SUMMER UNDERGRADUATE RESEARCH POSTER SESSION

ABSTRACT BOOK

Wednesday, July 31, 2024

Interdisciplinary Life Sciences Building Lobby

Morning Session

10:00 AM – 12:00 PM

Afternoon Session

2:00 PM – 4:00 PM

LAUNCH
UNDERGRADUATE RESEARCH

Undergraduate Research Summer Poster Session

ABSTRACT BOOK

July 31, 2024

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MORNING SESSION

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1. Investigating Learning Engagement with Visual Aids in AI Generated Construction Safety Talks

Claire Rawlins (Penn State)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: Mo Hu, Xi Wang, Zhenyu Zhang, and Jia Xu

Lack of effective communication between supervisors and construction workers causes hundreds of injuries and fatalities annually in the U.S. A possible solution for this problem is through Large Language Models (LLMs). An LLM is a type of machine learning that, when given an input, develops outputs trained based on large amounts of information, such as Chat GPT. An LLM-based code, developed earlier, takes construction safety content used by the foreman to relay concerns to the laborers through scenario-based stories. The project's overall objective is to analyze if an LLM-based code, improved by visual stimulation and industry feedback, makes more engaging safety training material. The project uses Google Slides API to generate the learning material's visual component automatically. Its main goal is to organize the information engagingly. To facilitate the design of the LLM-based codes, construction industry members surveyed a manual poster to measure attentiveness, engagement, and overall comfort while learning through the manual poster. Then, we will edit the feedback to reflect the industry feedback. The poster revision will be a template for further LLM-based coding that combines Google Slides API and GPT API. The expected outcome is that the LLM-based codes can automatically generate safety training posters that are effective in enhancing attentiveness, engagement, and learning outcomes compared to traditional toolbox talks. AI-powered safety training with automatic training material generation may contribute to safer construction sites.

2. Enhancing Worker Health and Safety: The Impact of Exoskeletons on Muscle Fatigue Under Time Pressures

Kyra Martindale (Penn State)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisor: Chuma Nnaji

Fatigue significantly undermines productivity, diminishes work quality, and increases the risk of accidents in the construction industry. This challenge primarily arises from physically demanding tasks, such as manual labor and prolonged periods of heavy lifting. Additionally, fatigue is a key factor contributing to work-related musculoskeletal disorders (WMSDs), which rank among the top causes of non-fatal occupational injuries. To address the effects of WMSDs and physical fatigue, the potential of various task-specific exoskeletons has been investigated. Prior research suggests that exoskeletons can boost productivity by reducing muscle activation and fatigue, leading practitioners to expect enhanced performance from workers. However, the impact of exoskeletons on workers' health when additional productivity is expected has not been thoroughly investigated. This study aimed to assess the impact of exoskeletons on muscle fatigue under varying time pressures. Participants performed drywall installation tasks at 90% and 80% of their baseline time, with and without the use of an exoskeleton, to evaluate changes in productivity and muscle fatigue. Data was collected using electromyography and a muscle discomfort scale. Amplitude analysis indicated that high muscle activation persists in scenarios

with 80%-time pressure, both with and without exoskeleton support, compared to other scenarios. This study highlights the need to promote exoskeletons as devices to maintain workers' health rather than merely as tools to increase productivity.

3. Transforming Construction Safety Training with Interactive Generative AI

Giselle Morocho Aguilar (Stony Brook University)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: Zhenyu Zhang, Xi Wang

The increasing occurrence of construction-related fatalities necessitates an urgent improvement of safety training methods. Traditional techniques often fall short in engaging workers and achieving desired learning outcomes. While adult learning strategies—such as interactive, realistic scenarios tailored to trainees' needs—have proven effective, creating such innovative materials can be time-consuming and require expertise in curriculum development. This study explores the integration of Large Language Models (LLMs) to automate the development of toolbox talks, a fundamental element of safety training programs on every construction site. Grounded in Andragogy adult learning theory , this research utilizes LLM to generate interactive scenarios based on real incidents happening on job sites similar to those of the trainees. This scenario forms the foundation of our toolbox talks and provides realistic contexts for presenting safety tips and end-of-talk quizzes. To evaluate the LLM-generated toolbox talks, this study used a mixed-methods approach including post-intervention surveys, focus group discussions, and observations in a real toolbox talk setting (one superintendent and four frontline workers). Both qualitative and quantitative findings align, indicating that LLM-generated materials were perceived as more relevant, accurate, comprehensible, and interactive than traditional toolbox talks experienced in the past. The increase in interactivity allowed workers to immerse themselves deeper into their learning. This study highlights the potential for enhancing both the efficiency and effectiveness of construction safety training using LLM and opening avenues for further research and practical applications in the field.

4. Insole-Based Fall Prediction Performing Construction Tasks

Jonathan Herrera (Texas A&M University)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: Chuma Nnaji, Muhammad Khan

In the construction industry, predicting and mitigating fall risks is crucial to ensuring worker safety. This research presents the development and application of an insole sensor database aimed at predicting fall risks while performing construction tasks. The study involved the collection of data from insole sensors to monitor various parameters associated with foot movement and pressure distribution. Utilizing this data, we implemented Support Vector Machine (SVM) and Decision Tree algorithms to classify unsafe and safe behaviors. Our approach focused on identifying 16 different types of unsafe behavior that are commonly encountered in construction settings. The machine learning models were trained and tested on the collected data, resulting in an impressive accuracy of 94% for both the SVM and Decision Tree

classifiers. These findings demonstrate the potential of insole sensor technology combined with advanced classification algorithms to effectively predict and classify fall risks in real-time. This research contributes to the existing body of knowledge by providing a reliable and practical solution for fall risk prediction, ultimately enhancing safety protocols in the construction industry. Future work will explore the integration of these predictive models into wearable devices for continuous monitoring and timely interventions to prevent fall accidents.

5. Muri and its Effect on Construction Safety

Jose Torres (Texas A&M University)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: David Jeong, Suryeon Kim

Muri(overburden), and its effect on safety, is often overlooked in the construction industry. There is a need to create serious games and simulations that educate construction workers on the importance of removing Muri in order to create safer and more sustainable construction job sites. This research aims to develop a serious game, designed to teach the concept of Muri to enhance the knowledge of construction personnel about safety in the industry. The current game I have developed involves solving a puzzle, however there are certain conditions that must be kept while the puzzle is being solved. This game will then be tested for its effectiveness at teaching the concept of safety. Results from this work will help in creating a safer construction industry, as workers are more educated on the concept of Muri.

6. Remote Teleoperation in Lunar Construction and Time Delay

Jaden Hamilton (University of Texas at Austin)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: Youngjib Ham, Miran Seo

The use of remote teleoperation is implemented on Earth through military controls, cross-nation surgery, and construction techniques. This research aims to investigate the feasibility of remote teleoperation through Lunar construction with an adept focus on time delay (lag). An analysis derived from the distance between terranean and lunar surfaces provided a basis of time delay in which this study created its control delays: no delay, 3.5 second delay [& with visual assistance], and 2.5-4.5 second varying delay [& with visual assistance]. In a controlled and simulated environment, subjects P1-P7 were tasked with grabbing, moving, and dropping two of four rocks with an excavator into a target truck under each of these conditions. Their results were measured through the in-depth NASA Task Load Index survey, or NASA-TLX, as well as a system usability scale.

7. Systematic Analysis of Building Envelope Properties for Energy Efficiency Considering Diverse Climates

Karolina Kaczor (Western New England University)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: Ashrant Aryal, Yilin Cai

Energy retrofitting of buildings is crucial for energy efficiency and accounts for nearly 40% of energy-related consumption in the United States, leading to increased emissions. Among those buildings, 75% of energy consumption comes from buildings built in the year 2000 or earlier, emphasizing the need for energy retrofitting in older buildings. The goal is to conduct a comprehensive analysis to identify the correlation between building envelope properties and energy performance under different climates. A systematic analysis of these properties will allow for a better understanding of which energy retrofitting measures to take depending on climate zones to save the most energy. The building envelope is critical for energy savings, as it serves as the barrier that prevents energy loss while also providing overall structural integrity to preserve its durability. Envelope inefficiencies result in increased reliance on heating and cooling systems, thereby producing unnecessary emissions and increased energy consumption. This research focuses on passive methods to reduce energy use, emphasizing conservation rather than increased production. The study utilizes the open-source Building Energy Modeling (BEM) software EnergyPlus to conduct testing on important building envelope properties related to energy. Current properties are still under consideration but anticipated to show that uncommonly considered parameters contribute to energy savings. This research will also contribute to building energy modeling and decision-making on building energy retrofitting.

8. Exploring Online Social Collaborative Spaces as Alternatives to Physical Site Visits in AEC Education: Development, Evaluation, and Insights

Kayla Johnson (Texas A&M University) and Patrick Voight (Auburn University)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisor: Gilles Albeaino

Site visits are crucial in Architecture, Engineering, and Construction (AEC) education, offering students hands-on experience and practical insights. However, physical visits often encounter challenges such as logistical constraints, safety concerns, and limited accessibility. Consequently, there's a growing trend towards virtual learning environments, providing flexible and accessible alternatives to traditional methods. This study discusses the development and evaluation of an Online Social Collaborative Space (OSCS) as a substitute for real-world site visits. The workflow for OSCS development is outlined, followed by a pilot study involving AEC students to assess the OSCS. The evaluation focused on quantitative measures of workload, ease of use, and sense of presence within the environment. The findings aim to enhance conventional AEC education practices by offering insights into the feasibility and effectiveness of immersive social collaborative spaces as substitutes for physical site visits.

9. Beam Optimization for Throughput Measurements of the Gas Operated Large Ion-bunch Atomic Trap for He6-CRES

Owen Rollins (William and Mary)
Cyclotron Institute REU
Research Advisor: Dan Melconian

The He6-CRES experiment aims to accurately measure beta decay spectra by observing the cyclotron frequency of emitted beta particles as they Larmor precess within a strong magnetic field. Ultimately, the experiment hopes to measure the Fierz parameter, a standard model variable, to within 0.1%. The Gas Operated Large Ion-bunch Atomic Trap for He6-CRES (GOLIATH) radiofrequency quadrupole (RFQ), a planned upgrade to the experiment, enables confining a continuous beam of ions into bunches during measurement, allowing for a wider range of isotopes to be used in CRES experiments. Furthermore, GOLIATH was designed to surpass expected limitations of bunch size caused by the space-charge effect by up to a factor of 50; maximizing the throughput of this trap is therefore essential to reaching our desired precision. Testing the GOLIATH RFQ requires a precisely aligned, well calibrated ion beam to gauge transmission through the device. Performing a non-destructive current measurement near the beginning of the beamline enables calculation of injected beam strength. Pairing this measurement with another rate measurement allows us to normalize our throughput measurements to source activity. Using a microchannel plate detector, we can also image the beam with single particle detection, aiding in calibrating beam steerers and lenses and providing transmission information at low intensities.

10. Data Refining: ROSbag Filtration (RBF) Node for Optimizing Autonomous Vehicle Sensor Data

Kaity Asch (Houston Community College)
Independent Research Project
Research Advisors: Jason O'Kane, Aaron Kingery

Autonomous vehicles (AVs) generate vast amounts of sensor data essential for navigation and decision-making. However, ROSbag data files often contain noise and irrelevant information, complicating analysis. This research introduces the ROSbag Filtration (RBF) Node, a tool designed to enhance data quality by filtering out extraneous and low-fidelity data points. The RBF Node refines data from key sensors—odometry, camera images, and IMU readings—using vehicle motion detection and signal-to-noise ratio (SNR) metrics to retain only high-quality information. Essential topics are hardcoded to ensure dataset integrity and avoid user errors. Testing on diverse ROSbag files demonstrates the RBF Node's effectiveness in improving data quality and reducing file size, facilitating efficient processing and enhancing machine learning model accuracy in AV systems. The RBF Node includes a graphical user interface (GUI) for visualizing processed data, further enhancing its utility and accessibility. As an open-source tool, the RBF Node provides the AV research community with a robust solution for optimizing sensor data, supporting advancements in autonomous vehicle technology and contributing to safer, more reliable autonomous driving systems.

11. Emergence of Cooperation in the Traveler's Dilemma

Kyeongseo Choi (Texas A&M University)
Independent Research Project
Research Advisor: Alexander Roitershtein

Social dilemmas are game theoretic models in which group welfare is conflicting with individual rational choices. Many real-world human interactions display these characteristics. The resulting equilibrium behavior of the group is often described as a paradox because the conflict promotes mistrust and inhibits cooperation, plummeting individual welfare of group members. For instance, in a so-called Traveler's Dilemma, if players cooperated, they would achieve better outcomes both individually and collectively. The paradox is rooted in the misalignment of game theoretic reasoning based on the concept of Nash equilibrium and welfare optimization. Rather than maximizing the well-being of group members, the former is seeking to create a situation where no individual is better-off by unilaterally changing their behavior. To resolve the paradox, game theoretic models often incorporate elements promoting cooperation such as reciprocity, altruism, reputation, and diversity of individual preferences within the population. This study explores the evolution of cooperation in stochastic games, conditioning strategies on environmental states and investigating how information availability affects cooperation. The availability of information turns out to significantly impact cooperation; in some instances, precise information about the environment fosters cooperation, while in others, the absence of information is more beneficial. We systematically analyze stochastic games to determine conditions under which information enhances or detracts from cooperation, highlighting the critical interplay between emotional reputation and environmental information. Additionally, we study how collaboration within the society is influenced by emotions and reputation of its members.

12. Autonomous Robotic System for Pavement Inspection Through Integration with Geographic Information System

Elliot Salas (Syracuse University)
Construction Science REU "Smart & Sustainable Construction in the Digital Era"
Research Advisors: Xi Wang, Jia Xu

The integration of robotics in the construction industry has been demonstrated as a promising way to enhance productivity, address labor shortages, and reduce the physical burden on workers. This research aims to automate pavement inspection with a mobile robot system capable of autonomously mapping the environment and collecting comprehensive inspection data. The system employs Simultaneous Localization and Mapping (SLAM) algorithms for real-time mapping and localization, while ROS facilitates seamless integration of various robotic components and sensors, including LiDAR, GPS, depth camera, and IMU. Additionally, the system is integrated with Geographic Information System (GIS) for geo-referenced urban information. This integration allows geospatial data contextualization data, creating a cyclical process where collected information guides future inspections, enables precise mapping of concerns, directs the robot to specific areas, and facilitates comprehensive spatial and temporal analysis of the construction site. The autonomous capabilities of these robots are anticipated

to play a pivotal role in inspection tasks within the construction industry, signifying a substantial stride toward the ultimate goal of transitioning workers into robot supervisors.

13. Determining the Distribution of Astatine-211 in a Column of Amberchrome (TM) Ketone Resin Through Dosimetry Analysis of Radiochromic Film

Gary Geier (University of West Florida)
Cyclotron Institute REU
Research Advisors: Sherry Yennello, Mike Youngs

Astatine-211 (At-211), has been of great interest recently for radiological treatments, where alpha treatment is necessitated. This can include treatment for leukemia, glioma, ovarian cancer, and lung cancer. Previous research into the production of At-211 yielded promising concentration of At-211 in Amberchrome™ ketone resin nested in a column enclosure. Previous production of At-211 has only identified the total activity within the column but not the distribution of how the astatine is distributed within that column. In order to study this, GAFchromic films were exposed to a column of At-211. These films were then analyzed using software designed to examine dosimetry using these films and compared to simulated results. Results comparing the dose on the films to simulated predictions will be shown.

14. Real-Time Monitoring of Astatine-211 Production by Alpha Particle Bombardment

Trevor DeMille (University of Utah)
Cyclotron Institute REU
Research Advisors: Gabriel Tabacaru, Lauren McIntosh

Iterative calculations were utilized to achieve real-time monitoring of astatine-211 (At-211) production from 28.8 MeV alpha particles hitting bismuth-209 causing the Bi-209(a,2n)At-211 nuclear reaction using target current readings. Real-time measurements are crucial for determining optimal beam irradiation times, especially given At-211's short half-life of 7.2 hours and its sensitivity to beam intensity fluctuations. This helps beam operators better understand when beam irradiation on the target is completed. The current was monitored on the aluminum-backed bismuth target every 5 seconds during irradiation using a picoammeter. This current correlates directly with the beam flux calibrated using previous Faraday cup measurements. A Python script incorporating: radioisotope production equations, cross-section data from NNDC and SRIM, bismuth properties, and real-time current data provides estimates of At-211 activity and predictive capabilities. The script generates an updating graph of activity over time, a value display of estimated present At-211 activity, and a predictability function of bombardment durations to achieve desired activity levels, providing valuable feedback for beam operators. Further work will better calibrate the At-211 production monitoring, this system will have a relative error goal of less than 20% in target activity when used for full-length bombardment when compared to “End-of-Bombardment” values collected from a dose calibrator.

15. Toward Commissioning of the Full TexNeut Array

Destynne Oliver (University of Texas at El Paso)
Cyclotron Institute REU
Research Advisor: Grigory Rogachev

The detection of fast neutrons plays a critical role in various applications in nuclear physics, from exploring the nuclear structure of exotic nuclei to determining cross-sections of astrophysically-important reactions. An efficient neutron detector system is essential for these studies. TexNeut is a novel neutron detector developed at Texas A&M University, that achieves high time and spatial resolution while maintaining compact dimensions and relatively high efficiency. It employs pseudo-bars composed of six optically-coupled p-terphenyl crystals, forming segmented bars with excellent neutron-gamma pulse shape discrimination (PSD) with Hamamatsu photomultiplier tubes (PMTs) on either end of each pseudo-bar. We describe progress toward commissioning of this detector system.

