-strain response, phase transformations, and dislocation mobility analyses were performed. Monte Carlo swaps were performed to generate alloys with varying degrees of short-range ordering.

COMPOSITIONAL LEARNING: ARE LANGUAGE MODELS LIKE CHATGPT ABLE TO DO IT?

Presenter(s): Sania Sinha (Michigan State University)
Science, Technology, Engineering & Mathematics
Mentor(s): Parisa Kordjamshidi (College of Engineering)

Mastering the ability to combine basic concepts and construct more intricate ones is crucial for human cognition, especially when it comes to comprehending human language and visual perception. Despite its integral role in intelligence, there is a lack of a formal definition that clearly elucidates the various aspects of compositionality. This research aims to comprehensively examine existing literature from both the AI and cognitive studies perspectives to discuss, formalize, and analyze the definitions, tasks, evaluation benchmarks, and datasets associated with compositionality. We delve into earlier as well as more recent studies on large language models to gain a deeper understanding of the cutting-edge compositional capabilities exhibited by the latest generation of AI models. Our objective is to identify abstract concepts of compositionality in cognitive and linguistic studies and establish connections between these concepts and the computational challenges faced by language and vision models in compositional reasoning. We highlight the challenges that computational models encounter in acquiring compositional learning and the obstacles in conducting thorough evaluations, ultimately pinpointing important directions for future research.

SHE9 DELETION MUTANTS ON A NON-FERMENTABLE CARBON SOURCE REVEAL A ROLE IN SACCHAROMYCES CEREVISIAE MITOCHONDRIAL PHOSPHOLIPID MAINTENANCE

Presenter(s): Kieli Philips (University of Detroit Mercy)
Science, Technology, Engineering & Mathematics

Mentor(s): Nicole Najor (University of Detroit Mercy)

In the inner membrane of the mitochondria, saccharomyces cerevisiae protein (SHE9) is thought to be involved with fission in the inner membrane and is known to form a homo-oligomeric complex. However, the overall molecular function of this protein is unknown. In this experiment, SHE9 was given multiple treatments to determine in what way it will grow the best. The treatments include two types of media (YPD and YPG) were used, varying temperatures, and UV treatment. A report of she9Δ showed growth decreased due to the diauxic shift switch from high glucose media to a non-fermentable carbon source (glycerol). The results of the experiment show sheΔ cells do not grow as well on YPG media compared to YPD. However, the growth on YPD zapped with UV does not grow as well as untreated YPD. To conclude, the molecular function of She9 is still a mystery, but figuring out where she9 is hindered can help lead to understanding its function.

SOCIAL SCIENCES, HUMANITIES & ARTS

LA LAÏCITÉ (SECULARITY) IN FRENCH SCHOOLS

Presenter(s): Marissa Panzarella (Eastern Michigan University)
Social Sciences, Humanities & Arts
Mentor(s): Audrey Viguier (Eastern Michigan University)

La laïcité, otherwise known as the separation of church and state, has been and is currently a prominent issue in French schools. Instated in 1905, the law set a precedent for religion in the country, and in schools. Students and teachers may not, under any circumstances, show any sort of religious affiliation. Despite the law (1905) prohibiting the wearing of religious clothing or attire in schools, some political parties denounce using this law to perpetuate religious discrimination and post-colonial racism as Islam is becoming a more prominent religion. The question is how far can the French implement la laïcité as a pillar of their society while society is evolving to be more diverse?

AUTHENTIC CULTURAL EXCHANGE IN STUDY ABROAD PROGRAMS: A CASE IN JAIPUR, INDIA

Presenter(s): Amina Darabie (Michigan State University)
Social Sciences, Humanities & Arts
Mentor(s): Eddie Boucher (College of Social Science)

In a pilot study abroad program to Jaipur, India, Michigan State University undergraduates team up with students from the Indian Institute of Craft and Design to produce a short documentary film on the entanglements of handicraft and social justice issues. The curriculum challenges the tourism model of education abroad to integrate authentic cultural exchange practices to both American and Indian university students alike. In this preliminary stage of research, broad findings suggest that even with extensive knowledge of the local Jaipur climate supported by strong relationships with faculty and cultural insiders, challenges still present themselves in the program. These barriers manifest through student motivations for academic success, the social paradigms between students of both Indian and American cultures, and the administrative motivations for supporting the program due to its inherently diverse, equitable, and inclusive principles. This research is just the beginning of a longitudinal study to further investigate how we can better integrate cultural student exchange abroad.