16. Developing a Pepper-Pot System for Beam Diagnostics in TAMUTRAP

Chris Dietert (University of Texas at El Paso)
Cyclotron Institute REU
Research Advisor: Dan Melconian

A pepper-pot is a beam diagnostic tool used to measure the emittance of a particle beam, which is a conserved quantity that is a measure of position and momentum of the beam. Emittance is critical for systems like mass separators that have finite acceptances; if the emittance exceeds these limits, efficiency plummets. Our project focuses on developing a pepper-pot system using a microchannel plate (MCP) detector, a mask, and a custom mounting frame to measure the emittance of lithium particles in the TAMUTRAP facility.

The MCP detector, positioned behind a mask with an array of holes (the pepper-pot), detects individual charged particles and provides high-resolution timing and spatial information. The mask allows only specific portions of the beam to pass through, creating a pattern on the MCP that can be analyzed to determine the beam's emittance. We imaged the beam on a phosphor screen to measure the precise location of detected particles.

In this project, I helped design and mount the mask, collected data, and analyzed it using a program named “PypperPot” developed by David McClain, which I am also helping to further develop. Results from the pepper-pot will provide insights for optimizing beam transport and improving injection optics setup at TAMUTRAP and around the Cyclotron Institute. These findings are crucial for the facility's ongoing enhancements and contribute significantly to the precision measurements required for testing the standard model. Future work will focus on further optimizing the system and continuing development of “PypperPot” analysis software.

17. Production and Isolation of 59Fe Beams Using MARS Mass Spectrometer

Parker Neilson (Brigham Young University Idaho)
Cyclotron Institute REU
Research Advisor: Brian Roeder

The study of 59Fe and 60Fe are of ongoing interest in nuclear astrophysics and stellar nucleosynthesis. Of particular interest is the production of 60Fe. One method to study this nucleus is to study transfer reactions with 59Fe. With a half life of just over 44 days, 59Fe is hard to produce in significant quantities. Our goal was thus to make beams of various charge states of 59Fe. To do this we sputtered 58Fe from an alloy of it with 58Ni which was then accelerated through the cyclotron at various charge states into a deuterium and havar target at energies found inside of stars. Exotic particles, including 59Fe were thus made in-flight. Using Texas A&M's MARS (Momentum Achromat Recoil Separator) mass spectrometer, nuclides could be separated by mass and charge-mass ratio. LISE++ was able to predict the energy losses of 59Fe in the ΔE - E silicon detector from each nuclide. We were successful in isolating 59Fe from 58Fe and 58Ni. 59Co, sharing the same mass as 59Fe made it effectively impossible to separate them from one another. 59Co does have an extra proton which causes it to be distinguishable from 59Fe using statistical methods in ΔE vs position and E vs position graphs. Production rates of 59Fe and methods for further improvement will be presented.

18. Calculating the Thermodynamic Potential of a Deuteron in Hot Nuclear Matter

Luke Frisoli (Carnegie Mellon University)
Cyclotron Institute REU
Research Advisors: Ralf Rapp, Nathan Holt

The fate of bound states in an interacting medium is a fundamental problem in many-body physics. In this work, we study the properties and thermodynamic potential of a deuteron at finite temperatures typical for the hadronic phase in heavy-ion collisions at RHIC and the LHC, T = 100-160 MeV. Employing previously calculated in-medium nucleon self-energies in the pertinent single-particle propagators, we use Python to compute the imaginary and real parts of the two-particle propagator of the proton-neutron (pn) system. In connection with a schematic (separable) interaction for the pn interaction which reproduces the vacuum binding energy of the deuteron, we use the two-particle propagator to quantify the modifications of the deuteron properties in a hot medium through the computation of the pn scattering amplitude. We find a strong broadening of the deuteron scattering amplitude as temperature increases, driven by the collisional widths of the nucleons. Further, we implement methods from finite-temperature field theory (Matsubara formalism) to obtain an analytical representation of the thermodynamic distribution of deuterons at finite temperature in terms of thermal Bose factors. Using the scattering amplitude in conjunction with the thermal factors obtained from the Matsubara calculation, we are in a position to compute the fully resummed thermodynamic potential of the deuteron. This calculation indicates an increasing suppression of the deuteron's contribution to the thermodynamic potential in a hadron resonance gas at finite temperatures, T = 100-160 MeV, suggesting the dissolution of the deuteron bound state under these conditions.

19. Utilizing Generative Deep Learning for Variational Calculations of Nuclear Few-Body Systems

Miski Nopo (Harvey Mudd College)
Cyclotron Institute REU
Research Advisor: Jeremy Holt

Variational Monte Carlo methods have long been a valuable tool to calculate nuclear ground-state wavefunctions and energies. In the present work, we explore the use of generative machine learning models to improve variational calculations of nuclear few-body systems. Deep learning offers a more flexible, parameter-free method to optimize variational wavefunctions through minimization of the energy. In this project, we employ the FermiNet Neural Network model with an improved Monte Carlo importance sampling scheme based on normalizing flows. We have applied the method to study the ground states of several light nuclei and find that the new importance sampling method can significantly improve the convergence of the variational Monte Carlo method.

20. Evaporative Production of Thin Foils for Accelerator Targets

Millyzient McClure (Hastings College)
Cyclotron Institute REU
Research Advisor: Alan McIntosh

Production of uniform targets is crucial for accelerator-based nuclear physics experiments. The TAMU Cyclotron Institute is launching a target production laboratory. I have begun testing and characterizing a newly installed evaporator. This Auto306 thermal evaporator is used to evaporate materials onto glass slides to produce thin foils. Copper, tin, and chromium are the first target materials I am working with. I float the foils on water from the glass slides onto target frames. I use a resistive-surface position-sensitive silicon detector and a Thorium-228 alpha-particle source to characterize the thickness and thickness variations of the targets I have made by measuring the remaining kinetic energy and position of the alpha particles after they pass through the target foils; the thicker the target, the more kinetic energy the alpha particles lose. In this poster, I will describe the operation of the evaporator and present the quality of the targets produced.

21. Resolving Differences in Mass Tables in Predictions for the Production of Elements 119 and 120

Christa Pritchard (Jacksonville University)
Cyclotron Institute REU
Research Advisor: Cody Folden

There have been many theoretical predictions of the excitation functions for elements 119 and 120. These theoretical predictions are not in agreement, and there is much debate about the optimum projectile energy and the optimum excitation energy. A common difference between these predictions is the mass model that they use. One way to unify the predictions is to recalculate the excitation

energies utilizing the same mass model. In this work, data from published predictions were digitized and excitation energies were recalculated using the P. Möller et al. mass model [P. Möller et al., Atom. Data Nucl. Data Tables 109-110, 1-204 (2016). doi:10.1016/j.adt.2015.10.002]. This largely resulted in a shift in the excitation energies, although any changes in cross section are outside of the scope of this work. This was done for all exit channels from the selected publications, allowing for a reliable comparison between multiple sources. The procedure generally caused the predictions to be in better agreement, showing that the differences are generally due to variations in the mass model used. This work should allow for better planning of future new element searches.

22. Automated Linearization Routine for Experimental dE-E data

Luke Knull (Ohio State University)
Cyclotron Institute REU
Research Advisor: Mike Youngs

Experimental detector data in nuclear physics experiments often require particle identification based on distinct non-linear curves. The shapes can depend on the isotope, the detection material, and the response of the electronics used. Current techniques for labeling data that contain particles with non-linear two-dimension energy curves involve a manual linearization process followed by Gaussian fitting. A current standard linearization technique involves plotting curves by having researchers manually select many points along the curve for each detector. This can take on the order of several hours per detector per experiment, limited mostly by the manual linearization step. In this work, image processing techniques were employed to take experimental detector data and automatically locate characteristic curves along maximal ridges of the data. A novel local linear approximation technique was developed to use these curves to linearize the data itself, without the need for clustering. The algorithm was designed to minimize distortions in arrangement and distribution of the data when linearizing, maintaining or even improving upon the accuracy of particle identification. This work could enable order of magnitude decreases in time spent by researchers calibrating experimental data. The techniques developed for this analysis, preliminary results, and comparisons to previous efforts will be presented.

23. Preparations for Measuring the Excitation Function of 149g-Tb with Alpha Beams at the TAMU Cyclotron Institute using Europium Targets

Samuel Apata (Texas A&M University)
Cyclotron Institute REU
Research Advisor: Alan Mclntosh

149Tb is desired for targeted alpha therapy cancer treatment as a theragnostic. However, there is no standard method for its production. We plan to measure the cross-section as a function of energy for fusion evaporation reactions using alpha particle beams on a stack of natural europium targets. Reaction products will be identified quantitatively using high-purity germanium detectors. In preparation, we used PACE and TENDL to predict the excitation function to aid with experimental design. Our

calculations of beam straggling and our CAD work will be presented to facilitate the beam current's measurement.

24. Modeling the Behavior of SONOS Devices using Experimental Results and GEANT4 Simulations

Hannah Lowrey (University of Dallas)
Cyclotron Institute REU
Research Advisor: Mike Youngs

In recent years, it has been discovered that computer chips containing different types of transistors have measurable effects when heavy ions pass through them. This provides a new way to detect radiation in a relatively cheap way however the full extent of their capabilities are still being studied and explored. Previously, Silicon-Oxide-Nitride-Oxide-Silicon (SONOS) chips were exposed to 78Kr, 14N, and 4He beams. In an effort to gain greater insight into the dependence on atomic number, chips were recently exposed to 40Ar, 22Ne, and 14N beams. The response of these transistors to heavy ions was also simulated in GEANT4. By combining the experimental results and GEANT simulations an analytical model has been developed to understand these devices. Results of the experiment and modeling will be presented.

25. Classical Novae Simulations

Leo Rodriguez (University of Texas at El Paso)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisor: Philip Adsley

Classical novae are key for the understanding of galactic chemical evolution and how elements are created. A classical nova occurs in a binary system consisting of a white dwarf star and a companion donor. The star does not have enough mass to explode like a supernova, but in this case it receives mass from its donor companion then it can start nuclear burning processes that creates heavier isotopes and ejects newly created elements including radioactive isotopes such as 22Na. Computer simulations help us understand the nucleosynthesis happening in these systems. WinNet, a single-zone reaction network, promises similar results to other stellar simulation codes while being less computationally expensive since other codes simulate multiple layers of the nova and thermodynamic evolutions while WinNet only focuses on one. Nuclear astrophysicists are looking into an isotope that will give us a better understanding of novae. Sodium-22 is the “star” of this project due to its radioactive nature, it radiates gamma rays after it undergoes beta decay. This is very important for us because it allows telescopes to detect it, therefore we will be able to link the abundance of 22Na with the detected gamma rays. This project aims to compare variation in 22Na production due to variations in the 22Na(p,γ)23Mg reaction rate from WinNet simulations. After performing simulations, the production of different isotopes is analyzed to determine the effect of rate variation on the 22Na production. By building computation tools, we analyze and compare final abundances of isotopes considering different reaction rates.

26. Design and Fabrication of a New Measurement Setup and Target Holder for a Germanium Detector

Aaron Salinas (Texas Lutheran University)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisor: Philip Adsley

Taking a target and bombarding it with neutrons has a variety of uses . Neutron-capture reactions are necessary for the production of medical and industrial isotopes, and the understanding of synthesis of the elements in stars. Neutron capture activation experiments involve a beam of neutrons which capture on target nuclei . After capture, radioactive nuclei created by the reaction then decay with a characteristic decay which can then be used for identification purposes. Measuring how many decays from the neutron capture products allows the probability of interaction, the cross section, to be determined If the radioactive products decay by gamma-ray emission, these can be detected using germanium detectors which are good for this task due to their high energy resolution. In order for accurate results to be obtained from these detectors, the efficiency of these detectors need to be well understood. Getting a better understanding of the efficiency of the detectors requires calibrations of the detectors with different sources at different distances. A source holder which can be moved to different distances and a container to house the target during and after neutron-capture experiments were designed and constructed. After the two pieces of equipment are built, the next step is to conduct a neutron capture experiment with gold and terbium targets and measure the decay at different distances with the germanium detector to ensure that the system is behaving as expected. Ultimately, we would like to irradiate short-lived nuclei produced in fission reactions to understand the behavior of nuclear reactors and nuclear weapons, and also the creation of new elements in neutron-star mergers.

27. The Imaging Compton Telescope (COMPTEL) and an Analysis of a Subset of its Data

Martin Ortega (Texas Lutheran University)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisor: Louis Strigari

COMPTEL is an imaging telescope that searches for gamma-rays within a specific energy range (0.8 MeV-30 MeV). This telescope allows physicists to investigate and explore gamma-ray sources in our universe, gamma-ray related events in space (gamma-ray bursts, solar flare gamma-rays, etc.), and gamma-ray line spectroscopy. Although COMPTEL has been active for decades, the technological development had to catch up to have the ability to do an analysis on the data. GammaLib is a software that is an extension of Anaconda, which was used in the process of analyzing a subset of COMPTEL data.

28. The 3-Dimensional Analysis of the B-Field Profile of X-Y Steering Magnets

Kera Davis-Manchette (University of Northern Colorado) and Flaco Martinez (Texas Lutheran University)
Cyclotron Institute REU
Research Advisor: Henry Clark

The "X-Y Steering Magnet" is an essential component of beam transport systems because it can provide small corrections to the vertical and horizontal positions of the beam. Since the profile of the beam can potentially fill the physical space of the magnet, knowing the actual 3-dimentional B-field structure is important for optimizing the transport efficiency of the beam along the beam line. Although the B-field structure of x-y steering magnets is academic, the TAMU Cyclotron Institute does not have empirical B-field maps of the x-y steering magnets used on their beam lines. Recently, the Cyclotron Institute purchased three new x-y steering magnets which need to be tested and compared to an existing x-y steering magnetic before being installed on the beam line. This study aims to gather empirical B-field maps from the four x-y steering magnets and compare the results to theoretical predictions. The work involved assembling a 3-dimentional positioning apparatus for a gaussmeter, designing a versatile base stand for the magnets, and comparing the B-field measurements to theoretical simulations. Magnetic fields were recorded at currents of 1, 2.5 and 5 Amps, at 3 points along the z-axis, and at specific x-axis and y-axis coordinates to obtain 3-dimensional B-field maps for each magnetic. The data was entered and analyzed in Microsoft Excel. The measured B-field values, and overall B-field structure agreed with the predictions made by the 2-dimesional FEMM software. However, the data also revealed a non-linear structure in the magnetic field at the center of the magnet along the z-axis coordinate, which then agreed with the simulations made by the 3-dimensional COMSOLE software. The findings of this work have enhanced our understanding of the magnetic field structure of the x-y steering magnets used at the Cyclotron Institute and will contribute to an improved transport efficiency of the beams along the beam lines. Future work will involve comparing the measured trajectories of actual ion beams against theoretical predictions.

29. Shortcuts in Obtaining Medication: Impact on Nursing Medication Errors

Samarah Kennan (Texas A&M University)
Independent Research Project
Research Advisor: Jodie Gary

Medication administration errors pose substantial risks in healthcare, contributing significantly to patient safety events and mortality rates. This review of literature examines the correlation between medication administration practices in nursing, particularly the use of shortcuts during medication withdrawals from Pyxis systems, and the incidence of medication errors. Specifically, it investigates how withdrawing medications for more than one patient at a time may contribute to errors such as medication confusion, omissions, misplacements, and/or dosage errors. Despite guidelines from The Joint Commission emphasizing patient safety and effective medication management practices, the practice of multitasking in medication management persists in many healthcare settings. This exploration of literature aims to quantify the impact of these shortcuts on patient safety, bringing attention to normalized deviations from recommended practices and their implications for nursing care. Methods involve an appraisal of recent literature regarding medication administration errors, focusing

on studies that explore the prevalence of workarounds implemented by nurses through the withdrawal of medications from the Pyxis and their consequences. By identifying patterns and potential causes of medication errors, this review of literature seeks to inform strategies for improving medication safety protocols and reinforcing adherence to established guidelines in nursing practice.

30. Utilization of Outpatient Mental Health Services During and 2 years After the COVID-19 Pandemic

Sachin Iyer (Indian Institute of Science Education and Research)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Hye-Chung Kum

The Population-based cohort study compares the impact of COVID-19 on OP-MH (Outpatient Mental Health) utilization patterns among eight different MH conditions with 2 year follow up, particularly in telehealth. The study sample consisted of a 5% national sample of Medicare beneficiaries aged ≥ 18 diagnosed with schizophrenia, depression, bipolar, anxiety, trauma, substance-use, other MH, and two or more MH conditions; comparing OP-MH utilization patterns among different MH Medicare beneficiaries in 2020-2021 for those newly diagnosed in 2019 as well as to comparable cohorts newly diagnosed in 2017 before the pandemic. The COVID group (N = 53,655) included 32,193 females (60%), 40,513 aged 65-84 (75.5%), 47,282 White (88.1%), and 3,823 Black individuals (7.1%). The non-exposure group (N = 54,917) included 33,387 females (60.8%), 39,749 aged 65-84 (72.4%), 48,314 White (88%), and 4,193 Black participants (7.6%). As expected, total OP-MH utilization dropped (a 67.9% decrease in April) for all MH conditions at the pandemic's onset compared with the non-exposure group. Utilization increased after but remained 22% below pre-pandemic levels by the end of 2021 . Visits conducted via telehealth rose from 0.5% in early 2020 to 55% in April 2020, decreasing to 18% by the end of 2021. Regression analysis showed that compared to those with anxiety, patients with schizophrenia, bipolar, and trauma had higher odds of telehealth usage and lower odds for those with substance-use disorders. Rural residents, older adults (65+), and men had lower odds while Northeast and West residents had higher odds compared to South. Subsampled models by MH condition indicated less telehealth odds for men only in patients with trauma and substance-use disorders, and lower usage for rural residents and older adults mainly in those with depression and anxiety. No racial disparities were observed. This cohort study highlights the need for tailored telehealth strategies to address specific demographic and geographical disparities across different MH conditions.

31. Thermoresponsive Hydrogel Building Blocks to Prepare Glucose Biosensors

Rachel Bear (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Melissa Grunlan

Diabetes continues to remain a significant health challenge worldwide. Current continuous glucose monitors (CGMs) are limited by biofouling which leads to diminished glucose diffusion and poor sensor longevity (~7-14 days). Additionally, CGMs that reside in the subcutaneous tissue may require invasive

surgical implantation and removal leading to irritation and infection at the insertion site. Thus, a thermoresponsive and photodegradable, subcutaneous sensor could be utilized to increase sensor longevity via decreased cell attachment and eliminate the need for surgical removal via on-demand light degradation. A thermoresponsive and photodegradable hydrogel membrane will be created as a hollow rod to house a liquid optical glucose-sensing assay in the central cavity of the membrane. The hydrogel membrane will allow glucose molecules to readily diffuse while simultaneously preventing assay diffusion out of the membrane, ensuring glucose monitoring goes undisturbed. To impart on-demand degradation of the hydrogel membrane a photocleavable ortho-nitro benzyl (oNB) moiety will be incorporated into the hydrogel network. The synthesis of a thermoresponsive and photodegradable crosslinker will be developed by functionalizing poly(N-isopropyl acrylamide) (PNIPAAm), a thermoresponsive polymer, via a series of sequential reactions to incorporate acrylated oNB moieties. The development of oNB-PNIPAAm will ensure the membrane retains its thermoresponsive properties while simultaneously allowing for its degradation following exposure to light. Utilizing NMR (1H-NMR) spectroscopy and Fourier Transform Infared (FTIR) Spectroscopy, the structure of unmodified PNIPAAm was verified. Additionally, Gel Permeation Chromatography was used to verify PNIPAAm's target molecular weight to ensure clearance from the body following degradation.

32. Detection of BNP and NT-pro BNP Biomarkers Using a Portable Electrochemical Biosensor

David Silvey (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Hatice Koydemir

When the heart strains, BNP and NT-proBNP are secreted into the blood to try and elicit a biological reaction to try and stop/ fix heart failure. These biomarkers are the standard for diagnosis for this reason. Currently, the test for BNP levels is a 5-minute test that can only be conducted at a hospital. Our goal is dedicated to diagnosing heart failure as early as possible while making it largely accessible. Electrochemical analysis will be utilized to locate BNP and NT-proBNP biomarkers simultaneously. This system will all be combined into a point-of-care device with a custom PCB, LIG electrodes, and a mobile app to allow it to be used anywhere, anytime.

33. Wearable Electrodes

Adam Reyes (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisors: Limei Tian, Saifur Rahman

The research focuses on wearable electrodes that attach to the PATHS-UP device and reads bioimpedence in order to acquire BP readings. The composition of the electrodes is being optimized by testing different different AgNW concentrations in order to arrive at a higher quality of the signal.

34. Utilizing a Polydopamine-Coated Cellulose-Nanofiber Hydrogel for pH-sensitive Antibiotic Release

Mike Lynch (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisors: Soaram Kim, Jungbin Ahn

Physicians worldwide consistently search for innovative treatments that increase patient care and ensure positive outcomes. One area that generates many research grants and papers is the study of hydrogels. Due to the matrix network and tunable properties, hydrogels can be used in for drug delivery, optics, and regenerative medicine. This study aims to generate a biocompatible hydrogel, capable of variable drug release in relation to the current environment of a patient's skin. Through multiple trials, various protocols were tested to determine the most effective method for coating a cellulose nanofiber (CNF) based hydrogel with polydopamine (PDA). The PDA coating seeks to maximize interactions with tetracycline, a common antibiotic for minimizing skin infections. PDA also supports increased drug release in a basic environment, often seen during the early stages of wound healing. Quantitative results were collected through UV-absorbance spectroscopy to determine drug releasing and loading rates of tetracycline. Different weight percents of CNF and coating techniques were selected to increase the effectiveness of the PDA coating while also maintaining mechanical properties necessary for application to the skin. This research presents a viable method for tunable drug release and a platform for research focused on targeted disease treatment.

35. Continuous Synthesis of Gold Nanostar Particles

Tran Nguyen (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Nhu Vu

The synthesis of gold nanoparticles holds significant promise due to their unique optical and chemical properties, with applications in biomedical engineering such as imaging, drug delivery, and photothermal therapy. Traditional synthesis methods often face challenges with reproducibility and scalability. This research aims to develop and optimize a continuous synthesis method for gold nanostars to address these issues. By varying the flow rates of 0.25 mM $HAuCl_4$, 25 mM Ascorbic Acid, 0.5 mM $AgNO_3$, and gold nanosphere (seed) solutions, we seek to identify the optimal conditions for producing gold nanostars with desired optical properties and specific size and shape characteristics. The resulting particles will be characterized using UV-Vis spectroscopy, Transmission Electron Microscopy (TEM), Dynamic Light Scattering (DLS), and Zeta Potential. The study will also create a comprehensive dataset of synthesis parameters and corresponding particle characteristics, facilitating future machine-learning applications in nanoparticle synthesis. Key research questions include determining the optimal synthesis parameters, understanding how variations affect particle morphology and properties, and evaluating the effectiveness of the collected data in predicting synthesis outcomes using machine learning algorithms.

36. Design and Development of a Robotic Multi-modal Data Collection Platform for Crop and Weed Biomass Estimation

Prisha Sharma (Texas A&M University), Arnav Shah (Texas A&M University), and Zohair Soofi (Texas A&M University)
Aggie Research Program
Research Advisors: Muthukumar Bagavathiannan, Joe Johnson

Cover crop biomass production can be highly variable under field conditions due to microsite variabilities. Effective estimation and mapping of cover crop performance and biomass production across large field areas is highly valuable for predicting areas of poor weed suppression and plan for subsequent management in a site-specific fashion. In this regard, the use of sensors and object localization applications can be beneficial; two prominent data sources for this purpose include optical imagery and the Light Detection And Ranging (LiDAR) point cloud. Both data sources have their unique characteristics that make them useful in specific field applications. The multi-modal sensor platform was designed in Computer-Aided Design (CAD) software and range sensor motion under physical constraint was analyzed using MATLAB Simulink software. In this research, an autonomous cartesian robotic system was designed and developed for multi-modal data collection over a high-performance field-based wheeled robotic platform. Using this data, different data features like canopy spectral reflectance, structure, texture, and category information derived from multiple sensors are investigated for plant biomass prediction within the framework of multi-modal data fusion and deep learning. The proposed data collection pipeline and processing framework achieve satisfactory performance

37. Dynamic Rendezvous of Autonomous Vehicles

Emily Tran (California State Polytechnic University)
Applied Computational Robotics REU
Research Advisors: Jason O'Kane, Dylan Shell

Advanced and efficient systems for intercepting moving ground vehicles and drones are increasingly desired due to their widespread use in delivery, security, surveillance, and other applications. This research addresses this need by developing a dynamic interception system where a ground vehicle autonomously intercepts a moving drone. The system enables real-time navigation and interception by utilizing advanced pathfinding algorithms such as A* and D* lite. The study employs a 2D environment to simulate and validate the algorithms. Results demonstrate the system's ability to generate optimal real-time paths for the ground vehicle, adjusting to the drone’s movements and other environmental changes. The system helps the moving vehicle intercept the drone within a minimal distance, showcasing the potential efficiency and robustness. The developed system significantly enhances the safety and efficiency of autonomous operations, providing valuable insights for real-time pathfinding, dynamic navigation, and interception, with possible future applications in more complex or real-world scenarios.

38. Verification of Sim-to-Real Transfer in RL-based End-to-End Autonomous Racing Using Visual Domain Randomization

Autumn Kwon (Grinnell College)
Applied Computational Robotics REU
Research Advisors: Jason O'Kane, Guni Sharon

There has been a growing body of work focusing on the sim-to-real transfer of autonomous racing in reinforcement learning (RL). However, traditional RL training methods still require significant time and resources. This study investigates the effects of domain randomization (DR) by augmenting the visual domain with various light conditions to enhance the RL-based autonomous racing algorithm. We trained five autoencoder models, each exposed to three distinct light conditions: light direction, light intensity, and shadow. For each model, the vehicle learns to navigate the track by taking steering and throttle actions given an encoded image and Inertial Measurement Unit (IMU) sensor data states. These models were evaluated in a simulated environment to determine their effectiveness in handling different light conditions. Evaluation metrics include the sample efficiency of the learning algorithm, measured by the number of episodes required for the autonomous vehicle to learn to drive on the full track. After the comparative analysis, the best-performing model was deployed in a real-world Figure 8 track setting to validate its efficacy. Preliminary results suggest that visual DR enhances the training process, reducing the time and resources required while improving performance in diverse real environments. This proposed approach contributes to more efficient training of RL algorithms for autonomous racing, facilitating their practical application in real-world scenarios.

39. Multi-Formula Sentential Decision Diagrams

Leah Burdette (Oberlin College)
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Research Advisors: Jason O'Kane, Dylan Shell

This paper introduces the multi-formula sentential decision diagram (MFSDD) and a method to construct the MFSDD using existing sentential decision diagrams (SDDs). MFSDDs are constructed via a product operation that takes two SDDs and combines them to create the MFSDD. The MFSDD is similar to an SDD, but it evaluates to a pair of Boolean values, instead of a single value. When given a specific set of Boolean values for the variables in the MFSDD, the product diagram correctly gives the outputs of both SDDs. MFSDDs have the potential to be useful in robotics, specifically for answering observation-grounded queries, as the MFSDDs have the potential to make it possible to ask multiple questions at the same time.

40. Verification of an Algorithm for Path Planning and Navigation Using Edge Detection and Angular Control in Checkpoint-Based Robotic Systems

James Laguerre (Prairie View A&M University)
Applied Computational Robotics REU
Research Advisor: Jason O'Kane

This study focuses on verifying preexisting code for an autonomous underwater robot named Aqua 2. The primary function of that existing algorithm is to create a plan to navigate from a given starting pose to a goal, using a robot which only has an edge detector sensor and angular control error. In that algorithm, the robot determines its position by localizing to a given landmark when detected. Aqua 2 will perform a rotational maneuver and proceed to the next checkpoint, repeating these sequences until it reaches the final goal. This paper describes a method to verify the correctness of that existing algorithm, by repeated Monte Carlo simulations of the robot's execution of the plan. The results provide insight into the performance of Aqua 2's navigational capabilities.

41. End-to-End Autonomous Racing: Verification of Sim-to-Real Transfer of RL Algorithms through Actions and IMU Sensor Domain Randomization

Meghana Indukuri (San José State University)
Applied Computational Robotics REU
Research Advisors: Jason O'Kane, Guni Sharon

Reinforcement learning (RL) offers a novel approach to developing efficient, autonomous racing agents; however, training and testing policies in the real world can be resource-intensive. Simulations provide a practical alternative through sim-to-real transfer. Yet, inherent differences between simulators and reality present many challenges. To bridge this gap, domain randomization can be utilized. This research investigates the impacts of domain randomization on sample efficiency—the number of training episodes needed to learn to drive the track—in RL-based end-to-end autonomous racing. To accomplish this, the DonkeyCar simulator and Nvidia JetRacer were first set up and calibrated on predetermined tracks. Domain randomization was then implemented by injecting Gaussian noise into the action space (throttle and steering) and the state space (IMU sensor data) of the simulated RL agent. Specifically, in the DonkeyCar simulator, four noise levels were examined: no noise (baseline), action noise, IMU sensor noise, and combined action and sensor noise. The noise level that outputted a sample efficiency closest to the baseline model had its policy deployed to the Nvidia JetRacer. To quantify the effects of domain randomization, the transferred policy was compared to a policy learned from scratch in the real world. These results offer an innovative insight into optimal noise levels for sim-to-real transfer, enhancing an RL agent's training efficiency. This study will contribute to an understanding of the effectiveness of domain randomization and the optimization of autonomous vehicle training.

42. Evaluation of Spinach Leaf Characteristics Following Various Treatment Techniques

Andrea Mendez (Michigan State University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisor: Janie Moore

The widespread presence of bacteria in leafy greens poses significant public health challenges, necessitating treatments to reduce microbial contaminations present. In this research, the physicochemical properties of the leaves was assessed to investigate the effects of different treatment methods on spinach.

43. The Effects of Non-Thermal Treatments on Black Soldier Fly Protein Flour

Alana Holland (North Carolina Agricultural and Technical State University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisors: Janie McClurkin Moore, Elena Castell-Perez

As the global population continues to expand, the demand for food and energy sources is increasing significantly. Currently, traditional protein sources such as beef, swine, and poultry occupy substantial amounts of land and water, and their production processes are resource intensive. To address this challenge, we propose the use of insects, specifically Black Soldier Flies (BSF), as an alternative protein source. Black Soldier Flies can be farmed on a much smaller land footprint compared to traditional livestock and they thrive on organic waste. BSF larvae are rich in protein, fats, and essential amino acids, making them an excellent ingredient for human and animal consumption. They can be processed into flour, providing a versatile and nutritious food source. To ensure that BSF protein flour is safe for consumption, we have employed advanced non-thermal processing techniques. These include: Ultrasound and Atmospheric Cold Plasma technologies. To test the effectiveness of these processing techniques, we inoculated the BSF protein flour with E. coli bacteria. After applying the combined treatments, we observed a 97% eradication of the bacteria. Our data confirms the reliability of our methods in producing safe and hygienic protein flour. The use of BSF as a protein source presents a promising solution to the challenges posed by traditional livestock farming. Embracing insects as a protein source could significantly reduce the environmental footprint of food production and contribute to a more sustainable future.

44. Transforming Pecan Shells into High-Value Biochar through Pyrolysis: Exploring Versatile Applications and Environmental Benefits

Nick Hall (Prairie View A&M University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisors: Janie Moore, Sergio Capareda

The world is being filled up with more waste now than ever, and available land is shrinking due to this. This study investigates the pyrolysis of pecan shell waste as a potential sustainable pathway for value-added products. The United States leads global pecan production partly due to pecan trees (Carya

Illinoinensis) being native to North America. Just two years ago, U.S. pecan crops totaled 278 million pounds which equivalates to $500 million USD. The main part of the Pecan targeted by consumers is the nutmeat. Rightfully so as it is scientifically proven they have the highest antioxidant content of all tree nuts (NPSA, 2021.). However, the data gained uncovers that the target aspect of the pecan nutmeat may not be as deserving as it seems compared to the pecan shell based off data collected. One thing stands between labeling pecan shells as waste rather than worthy... Pyrolysis! Defined as the heating of an organic matter in the absence of oxygen. Usually conducted at or above 500C, pyrolysis provides enough heat to deconstruct the organic substances in natural sources and transform it into three different byproducts. Biochar, Bio-oil, and syngas. In this research, we will take a closer look at the biochar byproduct. After pyrolysis on pecan shells, out comes a carbon dense, energy-rich, environmentally beneficial, profitable biochar with limitless applications.

45. The Effects of Non-Thermal Treatments on Black Soldier Fly Protein Flour

Josh Evans (Prairie View A&M University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisors: Janie Moore, Elena Castell-Perez

This study seeks to investigate the effects of non-thermal treatments on the nutritional properties of black soldier fly protein flour and evaluate its potential as a novel food ingredient. Black soldier fly protein flour was subjected to non-thermal treatments, such as atmospheric cold plasma and ultrasonic procedures. Subsequently, a thorough examination was performed on the processed flour to evaluate any changes in its nutritional characteristics, such as protein content, digestibility, and functional properties. Analytical approaches were used to ascertain these parameters. The nutritional content of black soldier fly protein flour was enhanced using non-thermal treatments. Atmospheric cold plasma has the potential to eliminate germs without altering the protein content.

Furthermore, these treatments improved the functional characteristics of the flour, including its solubility and emulsifying ability, making it appropriate for use in a wide range of food items. This research indicates that non-thermal treatments are superior in enhancing the nutritional and functional characteristics of black soldier fly protein flour compared to the thermal treatments currently used in the food sector. This improvement creates opportunities for its use as an innovative food additive. The enhanced protein content and functional attributes demonstrate its potential for use in a wide range of food items, promoting sustainable food production and resolving the issues associated with protein supply. Future studies should prioritize the assessment of both the effectiveness and consumer reception of food items that use treated black soldier fly protein flour. This will help to confirm its suitability for broader use in the food sector.