ASSOCIATIONS BETWEEN DISORDERED EATING AND TYPES OF ANXIETY IN ADOLESCENT GIRLS

Presenter(s): Maria Clara Araujo (Michigan State University)
Social Sciences, Humanities & Arts
Mentor(s): Carolina Anaya (College of Social Science), Kelly Klump (College of Social Science)
Disordered eating has been shown to co-occur with anxiety symptoms; however, very few studies have examined how different types of anxiety may be associated with disordered eating. Anxiety is composed of subtypes (e.g., generalized anxiety, panic disorder, social anxiety, etc.) that may relate to disordered eating differently. For example, one may overeat to cope with feelings of nervousness while another person may be more likely to restrict if their stomach is upset due to physical symptoms of anxiety. Previous studies also conclude that more advanced pubertal status in female adolescents is associated with an increased risk for internalizing symptoms, including anxiety and disordered eating. The current study examined the relationship between the types of anxiety and disordered eating, and whether these associations differ across puberty. Participants from the MSU Twin Registry database included 312 female adolescents ages 10-17 years old ($M = 12.61$, $SD = 1.48$). Anxiety types were examined with the Multidimensional Anxiety Scale for Children (MASC) using the subscales (social anxiety, perfectionism, anxious coping, somatic symptoms, and total anxiety score). Disordered eating was measured using the Minnesota Eating Behavior Survey (MEBS) total score which examined binge eating, body dissatisfaction, weight preoccupation, and compensatory behavior. Puberty was measured using self-report on the Pubertal Developmental Scale. Of the five anxiety subscales considered, three (social anxiety, somatic symptom, and total anxiety score) had a significant positive relationship (all p's<.001) with disordered eating. Adolescent girls' demonstration of anxiety symptoms was associated with higher levels of disordered eating ($ß = 0.37$; $p<.001$).

REWARD RESPONSIVENESS BUT NOT OVERALL BEHAVIORAL ACTIVATION IS PREDICTIVE OF REWP AMPLITUDE IN A YOUTH SAMPLE

Presenter(s): Vikshita Pallerla (Michigan State University)
Social Sciences, Humanities & Arts
Mentor(s): Jason Moser (College of Social Science)

Reward responsiveness (RR) refers to a hedonic response to reward anticipation and receiving rewards, which can be recorded through brain activity and behavioral responses. Changes in RR can impact mood disorders like depression. Youth with anhedonia, a common symptom of depression, do not elicit positive responses to previously rewarding stimuli. Thus, it is critical to understand individual differences in activation and RR. We addressed this by investigating the relationship between the Behavioral Activation System (BAS) questionnaire and Reward Positivity (RewP) amplitude. RewP is measured by electroencephalogram voltage change 225-325ms after positive feedback, reflecting RR. Previous research has explored the relationship between RewP and BAS across several developmental periods, but none have investigated adolescents during the onset of puberty. Therefore, we explored whether overall BAS and its three subscales (Fun Seeking, Drive, and Reward Response) had significant relations to RewP in youth ages 11-13 (N = 15) from a sample with familial transmission of substance use disorders. We hypothesized that youth with more BAS activation would display a larger RewP in response to reward, with the drive, reward, and fun-seeking subscales following a similar trend. Our hypothesis was partially supported as the Reward Responsiveness BAS subscale was predictive of RewP amplitude. However, our findings suggest that RewP amplitude and overall BAS are not associated in this sample ($p>0.05$). This could be a result of previous research having samples spanning multiple developmental stages, whereas our sample focuses on the onset of puberty.

Research Mentors

Many thanks to the dedicated research mentors who guided and supported the undergraduate research and creative activities presented throughout this program book.

Presenter Index

Presenters are listed alphabetically by last name.

URCA.MSU.EDU

MICHIGAN STATE
UNIVERSITY