46. The Effects of ACP on Eastern Medicine

MJ Vogtembing (Texas A&M University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisor: Janie Moore

The health of a person is undoubtedly one of the most important aspects of life. With threats like viruses, bacteria, diseases, other humans, and even our own genetics, our health is constantly under some kind of pressure and threat. Medicine helps alleviate some of this pressure and reinforces our body and its immune responses. However, modern Western medicine often uses symptom-specific drugs that can have side effects and potentially worsen one's condition. Eastern medicine, on the other hand, takes a more holistic perspective on health and treats the body as a whole. Increasing the efficiency and safety of these medicines is a topic of great interest. Atmospheric Cold Plasma (ACP) shows promise as a method to enhance these medicines due to its antibacterial, antifungal, and anticancer properties. ACP has many different modes of use and has been employed in the medical field for quite some time. However, science has only scratched the surface of its potential. This paper analyzes the effects of ACP on Eastern medicine products and explores a new frontier for research combining ACP and Eastern medicine

47. Evaluating Pecan Waste Pyrolysis By-Products and Effects of Atmospheric Cold Plasma (ACP) on Produced Bio-Oil

Mari Wilcock (Texas A&M University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisor: Sergio Capareda

This study investigates the properties of the pecan middle septum as a potential biomass source for large-scale fuel production. Multiple samples of milled biomass were pyrolyzed at three different temperatures to assess their properties. The mass percentages of by-products varied slightly across samples, generally showing an increase in biochar production at lower temperatures and higher syngas production at higher temperatures. Notably, the pecan biomass consistently yielded a significant amount of biochar, ranging from 43% to 56% in each trial. The optimal temperature for producing bio-oil was seen to be 600°C. Variations in the data were attributed to atmospheric conditions during the trials. Oil characterization was performed using FTIR and GC-MS, and the properties of the selected feedstock were analyzed prior to pyrolysis.

48. Evaluating the Effects of Atmospheric Cold Plasma and Nanoparticle treatments on Lettuce Quality

Audrey Bishop (Texas A&M University)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisor: Janie Moore

The world's growing population faces challenges to provide sustainable systems that deliver water, energy, and food resources. Our research goal focuses on providing better food safety and security in sustainable ways. According to the Center of Disease Control and Prevention (CDC) (2023), several cases of E. Coli and other diseases have been found to be caused by the consumption of romaine lettuce and other leafy greens. In response, our research focused on finding alternative ways to treat lettuce to prevent the growth of these different bacteria pathogens without significantly impacting the quality of the lettuce leaves. This study tested different antimicrobial treatments and their impacts on the quality of fresh lettuce leaves. The study consists of water content, texture, and color testing in order to determine the changes in the quality of lettuce in these parameters over time. All samples were rinsed for 1 min in each treatment, with 30 seconds on each side of the leaf. Samples were treated with Zif-8, 10% Iron (Fe) Zif-8, Atmospheric Cold Plasma via 70 kw for 2 minutes, 200 ppm Chlorine, or sprayed with water. The quality of the lettuce leaves were assessed by monitoring changes in moisture content, color, texture, and taste.

49. Enhancing Cotton Seed Germination and Growth Through Plasma Treatment: A Comparative Study

Sophia Seck (Dover)
Food and Renewable Energy Summer Hands-on (FRESH) REEU
Research Advisor: Janie Moore

This study investigates the effects of plasma treatment on cotton seeds using a 70 kV/7-minute exposure under controlled environmental conditions (30°C, 60% RH, 8 hours light, 12 hours dark). The research compares untreated seeds with those subjected to plasma treatment, aiming to assess its impact on seed germination and early growth stages. Scientific literature suggests that plasma treatments offer fungicidal and bactericidal effects, enhance water permeability through surface coat etching, and stimulate germination and seedling growth. This experiment specifically explores whether these benefits extend to cotton seeds, potentially accelerating germination and enhancing growth rates. Preliminary results indicate that plasma-treated seeds exhibit significantly higher germination rates and enhanced early seedling vigor compared to untreated seeds. Furthermore, plasma treatment shows promise in promoting overall plant growth, which could ultimately increase cotton production yields. The study proposes that leveraging plasma technology could offer practical applications in agriculture, particularly in enhancing seed performance and supporting sustainable crop production practices. Looking ahead, this research suggests that major production companies may adopt plasma treatment as a viable method to improve seed quality and crop yields. Future studies will focus on optimizing plasma treatment parameters and scaling up these techniques for broader agricultural applications.

50. Generative AI Chatbot for Industrial Control Education

Alex Alvarez (Texas A&M University) and Adeeb Momin (Texas A&M University)
First Generation Undergraduate Research Experiences in STEM (FIGURES)
Research Advisor: Sheng-Jen Hsieh

The transition to online learning, particularly during the COVID-19 pandemic, underscored the need for educational tools that address the limitations of traditional e-learning methods, especially the lack of engagement and real-time interaction. This study explores the development of a cloud-based intelligent tutoring system (ITS) tailored for industrial control education to complement current work (ASI-Tutor) using Google's Gemini generative AI model, fine-tuned with lecture materials. The chatbot offers a cost-effective and accessible learning support which will make learning more efficient and supplement traditional classroom learning. A prototype framework was successfully implemented in a local PC environment. Lecture notes in PDF format were used to train the model; preliminary results suggest that new knowledge can be added to the prototype to refine the knowledge base. Future work includes comparing different types of knowledge input formats and how they might affect the training time and response accuracy. In addition, we plan to host the web page in an AWS environment and pilot test the chatbot system with students.

51. Robot Programming by Demonstration via LEAP Motion and Kinect Sensors

Kelvin Zheng (Texas A&M University)
First Generation Undergraduate Research Experiences in STEM (FIGURES)
Research Advisor: Sheng-Jen Hsieh

In robot programming by demonstration, selecting an optimal method for capturing demonstration data is a crucial step that can greatly affect performance. Given the large variety of available techniques, users need comprehensive ways of comparing the performance of different demonstration methods. Much existing work has focused on analyzing the performance of specific sensors. This research aims to fill in gaps in existing work by comparing the performance of two relatively cost-friendly infrared imaging sensors: the LeapMotion controller and Microsoft Kinect v2. In doing so, this study aims to compare and contrast hand tracking versus body tracking, as well as smaller versus larger fields of view, with regard to performance in capturing demonstrations of varying types of tasks. This research employs Python and C++ programs that interface with the LeapMotion and Kinect v2, respectively. Both programs convert positional data from their respective sensors into commands that are sent to a TeachMover robot using the USB to Serial Port communication protocol. Additionally, the programs for both sensors have specific gestures that are used to communicate specific actions to the robot including opening the gripper, closing the gripper, and returning to the start position. These two programs were used to successfully guide the Teachmover through two different tasks. Speed and accuracy of demonstrations were measured and recorded for analysis. Preliminary results suggest that the LeapMotion performs better than the Kinect v2 in capturing fine, high precision movements. In the future, we aim to expand this work by experimenting with higher complexity tasks.

52. Overview of Functional Near-Infrared Spectroscopy (fNIRS) and its Applications in Understanding Human Neurophysiological Conditions During Work

Aline Moller (Texas A&M University)
Aggie Research Program
Research Advisors: Prabhakar Pagilla, Tiash Rana Mukherjee

This poster provides a review of studies that have utilized Functional Near-Infrared Spectroscopy (fNIRS) in occupational settings, and to inform of the cognitive cost associated with task demands. fNIRS is a non-invasive, ambulatory neuroimaging technique that measures changes in cerebral blood flow to quantify brain activation in functionally independent regions. This method uses near-infrared light to detect changes in oxygenated and deoxygenated hemoglobin concentrations, providing insights into neural activity for cognitive processes such as cognitive load, fatigue, and decision-making processes in real-time work scenarios. This poster aims to highlight the versatility and the promise of combining fNIRS with other physiological and subjective methodologies to allow for a multi-modal approach. In using fNIRS, it would allow for a comprehensive understanding of how work affects the underlying neural mechanisms contributing to human behavior and perception which influence both cognitive and physical performance. In studies addressing human movement in occupational domains, few have explored the long-term implications between the neuro-biomechanical interactions with humans and machines. By synthesizing current research and identifying gaps in the literature, this work discusses the promise of fNIRS in occupational research and its potential to inform workplace design, task allocation, and performance optimization strategies.

53. Human Factors Considerations in the Development of Sensors for Biomechanical Measurements

Jimit Mahadik (Texas A&M University)
Aggie Research Program
Research Advisor: Prabhakar Pagilla

This work discusses the need to integrate human factors throughout the sensor development process. The poster will provide a discussion of the criteria employed in current literature to consider human factors in sensor development. Sensors designed for biomechanical analysis, such as motion-capture cameras (MOCAP) and force plates, measure and quantify data directly from the human body by detecting changes in position and center of pressure. The information from the sensors is further analyzed and relayed to the users to enhance their understanding of human movement that can aid training methodologies, rehabilitation research, design of assistive devices, and workplace development for better ergonomics and risk mitigation. Some of these sensors directly interact with the human body to evaluate the biological or physiological signals. However, most available sensors for this purpose do not consider participant needs and human factors during their development. Many invasive physiological sensor technologies (eg. endoscopes) consider human factors, but non-invasive sensors (eg. EKG/ECG) do not generally consider human factors although there is a significant need for this category of sensors also. For example, Human-Machine Interaction studies employ non-invasive measurement systems which often consider accuracy and functionality in the sensor development

process over human factors, that is, human participants must conform to the sensor design. This work will provide a critical discussion of the deficiencies in the available

54. Investigating the Effects of Symmetrical Repetitive Lifting on the Muscle Activity of Low-Back Musculature

Samuel Nunez Jr. (Texas A&M University)
Aggie Research Program
Research Advisors: Prabhakar Pagilla, Tiash Rana Mukherjee

This study aims to investigate the muscular activity of the lower extremities during precision and non-precision lifting tasks. Low-back injuries account for 38.5% of all work-related musculoskeletal-disorders. These injuries are common across various occupations (logistics, manufacturing, healthcare, etc). These occupations often involve repetitive lifting with varying physical demands that affect the musculoskeletal system, particularly the lower back. A pilot investigation was performed to better understand the effects of repetitive symmetrical lifting over an extended period of time affecting the lower extremities. The pilot consisted of two – 15 minute blocks with a rest period of 5-minutes between each block. The participant followed an ABA repetitive lifting protocol. A: High Precision – Box placement within the marked position, B: Low Precision – Box placement irrespective of marked position at the hip level. The weight of the box used for this experiment was calibrated at 10% of their body weight. Electromyographic (EMG) data was collected bilaterally using Delsys Trigno Wireless sensors, from the Erector Spinae (L4/L5) and the Biceps Femoris (lower limbs). This data was processed using a 4 th order Butter-Worth Filter and filtered between 45-450 Hz. We hypothesized that the muscle activity of the lower back will increase over time, and that the activity varies between tasks. These factors would indicate that participants are using their lower back more to lift due to fatigue. Our results verified our hypothesis and showed that there is a difference in muscular activity between the tasks with the high-precision tasks requiring higher activity than the low-precision tasks.

55. Detection of Methane in Titan's Atmosphere Using the ETSI Instructment

Shawn Yifan (Texas A&M University)
Independent Research Project
Research Advisor: Ryan Oelkers

Our research aims to detect methane in Titan's atmosphere using the innovative ETSI instrument, which measures multiple wavelengths of light simultaneously. By observing Titan as it transits a known star, we illuminate its atmosphere and measure various molecular species, including methane. The poster will detail our methodology, the significance of methane detection, and the current status of our research.

56. Color Correcting for White Dwarf Supernovae

Gabby Cruz (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisor: Peter Brown

Type Ia supernovae are important because they are great standard candles for measuring distances to galaxies and the expansion of the universe. The main challenges are the intrinsic diversity in the light they give off and the amount of dust dimming the light before it reaches our telescopes. Using data from the Swift satellite's UltraViolet Optical Telescope, we can analyze and study the brightness and color of dozens of supernova explosions in different filters in the ultraviolet and optical range. By accounting for the change in spectral flux within a filter, using spectral templates to assume a spectral shape, color correcting for Milky Way extinction while also making spectrum-specific extinction corrections, and comparing the colors of redder supernovae to the bluest supernovae (which are presumably dust-free), we can then measure the amount of dust reddening accounting for the redder colors and fit spectroscopic models. In correcting for dust, we can constrain differences in the intrinsic colors.

57. Design of a Long Split Spectrometer

Evan Batteas (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisors: Luke Schmidt, Darren DePoy

Spectrographs are a key instrument in astronomical observation. They spread out incoming light into its component wavelengths. Analyzing the spectra produced by spectrographs can tell us the elemental composition of what we are looking at, which can provide context clues to help us figure out how old an object is, how far away it is, and if a planet may contain life. A long slit spectrometer is designed and assembled, utilizing an asymmetric Offner relay. Due to the asymmetry of the Offner relay, an accessible pupil is formed, where a grating is placed to disperse the light. It is designed to utilize 3D printing in its construction, and commercially available parts, and is designed for mounting on a C14 Celestron telescope.

58. Generating a Test Set for Machine Learning Detection of AM CVn Transients with TESS

Nicole Ton (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisor: Ryan Oelkers

The Transiting Exoplanet Survey Satellite (TESS) has observed nearly the entire celestial sphere sinces its launch in 2018. While the primary goal of the spacecraft is the identification of exoplanets, we will use the data to search for accreting white dwarf binaries (also known as AM CVns) using machine learning methods. This work details our attempts to generate a test set of AM CVn observational characteristics from known objects. We have performed photometry on several known AM CVns observed with TESS, cataloged their characteristics, and we have also identified several other possible transient objects of

interest. The data set generated in this work will form the basis of the machine learning model we will use to detect AM CVns on a large scale.

59. Design and Fabrication of the Back-End for a Prototype Multi-Object Spectrograph

Mason Jelken (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisors: Luke Schmidt, Darren DePoy

We present the results of the design, fabrication, and testing of a spectrograph to be fiber-fed by a prototype multi-object fiber positioner. This project is in collaboration with Open Source Instruments (OSI), who have designed and constructed the front-end light collection method that will observe 4 astronomical objects at a time. This prototype serves as a proof of concept for the Texas A&M Astronomical Instrumentation Laboratory's continued collaboration with OSI. In the future, OSI and Texas A&M plan to construct an instrument that can observe and take spectra of up to 80 objects at a time with the eventual goal of scaling to thousands of objects. The current spectroscopy setup utilizes ORIEL's MS125J spectrograph to spread light into its spectra, which is then collected by a KURO 2048B camera from Teledyne Princeton Instruments. The readout of the camera is then sent through a custom data pipeline to extract the unique spectra from each object. This data can then be used to determine the 4 objects' relative elemental abundances via observations of emission and absorption features that will give insight on the formation and behavior of these celestial bodies.

60. Radio Observations of Dual Active Galactic Nuclei in Nearby Galaxies

Elizabeth Jones (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisor: Krista Smith

We studied candidate pairs of Active Galactic Nuclei (AGNs) and possible companions to identify radio signatures of AGN activity We took data from the Jansky Very Large Array (JVLA) at a 22 GHz frequency, the CIRADA Database (VLASS), and the Faint Images of the Radio Sky at Twenty-cm" survey (FIRST) telescope database to identify possible AGN signatures in companion galaxies through radio waves at different observing frequencies. We made contour maps measuring the various amounts of radio emission in the JVLA data, overlapping those contour maps in the VLASS, and a set of optical images from the Sloan Digital Sky Survey (SDSS) to find the companion in our database. In total, 103 starting galaxies were present within X-rays with set companions (KOSS, 2012), out of those there 73 (71%) were collected in our JVLA data with radio wavelengths. The VLASS Survey found 62 (82%) of both the AGN and the Companion within its database. However, out of those 22 GHz data, 12 companion galaxies (16%) were accessible for the FIRST database. As a result, 71% of companions were detected at 22 GHz, 82% in VLASS, and 16% in FIRST. In addition to simply determining whether the companion galaxy is detected in various frequencies, in the cases where more than one survey is detected by the companion, we construct a spectrum across the observed frequencies. The slope of the radio spectrum can indicate the physical nature of the source.

61. Utilizing a High Power Broadband Light Source to Measure Throughput Efficiency of Fiber Optics

Noah Siebersma (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisors: Jennifer Marshall, Luke Schmidt

Accurately measuring the night sky is imperative for large, ground based astronomical telescopes; the goal is to subtract the spectrum of the sky background from the target spectrum and reach reliable scientific results in an effective manner. The Fiber Optic Characterization for Unprecedented Sky Subtraction (FOCUSS) project aims to measure the throughput efficiency and focal ratio degradation (FRD) in multiple fiber optic cables to inform design choices for future fiber fed astronomical spectrographs. Throughput efficiency measures absorption as a function of wavelength in a fiber optic, while FRD measures the change in angular distribution of the light after passing through a fiber as a function of the initial incident angle. The FOCUSS project measures these two parameters between wavelengths of 400nm and 1000nm with 18nm step sizes, equal to the band-pass of the monochromator. The measurements of the throughput and FRD are acquired between two respective tests, one to measure the FRD where a photo-diode, CMOS sensor, and a five axis motor are utilized to align and step through incident angles and wavelength. While the transmission test measures throughput efficiency by utilizing two identical CMOS sensors and an integrated sphere of light capturing images of similar periods of light. The Python programming language is used to interface with the testing hardware and automate the data collection and reduction process. With validation of the experimental setup completed, we've begun testing various samples comparing the desired characteristics between fibers, which this presentation will primarily focus on the transmission portion of the project.

62. Investigating Low-Frequency Radio Variability of AGN with VLITE

Jonas White (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisor: Krista Smith

Active galactic nuclei (AGN) are some of the most energetic and variable objects in the observable universe. They often exhibit different patterns of variability in various parts of the electromagnetic spectrum, variation which is uniquely strong and consistent in this class of objects. Some AGN, especially blazar-like objects, are highly luminous and variable in radio wavelengths, another feature observed almost exclusively in AGN. Much of this radio emission is thought to be caused by jet activity, particularly synchrotron radiation. The VLA (Very Large Array) Low-band Ionosphere and Transient Experiment, or VLITE, is a project that utilizes the VLA to make low-frequency radio observations of objects with declination > -41.7 degrees. VLITE records data between 320 and 384 MHz (National Radio Astronomy Observatory, 2023), making it ideal for studying low-frequency radio emission in AGN, particularly blazar-like objects and objects with strong jet activity, which are especially bright in these wavelengths. This project used a sample of 97 objects, of which 28 were found to exhibit non-negligible variability and have sufficient data (at least 5 data points from VLITE). For these 28 objects we analyzed

their radio spectra, estimated the minimum size of their radio-emitting region, and investigated the possible role of both interplanetary and intergalactic scintillation in their variability. The results are promising and provide a useful sample of candidates for further observation and analysis, potentially shedding light on the mechanisms of radio emission in AGN. Their variability could be due to detailed processes within the jet in the case of blazars, or along the interface of an AGN outflow and the interstellar medium gas in normal AGN, both possibilities that can be investigated through detailed observation of the objects in this project.

63. Fiber Optic Characterization for Unprecedented Sky Subtraction (FOCUSS)

Hudson Malone (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisor: Jennifer Marshall

In order for the future large, Earth-based, fiber-fed astronomical spectrographs to function precisely and efficiently, the background sky spectra must be removed without compromising the target spectra. The Fiber Optic Characterization for Unprecedented Sky Subtraction (FOCUSS) project aims to examine multiple fiber optic cables to determine their respective throughput efficiency and focal ratio degradation (FRD). The throughput efficiency simply measures the percentage of light that enters the fiber and ends up at the detector, while the FRD test measures the angular spread of light out of the fiber as a function of incident angle. The FOCUSS project conducts these tests within the 400-1000nm regime, limited by the bandpass of the monochromator, which is 18nm. Our experimental setup consists of a laser-driven light source, a monochromator, an integrating sphere, a photodiode, a five-axis motor for alignment, and three CMOS sensors for data acquisition. Our results will be used to guide future astronomers as to which fibers should be used within spectrographs for the best data quality and sky subtraction. The Python programming language was utilized for data collection, reduction, and analysis.

64. Ages, Heavy Metal Enrichment, Star Formation, and Dust Attenuation of Quiescent Galaxies at 0.5 < z < 3.5 Derived from James Webb Space Telescope Grism Data

Rishmita Rao (Texas A&M University)
AggieSTAAR: Aggie Scholarships for Technology Advancements in Astronomical Research
Research Advisor: Casey Papovich

Understanding how galaxies form and quench their star formation is one of the most important questions in astrophysics. An effective way to answer this question is by studying the properties of quiescent galaxies – galaxies that lack significant star formation – in the distant universe because we can characterize their properties at a time much closer to when they quenched. To do this, we use new, deep spectroscopy from the James Webb Space Telescope (JWST) to constrain parameters of massive galaxies selected to have quiescent stellar populations at $0.5 < z < 3.5$. The galaxy data is taken with JWST's NIRISS camera with a grism covering 0.9 to 2.4 microns at a resolution ($R = \lambda/\Delta\lambda$) of $R \sim 100$. We selected 24 galaxies from the data as quiescent based on their UV–visual and visual–infrared colors (using a "U-V and V-J" color-color plot). This selection method separates galaxies with older stellar

populations from star-forming galaxies obscured by dust extinction. The galaxies have estimated stellar mass of more than 3 × 1010 solar masses. We then fit a suite of stellar population models to simulate the spectra of the galaxies, which provides constraints on their stellar population ages, heavy metal enrichment, star-formation histories, and dust attenuation. These constraints are compared to previous work from the literature to study how these properties evolved over the history of the universe.

65. Force Induced Electron-Rich Lanthanide Complexes from Trivalent Precursors and Alkali Metals

Ethan Clare (Gettysburg College)
Center for Mechanical Control of Chemistry (CMCC) REU
Research Advisor: Alison Altman

The unique bonding and reactivity of low-valent lanthanide molecular complexes challenges our previous understanding of electronic and magnetic structure. Electride formation in low-valent lanthanide systems may be possible through the matching of orbital energy using heterobimetallic molecules that incorporate electrostatic interactions. Electrides, characterized by anionic electrons, have strong potential in synthetic chemistry in the right environment. Under ambient conditions, restrictive ligand environments limit the use of binary intermetallic materials that combine electropositive lanthanides and alkali metals. However, under pressure, the potential for increased reactivity is promising due to the good energy matching predicted in Alkali metal and lanthanide systems. This reactivity under pressure can form a new class of electron-rich lanthanide complexes that may support the right conditions for an electride. Experimentally, using a planetary ball mill to study force reactions, yttrium and samarium silyl amides reacted with potassium or sodium metal. While further experimental proof of electride formation is still underway, initial hints of reactivity were shown through noticeable color changes upon the reaction of YHMDS3 (HMDS = bis(trimethylsilyl) amide). This shows changes in the electron configuration from the high-pressure reaction conditions because YHMDS3 species are colorless as they have no valence electrons. 1H nuclear magnetic resonance spectroscopy supports this formation of a new species as there is a shift of the paramagnetic species from milling.

66. The Controlled Patterning of Single-Layer Graphene by Mechanochemical Means

Riley Davenport (Texas A&M University)
Center for Mechanical Control of Chemistry (CMCC) REU
Research Advisor: James Batteas

Mechanochemical reactions involve the use of mechanical force to drive a chemical reaction. Using mechanical forces instead of more traditional reaction methods can increase energy efficiency and product yield, allowing for more sustainable reaction processes. A unique two-dimensional materials strain reactor (2D-MSR) has been developed that allows for pressurized solvents to interact with 2D materials, monitored in situ with Raman spectroscopy and atomic force microscopy (AFM). Previous work has shown that a reaction can be achieved between single-layer graphene and pressurized water

using the 2D-MSR, but not in a localized manner. As graphene is a popular 2D material given its high strength, durability, and electrical conductivity, developing methods to controllably pattern it expands its potential applications. Here, we aim to exploit graphene's computationally demonstrated capacity for site-specific molecular migration based on changes in the material's curvature. Thus, single-layer graphene suspended on a transmission electron microscope (TEM) grid is reacted with water while an AFM tapping mode tip is oscillated at resonant frequency. These frequencies should allow for so-called rings of increased reactivity to be detected spectroscopically. The reactivity of graphene is measured by observing changes in the intensity of the Raman D peak, which corresponds to defects in graphene's lattice structure. Raman spectral maps of pores allow for the visualization of these rings. Controlling mechanochemical reactions to this extent would allow for the tunable manipulation of this and other materials' properties.

67. Integrating Machine Learning with Cheminformatics Methods and Machine Learning Potentials for Efficient Mechanochemical Reaction Analysis

Daniel Williams (Texas A&M University)
Center for Mechanical Control of Chemistry (CMCC) REU
Research Advisors: Daniel Tabor, Tzu-Hsuan Chao

Understanding mechanical effects in reactions is crucial for the development of sustainable and efficient chemical processes, especially within the emerging field of mechanochemistry. Traditional electronic calculation packages such as Gaussian and ORCA employ Density Functional Theory (DFT) to calculate electronic energies of reactants, transition states, and products to obtain activation energies. However, these calculations are expensive and time-consuming. We propose an alternative approach developing end-to-end workflow that begins with the molecule SMILES strings and uses the AIMNET2 and RDKit to efficiently generate electronic energy data for different molecules. The SMILES strings of reactants and products are processed using RXNmapper, a semi-supervised machine learning model that tracks the location of atoms from reactants to products to preserve atomic identity. AIMNET2 uses advanced neural networks to encode atomic environments and capture both local and global chemical contexts. This process can obtain energies within seconds. To simulate the impact of mechanical force on activation energy, we incorporated force constraints into our calculations in conjunction with AIMNET2. Using this process, SN2 reactions were run and obtained results that align with expected values. Additionally, by incorporating force constraints, we have successfully simulated the impact of mechanical forces on activation energy. Future work on this project entails testing different reactions such as E2 elimination and Diels-Alder cycloaddition reactions.

68. Effects of Milling Conditions on Kinetics and Rheology of Mechanochemical Knoevenagel Condensation between Barbituric Acid and Vanillin

Paulina Gonzalez (University of Texas at Austin)
Center for Mechanical Control of Chemistry (CMCC) REU
Research Advisors: James Batteas, Jonathan Felts

The field of mechanochemistry has gained increasing attention in recent years for its affordability, sustainability, and safety as an alternative to traditional, solvent-based chemistry, but it generally progresses on a trial-and-error basis. The mechanochemical Knoevenagel condensation between barbituric acid and vanillin is known to obey sigmoidal kinetics within a stainless steel ball-mill system, where the rapid increase in conversion is accompanied by a cohesive state in which the powder reactants form a plasticized layer around the milling ball. Though the product returns to a free flowing powder, it is unclear whether the mechanical properties of the cohesive state directly contribute to the rapid increase in conversion. Our goal was to explore the effects of jar material, milling ball size, and milling frequency on the kinetics and rheology of the chemical system. We found that all materials, ball sizes, and frequencies obey the sigmoidal kinetics, though conversion occurs most rapidly in stainless steel, then aluminum, and then teflon. The intermediate cohesive state was only observed in stainless steel.

69. Transfer of Nitrosyl Groups Between Varied Metal Complexes: A Study on Metal Nitric Oxide Release Molecules

Nadia Small (Agnes Scott College)
Chemistry REU
Research Advisors: Marcetta Darensbourg, Sarnali Sanfui

The dimerization of metal complexes has long been shown to hide coordination sites. Because of this, when purging the dimers with nitric oxide, mononitrosyl complexes (MNCs) are formed. Here, the NO transfer abilities of some mononitrosyl iron and cobalt complexes are evaluated. The complexes evaluated have the N2S2 conformations to their structures and have varied backbones such as N,N'-bis(mercaptoethyl)-1,4-diazacycloheptane (bme-dach) and N,N-bis(2-mercaptoethyl)-N',N'-diethylethylenediamine (bme-dame). The lability of the coordination site containing the NO in the MNCs was tested using methods to verify inter- and intramolecular NO ligand transfer between iron and cobalt complexes, NO receiving compounds, and a cobalt porphyrin. The kinetics and outcomes of the reactions were assessed using FT-IR spectroscopy over time (including ReactIR) and mass spectroscopy. Additionally, changes needing to be made to existing protocol in the synthesis of these complexes were addressed to increase yields and purities. The varied ligand backbones of the complexes impacted the lability of the nitrosyl on both iron and cobalt complexes as well as the different metals yielded different results regarding their capabilities to be NO releasing molecules (NORMs).

70. Synthesis of Bio-Based Epoxy Monomers from Natural Eugenol Derivative for Copolymerization of CO2 and Epoxides

Tristan Roland (Prairie View A&M University)
Chemistry REU
Research Advisor: Donald Darensbourg

The reduction of carbon dioxide (CO2) has gained much attention since the increasing environmental concerns about global warming associated with carbon emission from industrial effluents, public transport etc. In this regard, over the past few years considerable attention has been made on the development of the chemical conversion of CO2 and its incorporation into synthetic materials. Among various efforts on the utilization of CO2 as a C-1 feedstock, the copolymerization of CO2 and epoxides has gained much interest from both academia and industrial communities because of its atom-economic and greener approach. The potential use of bio-based monomer as sustainable alternatives to replace the currently used petroleum-derived products represents an outstanding alternative to reduce their impact on the environment. In this presentation, we will describe the synthesis, characterization of bio-based monomer derived from eugenol and our attempts towards the copolymerization with CO2 as a C-1 source to access degradable polymeric materials.

71. Synthesis of 6-methyloxane-2,5-diol via Constructive Ozonolysis and Syn-Dihydroxylation

Hai Ly (Texas A&M University)
Chemistry REU
Research Advisor: Andy Thomas

Dihydroxylation of olefins has found use in many laboratory applications including the synthesis of relevant pharmaceuticals. Pioneering studies by Milas, the Upjohn company, and Sharpless have demonstrated reliable syn-dihydroxylation techniques using osmium tetroxide (OsO4) in stoichiometric and catalytic amounts. The Sharpless asymmetric dihydroxylation enhances these results by demonstrating an enantioselective strategy towards syn-glycols. The aforementioned procedures of Upjohn and Sharpless rely on high oxidation state transition metals like osmium in basic solutions for their reactivity. Although highly effective and reactive, OsO4 is incredibly toxic posing complications towards its use in pharmaceutical applications.

Recently, the Thomas Group has developed a green syn-dihydroxylation via an interrupted ozonolysis, capturing a key intermediate known as the primary ozonide (POZ). Initially their studies were focused on capturing POZs in batch at low temperatures, however the implementation of continuous flow reactors allowed for a facile generation and subsequent capture to yield various syn-glycols. The development of this reaction has been limited to small scale and herein we present the utility of this reaction on scale (>10 mmol) as part of the racemic synthesis of the uncommon sugar Rhodinose. The planned synthesis will consist of first a Claisen-Johnson Rearrangement, then Constructive Ozonolysis in continuous flow, and lastly a reduction with DIBAL.

72. Mechanism of CyuA

Mala Francis (Texas A&M University)
Chemistry REU
Research Advisor: David Barondeau

CyuA is a cysteine desulfidase that converts cysteine into sulfide, pyruvate, and ammonia. This enzyme was observed in Methanocaldococcus Jannaschii, which contains a [4Fe-4S] cluster. There were four residues identified in this study that likely play a role in the mechanism of this enzyme. The residues identified were K59, R218, C25, and E27. K59 likely participates in acid-base chemistry with water. R218 is thought to form a salt-bridge with the cysteine ligand's carboxyl group. C25 likely deprotonates the alpha carbon, which starts the reaction, and E27 eliminates the thiol group. To study the effects of these residues on the mechanism, the residues are converted to alanine, and then will be purified using nickel and size exclusion columns. Then, various assays (methylene blue, bradford, ferrozine) are used to quantify cluster occupancy and desulfidase activity of the enzyme.

73. Micro-droplet Reactions in a Triple-Barrel Capillary

Joohan Kim (Texas A&M University)
Chemistry REU
Research Advisor: Xin Yan

In recent years, as mass spectrometry has been utilized for reaction monitoring, the concept of reaction synthesis via mass spectrometry (MS) has emerged, employing techniques such as electrospray ionization to generate charged microdroplets serving as unique chemical microreactors. Leveraging the large surface-area-to-volume ratio inherent to microdroplets, our strategy focuses on delivering thin films directly to the interface via electromigration 1 in a triple-barrel capillary. Electromigration is the movement of charged particles, such as ions or electrons, under the presence of an electric field. This approach not only facilitates interfacial chemistry but also accelerates reactions by the microdroplet at the orifice of the capillary, in which multicomponent reactions can take place using this triple-barrel system. By coupling interfacial electromigration with MS analysis, we aim to investigate the accelerated electro-oxidative C-H/N-H coupling of pyridine with N, N’-dimethylaniline (DMA), and capture short-lived intermediates in the radical-radical coupling of DMA. The utilization of a triple-barrel system is imperative in our work as it offers enhanced control over the separation of competitive reactions.

74. Synthesis of Non-Canonical Amino Acids for Use in Phage Display Drug Assays

Ryan Fallon (Texas A&M University)
Chemistry REU
Research Advisor: Wenshe Liu

There are 22 naturally occurring amino acids but the 22nd amino acid, pyrrolysine, is only found in certain prokaryotes. Pyrrolysine is unique in that it is incorporated into proteins through post-translational modifications (PTM) of specific sites using the enzyme pyrrolysine tRNA synthetase (PylRS)

and its cognate tRNA. PylRS is an enzyme that displays exceptionally low substrate selectivity allowing for many different non-canonical amino acids (ncAAs) to be incorporated and subsequently displayed in bacterial proteins. Non-canonical amino acids are a group of molecules containing a peptide backbone but have a modified sidechain different from the 22 proteinogenic amino acids. Hydroxyproline and hydroxylysine are ncAAs that occur naturally through PTM, however their function in the cell still is not fully understood. ncAAs have unique chemical properties which can lead to unique functionalities in proteins that incorporate these molecules and have also shown promise for drug discovery as these molecules can provide unique building blocks to facilitate drug-substrate interactions for drug discovery projects. The aim of this project is to synthesize two amino acids, N6-propionyl-lysine (PrK) and N6-butyryl-lysine (BuK) for incorporation into Escherichia coli cells for further study using PTM. Synthesis of these molecules followed known synthetic routes to yield PrK (92%) and BuK (98%). This project seeks to further test the limitations of the enzyme pyrrolysine tRNA synthetase from methanosarcina mazei (mmPylRS) and its ability to incorporate ncAA into the proteins of E Coli. cells.

75. Toward 2D Lanthanide-based Magnetic Materials

Ryan O'Shea (Texas A&M University)
Chemistry REU
Research Advisor: Alison Altman

Long-range magnetic ordering in two-dimensional materials is impossible at nonzero temperatures under the isotropic Heisenberg model, so the isolation of a magnetic monolayer of CrI3 in 2017 was quite surprising. Since then, many other magnetic monolayers and nanosheets have been discovered, including Cr2Ge2Te6, VSe2, and Fe3GeTe2. Despite the high atomic magnetic moments and strong spin-orbit coupling (SOC) of the lanthanide series, relatively few nanosheets of lanthanide-based materials have been studied experimentally. While the radial contraction and core-like behavior of the 4f orbitals dampens superexchange interactions with neighboring anions, enhanced SOC in lanthanides leads to strong magnetocrystalline anisotropy that promotes structure-dependent intralayer magnetic ordering. This makes monolayers and nanosheets of lanthanide-based materials promising candidates for spintronic applications, as interlayer exchange interactions play less of a role in bulk susceptibility than materials with p or d frontier orbitals exhibiting more covalent character. Here, the exfoliation chemistry and magnetic properties of some layered lanthanide-based materials have been explored.

76. En Route to a Molecular Polygon with Square Geometry Containing Four (C≡C) Edges and Four Platinum Vertices

Tara Jackson (Texas A&M University)
Chemistry REU
Research Advisor: John Gladysz

Macrocycles with well-defined polygonal geometries – containing transition metal vertices and sp hybridized alkynyl edges – have become increasingly relevant. These molecular polygons, including triangles, rhombus, and squares, are speculated to be applicable in the development of metal-

containing anti-cancer drugs, supramolecular coordination complexes, and metal-organic frameworks. Molecular squares, in particular, have been extensively investigated by the Gladysz research group. Accomplishments include the synthesis of molecular squares with skew rhombus geometries constructed from polyynyl edges (of four and six carbons in length), with each edge attached to a platinum vertex containing chelating phosphines. From this work, attention has shifted to produce a molecular square constructed of eight carbon polyynyl edges. Progress has followed procedures developed by former group members to construct the molecular building blocks H(C≡C)2SiMe3, Me3Sn(C≡C)2SiMe3, (p-tol3P)2PtCl2, and trans-Cl(p-tol3P)2Pt(C≡C)2SiMe3. Future synthesis will continue to elongate the chain stepwise to build trans-Cl(p-tol3P)2Pt(C≡C)4Pt(Pp-tol3)2Cl, trans-Cl(p-tol3P)2Pt(C≡C)4Pt(Pp-tol3)2(C≡C)2SiMe3, and trans-Cl((p-tol3P)2Pt(C≡C)4)3Pt(Pp-tol3)2Cl. With the latter synthesized, new reactions conditions – based on the published procedures for C4 and C6 sided analogs – will be used to generate Me3Si(C≡C)2((p-tol3P)2Pt(C≡C)4)3Pt(Pp-tol3)2(C≡C)2SiMe3. This product will then be treated with chelating phosphines, used to enforce cis geometry, to create H(C≡C)2((PP)2Pt(C≡C)4)3Pt(PP)2(C≡C)2H, termed the “chain cut” square. This “chain cut” square will be a pre-organized orientation for square formation, characterized by two terminal alkynyl hydrogens oriented parallel to one another. Once obtained, attempts to homocouple via Hay-Glaser conditions will be investigated as a means to complete the square.

77. Tuning the Optoelectronic Properties of PPV through Installation of Phenyl Ring Substituents

Amanda Foster (Texas A&M University)
Chemistry REU
Research Advisor: Quentin Michaudel

Practical applications of conjugated polymers in organic electronic devices such as OLEDs and OPVs became widely realized in the 1990’s with poly(p-phenylenevinylene) (PPV) being used to make the first organic light-emitting diode (1). PPV derivatives are a class of polymers that have sparked interest in the scientific community due to their unique optoelectronic properties including small optical band gap, tunability, and ability to be conveniently made into high-quality films (2). PPV can be prepared through several methods, such as by the ring-opening metathesis polymerization (ROMP) of [2.2] paracyclophane-1,9-diene (PCPD), a highly strained and readily modified monomer which favors ring opening, driving the formation of the open-chained product when treated with a ruthenium catalyst (Figure 1a) (3). This powerful method can provide access to easily derivatized and electronically unique conjugated polymers via strategic installation of phenyl ring substituents. This research aims to synthesize electronically unique PCPD monomers by leveraging the Suzuki-Miyaura cross coupling reaction on bistriflate PCPDs and compare their electronic characteristics for a new generation of ultra low-cost and sustainable electronic devices such as solar cells and OLEDs.

(1) Polymer 2020, 207, 122874. (2) J. Am. Chem. Soc. 2020, 142 (28), 11983–11987. (3) ACS Macro Lett. 2024, 13(2), 112–117.

78. N-Pyridinium Arylamine Reagents for Anti-Markovnikov Olefin Aminofunctionalization

Lauren Brown (Texas A&M University)
Chemistry REU
Research Advisor: David Powers

As of 2014, 84% of all FDA approved small-molecule drugs contain at least one nitrogen atom. Within the family of nitrogen-containing compounds, aromatic amines specifically are important to many industries, including: pharmaceuticals, agrochemicals, photography, xeroxography, pigments, and electronics. Currently, olefin aminofunctionalization can provide access to arylamines; however, these reactions typically yield Markovnikov products. Utilizing nitrogen-centered radical intermediates, the anti-Markovnikov product can be selected for. In this work, we introduce N-pyridinium arylamine reagents as a means to generate arylamine radicals that engage in anti-Markovnikov olefin aminofunctionalization and allow for rapid structural expansion.

79. Synthesis of Fully Fused Polypyridine Ligands

Ian He (Texas A&M University)
Chemistry REU
Research Advisors: Lei Fang, Vikki Shinde

We have explored the various synthesis strategies and applications of spirotenes, a class of polycyclic aromatic compounds characterized by their non-planar helical skeleton composed of ortho-condensed aromatic rings. The study delves into various synthesis methods, including halogenation, cross-coupling, and [2+2+2] cyclization. Recent advances in molecular design strategies are also discussed, with a focus on improving the selectivity of thermodynamically beneficial products through "proofreading" mechanisms, and the challenges of olefin binding and catalysts in reactions such as closed-loop complex decomposition (RCM) are outlined. Emphasis is placed on experimental methods, including synthesis of specific helicene precursors, purification techniques, and interpretation of nuclear magnetic resonance (NMR) data to determine structural integrity and composition.

80. Characterization and Utilization of a Lattice-Isolated Distorted Pd(0) Center in Phosphine-Based Metal Organic Frameworks

Saim Waheed (Texas A&M University)
Chemistry REU
Research Advisor: David Powers

Palladium-catalyzed cross-coupling is one of the most popular reactions in modern synthetic chemistry. In this work, we generate and characterize lattice-isolated, geometrically distorted Pd(0) centers thought to be the active catalytic conformation/species in the oxidative addition step of traditional palladium reactions. Through the photochemical excitation of inactive palladium oxalate precursors, the reactivity of these high-energy, bent complexes is explored via oxidative addition with chlorobenzene, as well as the formation of alkene adducts. Initial investigations into the activity of L2Pd(C2O4) as a

photochemically generated precatalyst for traditional palladium-catalyzed reactions highlight the applicability of these catalysts as versatile and powerful alternatives to traditional Pd(0) and Pd(II) catalysts. Further characterization and reactivity is explored via metalation of a phopshine-based MOF ancillary ligand with palladium oxalate, utilizing the structural rigidity of the coordination network to photochemically generate stable, lattice-isolated bent Pd(0) centers.

81. Exploring Charge Distribution at Human Hair Roots with Scanning Ion Conductance Microscopy (SICM)

Kamila Alvarado Ortiz (University of Puerto Rico at Cayey)
Chemistry REU
Research Advisors: Lane Baker, Alyssa Hash

Scanning Conductance Ion Microscopy (SICM) is a scanning nanopipette technique that measures the ion current between two electrodes, a pipette electrode (PE) and a reference electrode (RE) present in the bath solution. At a constant potential, the ion current through the nanopipette depends on the tip-sample separation, which can be used as a feedback signal to allow the pipette to control distance between the pipette tip and an interface. SICM can be used to perform non-contact imaging of samples with high-resolution and to simultaneously observe topographical and surface charge maps. Changes in asymmetric charge distributions impact the ion current rectification (ICR), quantified as the ion current rectification ratio (ICRR). The ICCR is calculated at each pixel to generate a surface charge map. This study aims to investigate charge distributions at human hair roots. Previous studies demonstrate that the hair follicle face changes due to factors, such as substance abuse, medical conditions, and aging. This investigation is focused on the potential charge variations among different samples of hair. Initially, Scanning Electron Microscopy (SEM) was used to characterize the region of interest in the hair roots. The SEM technique relies on electron emission to provide high-resolution imaging. Subsequently, SICM was employed to generate detailed topographical and surface charge maps of hair roots.

82. First-Generation, Low-Income Students of Color: The Role of Microaffirmations in their Higher Education Experiences

Lilly Juarez (Texas A&M University)
Aggie Research Program
Research Advisor: Cristina Nader

First-generation, low-income (FGLI) Students of Color experience microaggressions and microaffirmations in higher education. We used a conceptual framework to investigate the microaggressions experienced and the impact of microaffirmations on FGLI Students of Color. We conducted a study with 11 participants attending predominantly white institutions (PWIs). Using a critical case study methodology, we conducted individual interviews, asking questions focused on student experiences with microaggressions and microaffirmations. We coded and analyzed interviews individually to identify the microaggressions and microaffirmations expressed by each student. The microaggressions encountered included microassaults, microinsults, and microinvalidations. The types

of microaffirmations observed were self-affirmations, cultural affirmations, social media engagement, and verbal and nonverbal affirmations. Analyzing the impact of microaffirmations on the experiences of FGLI Students of Color, our findings suggest microaffirmations empower these students to persist in higher education. Based on preliminary findings, educators and administrators can promote inclusivity and support by implementing microaffirmations in the form of inclusive language and FGLI program initiatives such as the Federal TRIO program. Furthermore, initial steps may include training faculty to better support FGLI students. Implications for research could explore the prolonged effects of microaffirmation practices on the persistence and graduation of FGLI Students of Color. Additional studies across different types of institutions such as historically black colleges and universities (HBCUs) or Hispanic Serving Insitutions (HSIs) could delve into the complexity of institutional context and its influence on the effectiveness of microaffirmations. Furthermore, addressing and mitigating microaggressions ensures FGLI Students of Color have better opportunities for success in their collegiate journeys.

83. Potential Impacts of Offshore Wind Farms to Recreational and Commercial Fisheries in the Gulf of Mexico: A Fisherman's Perspective

April Garza (Texas A&M University at Galveston)
Independent Research Project
Research Advisors: Jenna Lamphere, Elizabeth Nyman

The use of offshore wind as a renewable energy source has grown steadily over the past 2 decades, with Europe and China leading the front. The Block Island Wind Farm is the only operational offshore wind farm in the U.S. and began operation in 2016 off the coast of Rhode Island. Multiple studies have assessed the impacts to biodiversity that offshore wind turbines have on the surrounding ecosystem, with a marked increase in sessile invertebrates colonizing the base of the turbine and attracting larger pelagic fish and their predators. Only one study out of the Block Island Wind Farm—conducted 6 months after operation began—gathers local fishermen's perspectives on offshore wind and how it affects their business; no such study has been done for the Gulf of Mexico. Based on the results from the Block Island study, this research aims to gather the same data for the Gulf of Mexico and determine if apprehensions to offshore wind can be bridged through education and outreach. Data will be gathered through semi-structured interviews with local commercial and recreational fishermen and captains to gain their perspectives on the ecology and fisheries of the Gulf of Mexico and how offshore wind turbines might affect the surrounding environment. Some pitfalls of this study include: the timing of the research project meant that fishermen and charter captains were contacted during the 4th of July holiday week, which is an incredibly busy time for tourism in Galveston; additionally, three days after the 4th of July a category 1 hurricane hit the region, causing wide-spread power outages and delaying the interview process. The information obtained in this study can be used to determine social acceptance of offshore wind farms and if educational outreach can be used to combat apprehensions to offshore wind implementation.

84. Sociopolitical Barriers to Offshore Wind Energy Adoption in Texas: An Analysis of Stakeholders and Public Opinion

Lauren Bothwell (Texas A&M University at Galveston)
Independent Research Project
Research Advisors: Jenna Lamphere, Elizabeth Nyman

Although Texas produces the most onshore wind power of any U.S. state, there has been an obvious hesitance to adopt offshore wind to the portfolio. This is evident from the 3 federally approved lease sales in the Texas Gulf Coast, where no bids were submitted. This research investigates the sociopolitical factors that hinder Texas's adoption of offshore wind energy, particularly focusing on stakeholder influences and public political alignment. Despite the recognized potential of OSW for renewable energy production, Texas's unique regulatory environment and political resistance due to economic ties to the oil and gas industry present significant challenges. The central hypothesis posits that the political alignment of stakeholders, especially those economically linked to the oil and gas sector, adversely impacts OSW initiatives. This project employs the Technological Innovation Systems framework explained in Bergek et al. (2008), focusing on the Texas Gulf Coast, to map out key players including state government officials, economic experts, and maritime energy leaders. The methodology involves semi-structured interviews with experts and figures in each respective industry. We plan on creating a network web chart to visualize formal and informal connections among these stakeholders. Preliminary research indicates substantial political barriers, with specific figures and policies, such as the proposed SB 1303, acting as significant hindrances, and aligning stakeholder interests could facilitate offshore wind adoption. The ongoing research aims to propose policy changes that could mitigate these barriers, contributing to a more supportive environment for offshore wind energy in Texas.

85. The Impact of Pubic Perception on the Implementation of New Offshore Wind Farms

Cassie Meads (University of Houston Clear Lake)
Independent Research Project
Research Advisors: Jenna Lamphere, Elizabeth Nyman

While offshore wind energy has been harnessed and utilized by various countries since the early 1990s, it has not been until recently that the United States joined the sector of offshore wind energy production. With the first offshore wind farm in the United States going online in 2016 off the coast of Block Island, data regarding the extent of the impact of public perception on the planning and implementation of new offshore wind farms is limited. Studies conducted regarding public perception of the Block Island wind farm are also limited, primarily due to the low year-round population of the island. This paper seeks to analyze available literature, from within the United States and other countries, in order to gauge the impact of public perception on the planning and implementation of new offshore wind farms. As this was a meta-analysis, all studies involved were analyzed using a matrix analysis. The literature included involves fifteen independently sourced articles using Google Scholar and the online Texas A&M library database. The keywords used to source these studies include: wind energy, wind power, public perception, offshore wind farm, public opinion, perceived impact, tourism, and social acceptance. The findings contained herein denote a primarily positive public perception across multiple

income levels, education levels, and geographic locations. Despite this, there are many factors that can influence this perception, including: perceived transparency about the project, how close the project would be to residences, the aesthetics of the wind farm against the landscape, and how well the turbines can be heard.

86. Design of Materials with Metal—Insulator Transitions for Applications in Neuromorphic Computing

Amanda L. Reyes Pagan (University of Puerto Rico)
Chemistry REU
Research Advisor: Sarbajit Banerjee

Faced with an upcoming deluge of data arising from increasing adoption of artificial intelligence and the need for low power paradigms at the edge of the internet, modern computing stands at a crossroads. The primary obstacles include the limitations imposed by Moore's Law, the von Neumann architecture, and Dennard scaling. Our research focuses on neuromorphic computing, aiming to develop materials that mimic neuron- and synapse-like fast-switching behavior manifested in the Human Brain, particularly metal-to-insulator transition (MIT) materials that respond to stimuli such as temperature, voltage, and stress. Our work centers on using V_2O_5 to synthesize novel polymorphs that exhibit these properties. By focusing on V_2O_5 polymorphs as our primary template, we aim to develop MIT components that can be integrated into future computing technologies. Key emphasis is placed on $M_xV_2O_5$ materials that enable access to underexplored phases. Materials such as ε-$Cu_xV_2O_5$ and δ-$Sn_xV_2O_5$ are promising candidates for neuromorphic computing as a results of to their nonlinear dynamical modulation of conductance in response to applied fields. This research will spearhead technological advancement beyond current limitations and revolutionize computing by creating brain-like processing capabilities, enabling faster data processing and improved energy efficiency. We have designed new materials that are then characterized by a combination of X-ray diffraction, scanning electron microscopy, and other synchrotron X-ray spectroscopy tools to examine the foundational mechanisms underpinning conductance nonlinearities.

87. Hippocampal alpha7 nAChR Modulation of Neuroinflammation following a Traumatic Brain Injury

Conner Danao (Texas A&M University) and Samhitha Mada (Texas A&M University)
Independent Research Project
Research Advisors: Samba Reddy, Ursula Winzer-Serhan

Traumatic brain injury (TBI) induces a cascade of neuroinflammatory responses that contribute to secondary brain damage and long-term neurological deficits. Here, we utilized controlled cortical impact injury to model severe TBI in mice. Neuroinflammation is characterized by glial cell activation and increased release of pro-inflammatory cytokines, which exacerbates brain injury and impairs recovery. Modulating this response is critical for improving long-term outcomes. The alpha7 nicotinic acetylcholine receptor (α7 nAChRs) regulates inflammation, and enhanced activation could reduce

neuroinflammatory responses offering neuroprotection after TBI. Here we wanted to determine the extent of neuroinflammation one week post injury, and to investigate anti-inflammatory efficacy of PNU120596 (PNU), an α7-specific positive allosteric modulator (PAM) which enhances receptor activation. Following TBI, mice received daily drug or vehicle injections. Relative mRNA expression levels of six neuroinflammatory markers were measured using qPCR and compared to Sham controls. Seven days post TBI, there remained significant neuroinflammation in the contralateral hippocampus, with elevated levels of GFAP and IBA1 (astrocyte and microglia activation markers, respectively), and significantly increased expression of pro-inflammatory cytokines, IL-1β and TNFα, and chemokines, CCL3 and CXCL10. PNU did not significantly affect relative expression levels of these neuroinflammatory markers suggesting that enhanced activation of α7 nAChRs had no anti-inflammatory central effect in this mouse model. These findings indicate that while TBI induces prolonged neuroinflammation, using an α7 specific PAM like PNU, does not change neuroinflammation. Given the potential beneficial effects of PNU on other measures following TBI, exacerbation of neuroinflammation is not expected to hinder its therapeutic use.

88. Assessing Urbanization Impacts on Soil Carbon Content in Urban Gardens of Major Texas Cities

Brandon Yong (Texas A&M University)
Aggie Research Program
Research Advisors: Binayak Mohanty, Leah Kocian

Urban gardens are a socioeconomic advancement and provide a solution to food insecurity in densely populated cities with rapidly growing populations. However, these gardens are vulnerable to the detrimental impacts of urbanization, which can degrade soil health (e.g., soil carbon content) and introduce anthropogenic contamination. Despite the increase in urban agricultural gardens over recent decades, understanding the impacts of urbanization on soil and crop quality in these environments remains limited. This study aimed to assess the impacts of urbanization on the soil carbon content of urban gardens within a 10-mile radius of Superfund sites in three major Texas cities: San Antonio, Dallas, and Houston. We analyzed the soil carbon content in the top 30 cm of soil using a Total Organic Carbon Analyzer (TOC-L). Employing data analysis techniques such as clustering, principal component analysis (PCA), and linear regression, we evaluated and compared soil carbon content in gardens at varying distances from the city center. We also examined the influences of active cultivation, soil profile depth, land cover, and land use, which are critical factors affecting soil carbon content. Our findings underscore the importance of understanding the impacts of urbanization on soil carbon content and the subsequent effects on the fate and transport of inorganic contaminants in urban gardens. This knowledge is essential for improving land management practices to mitigate the impacts of urbanization and for planning future urban gardens.

89. Obstacle Avoidance for Unmanned Aerial Vehicles in GPS Denied Environments

Carter Klebuc (University of Houston)
Applied Computational Robotics REU
Research Advisor: Jason O'Kane

Unmanned Aerial Vehicles (UAVs) predominantly rely on Global Positioning Service (GPS) data for autonomous navigation. GPS-denied environments, such as indoor areas or urban canyons, cause GPS signals to become unreliable. This unreliability causes path planning algorithms used for navigation to fail, resulting in UAVs traveling in unintended directions and potentially colliding with the environment. Pathfinding techniques for UAVs in GPS-denied environments have been developed by researchers. This paper describes an approach to this pathfinding problem, based on a visibility graph combined with the A* algorithm. The visibility graph constructs a map of the environment by connecting visible vertices of obstacles, to create a network of possible paths. The A* algorithm is applied to this graph to find the optimal path to the desired location. This combined approach enables UAVs to navigate complex, obstacle-laden environments. UAVs can autonomously plan and adapt routes, avoiding collisions utilizing the visibility graph for mapping and A* for efficient pathfinding. This initial integration of the Visibility Graph and A* algorithm is the beginning of a robust solution for navigating UAVs in GPS-denied spaces. Future work will extend this approach by integrating Control Barrier Functions to facilitate the navigation of a swarm of UAVs, ensuring they reach their destination without colliding with obstacles or each other, further enhancing the robustness and applicability of the navigation system in GPS-denied environments.

90. Visibility-Based Pursuit-Evasion in an Occupancy Grid

Tyler Leffew (University of Dayton)
Applied Computational Robotics REU
Research Advisor: Jason O'Kane

The visibility-based pursuit-evasion problem calls for a pursuer to systematically search an environment to detect, and therefore capture, an evader in a known environment using an omnidirectional viewing ability. An existing algorithm for this problem by Stiffler and O'Kane utilizes a representation of the environment using simply-connected polygons. This paper describes the modification of that existing algorithm to work in a setting where the environment is represented as an occupancy grid. The method computes visibility from a point in an obstacle filled occupancy grid environment, decomposes multiple zones of non-visibility into discrete zones, and computes movement of those zones to track possible movements of an evader. Simulated results show effectiveness of this algorithm in real occupancy grids.

91. Control Systems for Autonomous Underwater Robots in High Risk Environments

William Xu (Texas A&M University)
Applied Computational Robotics REU
Research Advisor: Jason O'Kane

This project focuses on enhancing the autonomous capabilities of the BlueRev underwater robot to navigate through a hole in a dam using processed sonar data. Key tasks include achieving neutral buoyancy with ballasts, developing robust PID controllers for precise movement and depth control, conducting extensive field trials for tuning, and implementing advanced signal processing to clean sonar data. The ultimate goal is to enable the BlueRev robot to accurately locate and navigate through the hole, contributing to safer and more efficient operations in high-risk underwater environments such as dam inspections.

92. Simulation of Static Target Detections from Automotive Doppler Radar

Christina Kim (San José State University)
Applied Computational Robotics REU
Research Advisor: Dezhen Song

Radars are often used for navigation in autonomous vehicles. While it is understood how the radar measures objects in the environment, the complete structure of the scene the radar observes is often unknown, and it is difficult to associate each radar detection with particular objects. In order to compare the output of radar algorithms to the ground truth, synthetic radar data from a simulated scene is often used. We simulate measurements of range, elevation angle, azimuth, and Doppler velocity from random points on geometric objects to provide ground truth information for the evaluation of radar algorithms.

AFTERNOON SESSION

2:00 PM – 4:00 PM

1. Screen Time and Oral Health in Children with Special Health Care Needs: The Mediating Roles of Physical Activity, Diet, and Dental Visits

Vy Ha (Austin College)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Raghad Obeidat, Peggy Timothé

Screen time has been linked to poorer oral health outcomes in the general pediatric population. Studies suggest that higher rates of screen time are associated with increased consumption of cariogenic foods, poor dietary habits, and reduced oral hygiene practices among children. Despite these findings, limited research has assessed this relationship within a particularly vulnerable population: children with special health care needs (CSHCN), who are at greater risk of adverse health outcomes due to multiple factors such as limited access to dental care, behavioral difficulties, challenges in self-care, and potential socioeconomic barriers. These unique challenges may exacerbate the effects of prolonged screen time on their oral health. Parental knowledge and practices are key to reducing the effects of screen time on children's oral health. Informed parents can better manage screen time and dietary habits. Understanding the impact of screen time on oral health in children with special healthcare needs (CSHCN) is vital for developing targeted interventions and preventive strategies. This cross-sectional study, using the 2021-2022 National Survey of Children's Health (NSCH) database, will explore the association between screen time and oral health among CSHCN and assess how physical activity, diet, and dental visits mediate this relationship. We hypothesize that increased screen time correlates with poorer oral health outcomes, mediated by unhealthy diet, infrequent dental visits, and reduced physical activity. The findings aim to guide healthcare providers, caregivers, educators, and policymakers in improving oral hygiene behaviors and tailoring treatment plans for CSHCN, thus enhancing their overall well-being.

2. A Comparative Study of the Association Between Hard Drug Use and Periodontitis Using NHANES Data

Angela Chen (Berea College)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Pati Debdeep, Peggy Timothé

Background: The goal of this study is to examine the correlation between hard drug usage and periodontitis in adults using the 2013-2014 NHANES medication and health examination datasets. By employing R Studio to make stratified analyses using the National Health and Nutrition Examination Survey dataset, this study can provide further context behind dental health gaps across America.

Methodology: The presence of periodontal disease will be defined by the CDC's guidelines based on attachment loss and probing depth measures (dependent variable). The independent variables are usage or non-usage of cocaine, heroin, and methamphetamine. Welch Two Sample t-test will be utilized in bivariate data analysis and will be done in the RStudio statistical software (version 4.4.0).

Hypotheses: H0: There is not a significant association between hard drug use and periodontitis prevalence. H1: There is a significant association between hard drug use and periodontitis prevalence.

Results: The analysis will focus on participants who have completed a full periodontal exam and use the individual mean of LOA (loss of attachment) to compare users of hard drugs to non-users. The results will be presented with the corresponding 95% confidence intervals and p-values.

Conclusion: This biostatistical study examines the potential association between two public health concerns: substance abuse and periodontitis. By utilizing the NHANES datasets, this research strives to contribute to the understanding of dental health disparities across the US. Findings may result in implications in both dental care practice and substance abuse treatment, potentially leading to more comprehensive healthcare strategies.

3. Patterns of Emergency Department Visits for Non-Traumatic Dental Conditions in Rhode Island

Tamiah Pelzer (Delaware State University)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Akinlotan Marvellous, Peggy Timothé

This research project investigates disparities in Emergency Department (ED) visits for non-traumatic dental conditions (NTDCs) in Rhode Island. Utilizing HCUP SEDD data from 2019 of the state's hospitals, the study aims to identify patterns of NTDC-related ED visits in Rhode Island. Rhode Island's small size allowed for an in-depth analysis within a limited timeframe, focusing on demographic variables such as age, gender, and socio-economic status. The dataset initially was comprised of about 420,395 general hospital cases including trauma, chronic conditions, surgical needs, etc. Our data was refined through a rigorous cleaning process to include 4,912 NTDC cases which is about 1.17 % of the general hospital cases, we are unsure how this compares to the national average but hopefully through more research and analysis we can dive deeper into this. We are currently analyzing the data to derive comprehensive findings regarding the demographics and patterns associated with NTDC-related ED visits. Our methodology involves detailed statistical analysis and data visualization using R Studio to elucidate the characteristics linked to these visits. By investigating these patterns, this study will highlight critical areas where dental health interventions are needed, particularly in regions with limited access to regular dental care. Ultimately, our findings will inform public health strategies and policies aimed at addressing disparities in dental health care access and improving overall oral health outcomes for both populations in Rhode Island. This research emphasizes the necessity for enhanced dental services to reduce the reliance on emergency departments for dental care.

4. The Influence of Unhealthy Lifestyle Behaviors, such as Alcohol Consumption and Marijuana Use, on Oral Hygiene Practices by Adolescents Aged 13-17 in Thailand

Tia Pandey (Texas A&M University)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Venkata Naga Nalini Dhurjati , Peggy Timothé

Introduction: Thailand is the third most populated country in Asia and 27.3% of young adults in Thailand engage in underage drinking. Illicit social behaviors such as alcohol consumption and marijuana use are

common amongst adolescents, but limited studies have been conducted to explore the influence of such behaviors on oral hygiene practices. However, from the studies conducted, patients with marijuana use and alcohol consumption history were more likely to present oral health conditions.

Methods: We performed a secondary data analysis from the Global Student Health Survey, Thailand 2021. We focused on self-reported personal habits of about 5,661 individuals aged 13-17, specifically alcohol consumption, marijuana use, and tooth brushing practice. In order to test association between unhealthy lifestyle behaviors and tooth-brushing frequency we utilized chi-square testing in R, a test comparing the expected and observed results. Age and gender were the only demographic variables taken into consideration.

Results: We will describe the percent of the population taking part in unhealthy lifestyle behaviors such as alcohol consumptions and marijuana use. We are also going to assess the influence of such behaviors on oral hygiene practices like tooth brushing.

Conclusion: Oral hygiene practices such as tooth brushing frequency is crucial to our oral health. If neglected, one can risk plaque build up which can attack our enamel causing various oral health issues ranging from caries to gum diseases. With the increase of unhealthy lifestyle behaviors it is critical that public health interventions are set in place to promote oral hygiene practices.

5. Access to Care for Medicaid-Eligible Children: Analyzing Healthcare Provider Distribution in Low-Income Texas Areas

Miranda Martin (Texas A&M University)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Josefine Ortiz Wolfe, Peggy Timothé

Medicaid, a crucial federal and state program, provides healthcare coverage to low-income individuals and families, including children.In Texas, the STAR Managed Care Program is a no-cost plan that offers Medicaid benefits specifically for low-income children. Understanding that Medicaid serves low-income families, it is essential that low-income areas have access to Medicaid-participating healthcare providers.This study investigates how the distribution of these providers affects access to care for Medicaid-eligible children in low-income areas of Texas. By analyzing the distribution of medical providers, dental providers, primary care providers, and hospitals, this research identifies gaps in healthcare services available to these vulnerable populations. The study focuses on counties with the lowest incomes in Texas, revealing disparities in provider accessibility, particularly in rural and underserved areas. Using the Superior HealthPlan provider search tool, the number of medical providers, dental providers, primary care providers, and hospitals within 50 miles of a zip code will be recorded. The results include maps pinpointing Medicaid-participating offices, graphs showing the proportion of different types of healthcare services available in low-income areas, and a gap analysis identifying and quantifying the discrepancies between the availability of healthcare services in low-income areas compared to high-income areas. These findings underscore the urgent need for targeted interventions to improve healthcare access and equity for Medicaid-eligible children statewide.

6. Assessing Ethics and Social Sciences Requirements in Dental Continuing Education in California, Texas, Florida, New York, Pennsylvania, and Illinois: Implications for Equity

Emma Loken (Texas A&M University)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Josefine Ortiz Wolfe, Peggy Timothé

Continuing education (CE) for dentists plays a crucial role in professional development and patient care quality. This study aims to assess the percentage of CE hours dedicated to social sciences and education categories across dental boards in the top 6 largest states in the US: California, Texas, Florida, New York, Pennsylvania, and Illinois. The importance of social science courses in dentistry lies in their enhancement of dentists' communication skills, cultural competency, and understanding of social determinants of health. This, in turn, can contribute to addressing health equity issues by improving access to care and patient outcomes. Demographic analysis of dentists will examine whether dental healthcare providers reflect the diversity of the communities they serve, with a focus on minority groups. This analysis will be conducted using demographic data from licensure records and census data. Other CE data will be sourced from state dental board records and professional education databases. The findings will include distribution of requirements for oral health outcomes, specifically tooth decay and caries in children ages 1-17. Furthermore, health outcomes related to untreated dental caries will be ranked and compared across different racial and ethnic groups in these states. Understanding these disparities can highlight areas where targeted interventions and CE efforts are most needed to improve oral health equity. This study aims to provide insights into the current state of dental CE practices, their alignment with social sciences education, and their potential for reducing health disparities in dental care among diverse populations in the largest US states.

7. Comparative Analysis of Dental Visits: Trends in Medicaid vs. Private Insurance (2017-2022) Using National Medical Expenditure Survey Data

Christine Tran (University of Houston)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Sawsan Salih, Peggy Timothé

Introduction: Access to dental care is a critical public health issue, significantly influenced by a patient’s type of insurance. This study explores dental visit trends among Medicaid participants and privately insured individuals from 2017 to 2022. By examining differences in expenditure and utilization, the study aims to contribute to understanding these disparities and inform future policy adjustments to promote dental care equity.

Methods: This study utilized data from the 2017-2022 Medical Expenditure Panel Survey, a comprehensive source of national expenditure information on each dental visit, including date, type of provider, procedure provided, source of payment, and payment amount. The data were collected via computer interviews and rigorously analyzed, identifying graphic displays to compare Medicaid participants and privately insured individuals.

Results: The analysis revealed significant differences in the total number of dental visits, types of procedures, and associated costs between Medicaid participants and privately insured individuals. Those with private insurance had more total visits and a broader range of dental services, specifically comprehensive care. However, those with Medicaid had limited coverage in comprehensive care and lower insurance payments.

Conclusion: The comparative analysis uncovers significant expenditure and dental care access disparities between Medicaid participants and privately insured individuals. The results of the study suggest a need for policy adjustments, such as increasing fees for participating providers and enhancing comprehensive coverage for Medicaid participants. These changes could have a profound impact, improving providers' willingness to accept Medicaid and enhancing overall dental health among Medicaid participants, thereby advancing toward greater dental care equity.

8. The Effects of Traumatic Brain Injury on the Development of Alzheimer's Disease Using Fluid Percussion Injury and CAP in Mice

Camerin Kimble (Xavier University of Louisiana)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Alan Dabney, Peggy Timothé

Traumatic brain injury (TBI) and Alzheimer's Disease (AD) are critical public health issues. This study explores the effects of TBI induction in mice through real and sham surgeries, focusing on various behavioral and physiological responses. Mice were randomly divided into four groups based on four variables: real TBI-inducing surgeries (fluid percussion injury), sham surgery, use of CLIP antagonist peptides for anti-inflammatory factors, and the use of a saline vehicle. Wild-type mice were given the sham surgery and the vehicle to use as a control. Key factors assessed included burrowing behavior, social index, and sucrose consumption, among other factors. Each variable was analyzed in a post-injury versus pre-injury context. Significant changes were noted within each variable combination, showing the effects of each surgery and protective measures on each mouse tested. Effects of TBI and AD on oral health were also studied. Major declines in oral health were found in patients based on the severity of TBI and AD.

9. Comparative Analysis of Emergency Dental Visits and Office Costs Across Maryland Counties (2008-2022)

Adelaide Sorbo (Texas A&M University)
Biomedical Informatics and Behavioral Sciences (BIBS) Summer Research Program
Research Advisors: Sawsan Salih, Peggy Timothé

This research analyzes the cost of dental care and emergency department visits in Maryland, investigating the roles of race and county poverty levels. Maryland's diverse population and significant healthcare disparities make it an ideal focus. Comparing emergency dental visit frequencies with office visit costs across counties aims to uncover systemic issues and inform health insurance policy changes to improve coverage and reduce emergency visits. Data from healthdata.gov, data.census.gov, and

data.cms.gov, collected between 2008-2017, 2020, and 2022, will be analyzed. The analysis examines racial and income disparities relative to county poverty levels using RStudio and Microsoft Excel. Statistical methods include Descriptive Statistics and Multiple Linear Regression to assess the impact of demographics on emergency visits and dental costs. It is expected that the analysis will show a positive correlation between the number of emergency department visits and the cost of dental care in the same area. Counties with lower poverty levels are expected to have a higher number of emergency department visits for patients seeking oral care. Disparities by county indicate changes should be made to the Medicare system to include better dental coverage and reduce the number of emergency department visits for dental care. Maryland's unique demographic and economic landscape highlights the need for targeted policy adjustments. Improved dental coverage is essential to address these disparities, but addressing the shortage of dentists is also crucial. Without these changes, systemic issues will persist, continuing to burden emergency departments and leaving many without adequate dental care.

10. Investigating Copper Trafficking from Cytosol to Mitochondria in Yeast Cells for Installation in Cytochrome c Oxidase

Clara Carroll (Bucknell University)
Biochemistry REU
Research Advisor: Paul Lindahl

Copper is an essential transition metal for cytochrome c oxidase or Complex IV in the respiratory electron transport chain located in the inner mitochondrial membrane. However, uncertainty remains as to how copper is trafficked from the cell cytosol into the inner membrane space (IMS) of the mitochondria. The Lindahl Lab hypothesizes that copper enters through pores in the outer mitochondrial membrane in the form of a low molecular mass copper complex, CuLMM, which contains an unknown ligand L. To understand copper trafficking into the IMS from cytosol and eventually identify CuLMM, WT303 yeast cells were grown in the presence of copper and their mitochondria were isolated. A cytochrome c oxidase activity assay was developed in which the oxidation of cytochrome c was monitored spectrophotometrically at 550 nm. With the addition of soluble mitochondrial extracts (SMEs) to reduced cytochrome c, the absorbance decreased, indicating that oxidation of cytochrome c was occurring, and that active cytochrome c oxidase was present in the SMEs. Future studies can be performed in which WT303 yeast cells are grown in copper-starved minimal media and their isolated mitochondria will be exposed to copper-containing cytosol. Trafficking of copper from the cytosol into the copper-starved mitochondria can then be spectrophotometrically monitored and later analyzed by analytical techniques such as inductively coupled plasma mass spectrometry (ICP-MS) to identify copper species present.

11. Optimizing the Isolation and Characterization of Lavendomycin

Josh Koval (Saint Francis University)
Biochemistry REU
Research Advisors: Paul Straight, Kalyani Josyula

Antimicrobial resistance (AMR) has become an increasingly problematic issue worldwide. The first major surge in AMR can be attributed to the "golden age" of antibiotic discovery (from the 1940s to the 1960s), which resulted in overuse of antibiotics and hindered future antibiotic discovery. Streptomycetes are responsible for the production of a wide range of antibiotics; however, each species can produce numerous secondary metabolites that have yet to be discovered and characterized. Lavendomycin is a peptide antibiotic produced by an NRPS biosynthetic gene cluster. Although the antibiotic was first discovered in 1985 and preliminary studies demonstrated its activity against Gram positive bacteria, no further reports have been documented about Lavendomycin. To study the metabolite's antibiotic potential, Lavendomycin was isolated from Streptomyces sp. Mg1 (SMg1) using organic extractions of the media and its presence was checked using MALDI-TOF MS (Matrix-assisted laser desorption/ionization-time-of-flight mass spectrometry). Preliminary studies were conducted with Bacillus subtilis to identify the mechanism of action. The chemical nature of the antibiotic suggests that Lavendomycin targets the cell envelope.

12. Oil Film Thickness Imaging Using Laser-Induced Fluorescence (LIF)

Ferris Turney (Texas A&M University)
Independent Research Project
Research Advisor: Waruna Kulatilaka

Knowledge of oil film characteristics and dynamics in turbomachinery applications is crucial for understanding machine performance. Insufficient lubrication, cavitation, and poor flow characteristics of lubrication can negatively affect turbomachinery performance and, if severe enough, cause damage. A variety of numerical methods and computational techniques are available for predicting film thickness behavior, but they prove difficult to validate experimentally due to the nature of conventional (intrusive) measurement techniques for flow characteristics within machines. This study aims to non-intrusively measure oil film thickness in turbomachinery using Laser-Induced Fluorescence (LIF) technology. Characteristics of the oil-soluble dye used in this experiment (Pyrromethene 597) were first demonstrated in preliminary studies to confirm its behavior, determine the optimal laser power, dye concentration, and camera software settings, and to adjust the laser beam profile for consistent power delivery. A custom-made calibration device will then be used to establish a relationship between fluorescence intensity and oil film thickness for future work. Verification of numerical and computational techniques for simulating oil film thickness with experimental data will allow for improved turbomachinery design and increased performance.

13. Ubiquitin Expression, Purification and Phosphorylation for monitoring the activity of the E3 Ubiquitin ligase, Parkin, by NMR Spectroscopy and Other Techniques

Jazmin Chavarria (University of the Incarnate Word)
Biochemistry REU
Research Advisors: Josh Wand, Rosana Lopes

Parkinson's Disease is a neurodegenerative brain disease that causes unintended body movements and other symptoms that progress over time making it difficult for an individual to execute daily functions. These symptoms are mainly caused by the loss of dopamine in the midbrain. Currently in the United States, about one million people are affected by Parkinson's Disease and although medications are administered to suppress the symptoms, a cure for this disorder has not been developed. Parkin is an E3 ubiquitin ligase that initiates mitophagy or the destruction of damaged mitochondria via the proteasome pathway. Mutations in Parkin have been associated with early onset Parkinson's Disease. Parkin is highly regulated by Phosphorylated Ubiquitin (pUb) which is an allosteric activator. A goal of the Wand Lab is to understand how human Parkin is regulated. One area of interest is the interaction of Parkin and phosphorylated ubiquitin using NMR spectroscopy. A protein pellet containing Ubiquitin previously expressed in an E. Coli culture grown in 15 N isotopically enriched M9 media was solubilized by sonication and purified by the ammonium sulfate precipitation method. The purified Ubiquitin sample was then phosphorylated with PINK1 to produce pUb. The pUb was then used to perform various assays to determine Parkin activity.

14. Characterizing the Cellular Permeabilization of DNA-Intercalating Agents during λ Infection with Super-Resolution Fluorescence Microscopy

Lily Torrans (William and Mary)
Biochemistry REU
Research Advisor: Lanying Zeng

Antibiotic resistance has become a prevalent issue in recent years as pathogenic bacteria are evolving to render many of our treatment strategies useless. Notably, bacteriophages-viruses that infect bacteria-have shown promise as novel tools to help combat this resistance. Bacteriophages and antibiotics used in combination to increase success of bacterial killing is known as phage-antibiotic synergy (PAS). However, little is known about the potential mechanisms for PAS, especially the permeability changes of antibiotics during phage infection. In an attempt to better characterize this process, we utilized super-resolution fluorescent microscopy and fluorescently-labeled bacteriophage λ to visualize phage infection at a single-cell level and further quantify the cellular permeabilization of both DNA-intercalating and non-intercalating agents into Escherichia coli cells. Our fluorescence data shows that upon phage infection, there is an increased uptake of daunorubicin, a known DNA-intercalating agent, by E. coli. Interestingly, when E. coli cells were treated with rhodamine B and fluorescein, which are not DNA-intercalating agents, any drug uptake post-infection was not significant. An efficiency of plating (EOP) assay further confirmed these results, as the EOP of λ on its host was inhibited by the known intercalating agent while remaining relatively unaffected by the non-intercalating agents. The

underlying mechanisms for the difference uptake consequences of these small molecules still need to be further investigated.

15. Evaluating the Adhesion and Structural Integrity of Epoxy-Infiltrated PLA and ABS Tensile Specimens Using Vacuum-Bagging Technique

Gavin Slone (Somerset Community College)
Metrology and Inspection REU
Research Advisors: Jyhwen Wang, Rishabh Yadav

This research investigates the mechanical properties of PLA and ABS tensile specimens infiltrated with epoxy resin using the vacuum-bagging technique. The primary objective is to determine whether the bond type (PLA-epoxy or ABS-epoxy) or the interconnectedness of the printed geometry has a greater impact on the strength of the infiltrated specimens. Over the course of this ten-week project, significant time was dedicated to optimizing the vacuum-bagging process to ensure successful infiltration of both PLA and ABS specimens. Preliminary observations suggest that the PLA-epoxy adhesion is noticeably stronger compared to the ABS-epoxy adhesion. However, due to time constraints, tensile testing has not yet been performed on the infiltrated specimens to quantitatively assess their mechanical properties. Additionally, the effect of infill pattern interconnectedness on the overall strength remains unexplored, though it is hypothesized that a continuous pattern, such as the gyroid pattern, will yield more favorable mechanical results when infiltrated compared to a less-continuous pattern such as the grid pattern. This project lays the groundwork for future studies by establishing a reliable vacuum-bagging process and providing initial qualitative insights into the adhesion characteristics of PLA-epoxy and ABS-epoxy bonds in tensile specimens. Future work will focus on conducting tensile tests to quantify the mechanical strengths and further investigate the role of infill pattern interconnectedness in the strength of infiltrated specimens.

16. Visualization of Oil Droplet Distribution for Minimum Quality Lubrication (MQL) Machining Optimization

Michael Clifford (University of Georgia) and Olivia Dillenbeck (University of Rochester)
Metrology and Inspection REU
Research Advisor: Bruce Tai

Minimum Quality Lubrication (MQL) machining is a manufacturing technique that reduces the amount of lubricant in various types of metalworking processes. As the name implies, this process aims to minimize the amount of cooling fluids used within the manufacturing process to keep the equipment at acceptable temperatures and minimize wear on mechanical components. To effectively minimize lubricant usage, we hoped to achieve a system that produces small oil droplet sizes. Within our project, we have developed a spiral foam polymer channel to control the size of the oil droplets. The helical polymer channel will act as a low pass filter in which centrifugal forces are used to separate heavier/larger droplets from the stream. Therefore, smaller oil droplets may only pass through to the end of the channel. Computational Fluid Dynamics (CFD) was used to predict the two-phase flow of oil

and air within the spiral channel, showing the difference of flow compared to that of a straight channel. Ending results include a computational analysis on the droplet size distribution out of both channel geometries. Results show that a foam polymer spiral channel produces smaller oil droplet sizes compared to that of a straight channel. The overall goal of our project is to effectively manufacture a spiral polymer channel design that fulfills the intended purpose of limiting the size of oil droplets while also maintaining a consistent air pressure throughout.

17. Low-Cost Ultra-High-Speed Imaging for High-Speed Machining

Sophia Fitzgibbons (Temple University) and Christian Lawson (University of Maryland)
Metrology and Inspection REU
Research Advisor: Dinakar Sagapuram

During machining and manufacturing, it is crucial to understand the flow of material near interfaces, free surfaces, and crack propagation. Material flow near surfaces, free surfaces, and crack propagation can be used to determine how a material will deform or fracture during manufacturing processes. Image-processing algorithms were developed and used to extract features from images of a chip being formed during machining. Algorithms such as entropy edge detection and fuzzy logic-based edge detection were used to distinguish the material from the rest of the image. In particular, both algorithms were optimized to map any discontinuities. Both algorithms were then used to create a binary mask of an image once they had been optimized. An image was processed iteratively using the fuzzy logic edge detection algorithm. After obtaining the resulting image, the entropy edge detection algorithm was applied to it. A built-in interpolation algorithm was then used to determine the properties of the points in the material based on the images. The entire model was developed using MATLAB and applied to microscope images of a machined chip exhibiting continuous, wavy, and segmented fractures.

18. An Investigation into the Print Parameters and Mechanical Properties of a Wide-Nozzle FDM Printer

David Jaggers (University of Louisville)
Metrology and Inspection REU
Research Advisor: Jyhwen Wang

Fused Deposition Modeling (FDM) is one of the most commonly used Additive Manufacturing processes to date. The FDM process extrudes thermoplastic materials layer by layer using pinch rollers and a heating mechanism. This technology enables the creation of complex geometries with efficiency and accuracy. Traditional FDM systems utilize a small circular nozzle to extrude filament, which allows for a precise print. However, this is potentially at the expense of both printing speed and mechanical strength. This research investigates the effects of a wide-nozzle geometry on the efficiency and mechanical properties of FDM-printed PLA specimens. Specifically, the nozzle exit was modified into a “stadium” geometry to increase the width of the extrusions. The study focused on determining optimal print parameters such as extrusion amount, nozzle velocity, and nozzle height tailored to this wide-nozzle configuration. Mechanical tests were conducted to quantify the impact of nozzle geometry on

the printed parts' performance. By systematically varying printing parameters, this research aims to establish guidelines for maximizing print consistency and reliability using this modified nozzle geometry, thereby advancing the capabilities and applications of this Additive Manufacturing technique.

19. Performance Of Geometry-Based Functionally Graded Additive Manufactured Interfaces

Meredith McNichols (Texas A&M University)
Metrology and Inspection REU
Research Advisor: Mathew Kuttolamadom

This project focuses on the design, simulation, and testing of functionally graded (FG) multi-material interfaces. In general, FG interfaces provide the “best of both worlds” by maximizing strength-based material properties while reducing crack initiation/propagation by eliminating harsh transition areas that would otherwise exist between materials having significant property differentials. In this project, functional gradation is achieved via interlocking graded geometric patterns at the contact regions between metal and polymer faces. First, finite element analysis was employed to determine suitable geometry configurations. Then, the metallic side was manufactured using selective laser melting (SLM), and then the polymer side was deposited onto it using fused deposition modeling (FDM). Various mechanical tests, including tensile and hardness tests were performed to determine the properties and performance of the resulting assemblies. The graded geometric patterns withstood higher tensile loads than their uniform pattern counterparts.

20. Design & Manufacture of Functionally-Graded Additive Manufactured Dental Crowns

Ayelen Mora (University of Central Florida) and Maya Yagan (Florida Gulf Coast University)
Metrology and Inspection REU
Research Advisor: Mathew Kuttolamadom

Compared to natural teeth, dental crowns exhibit a higher propensity for fractures and chipping post-implantation. This study aims to replicate certain mechanical property distributions of natural teeth through the utilization of selective laser melting (SLM) additive manufacturing. For this, pore-based designs were employed to impart spatial gradients in stiffness and hardness within bulk tooth models. Using stainless steel 316L, representative structures were fabricated via SLM while also investigating the influence of pore unit cell size and distribution on the resulting local/global property distributions. These were then subjected to compressive tests to correlate their performance with the processing-structure-property framework. Results from this work are expected to help inform future bio-inspired dental crown designs and the comparative performance achievable.

21. Corrosion Detection and Inspection Using Computer Vision and Machine Learning

Tom Hill (Penn State)
Metrology and Inspection REU
Research Advisor: ChaBum Lee

Early detection of potential corrosive areas is crucial for various industrial and technical applications. This research project aims to measure and classify various levels of corrosion on a surface using computer vision as well as detect the earliest signs of corrosion using a machine learning algorithm. It is important to be able to inspect and measure areas of corrosion in a way that does not affect the inspected object. Using a computer vision technique allows for the corroded area to be identified and measured using an image of the inspected object, allowing for the object to be inspected without potential harm. By taking a background(non-corroded) image alongside images containing various levels of corrosion and comparing this to an image of the sample, pixels that differ in intensity can be marked and stored to create a mask of the corroded area while also being categorized as different degrees of corrosion. Further, using machine learning, corrosion can be detected within potential corrosive areas at their earliest stages. By documenting how a surface corrodes over time using sequential images, a machine learning algorithm is able to label surfaces based on various stages of corrosion.

22. Additive Manufacturing of a Polymerization Machine Utilizing the Digital Light Processing Technique

Anya Hawkins (Arizona State University)
Metrology and Inspection REU
Research Advisor: Jyhwen Wang

The focus for this research study is to explore the manufacturing of a polymerization machine by curing photopolymer resin through the digital light processing technique. The aim is to optimize the manufacturing process for improved precision and quality in dental applications. The process begins with the setup of the machine and testing parameters. Parts are created by using photopolymer resin followed by characterization analysis to assess their suitability for dental crowns. Thinner layers below 25 micrometers have a greater dimensional accuracy than the thickest layer of 100 micrometers. Results indicate that reduced layer thickness not only improves detail resolution but also contributes to better overall structural integrity. Additionally, the resolution of the projector’s light source affects the dimensional accuracy across all layer thicknesses. By examining the angular precision of printed cube specimens, we assess the machine's capability to produce geometrically accurate figures. Moreover, the study explores the effects of varying parameters, including photopolymer resin composition and curing time, to refine the manufacturing process and establish best practices for clinical applications. This research lays the groundwork for future advancements in dental crown production, highlighting the potential of digital light processing technology to deliver high-quality, precise dental restorations.

23. Elevating Elevators: Optimizing Counterweight Balanced Elevators

Logan Johnson (Coe College)
Metrology and Inspection REU
Research Advisor: Chabum Lee

Elevators are near-constant in our lives, taking people and cargo to new heights. The useful machine, however, can be limited by how comfortable it is for those who use it. We as riders are conscious of the velocity, acceleration, and jerk of the elevator. Many want to have the fastest elevator, but with this speed, there is a tradeoff of needing higher acceleration and therefore jerk. We strive to find the best configurations that give riders the fastest ride, with the lowest jerk to have the most comfortable ride. We can understand this system with a counterweight balanced elevator model with a chain-driven motor. Along with a myriad of sensors, an accelerometer, laser displacement sensor, and load cell force sensor. This group of sensors allows us to measure our velocity, acceleration, and jerk. We also study the frequency of the system in order to more accurately measure the transient response of the system. By conducting a series of trials with varying counterweights and motor speeds we can put together a collection of configurations that are determined to be in a comfortable range for users. Altogether this study's goal is to optimize elevator performance and give insights for smoother and more efficient elevators.

24. Anxiety and Depression in Latino College Students: Sex and Nativity Differences in the AGGIES Pilot Study

Aimee Cisneros (Texas A&M University) and Alexa Linarez (Texas A&M University)
Independent Research Project
Research Advisors: John Hettema, Shaunna Clark

Background: Anxiety and depressive disorders are a leading mental health concern, impacting a significant portion of the global population. Despite US Census projections that Latinos will comprise 24% of the U.S. population by 2050, they remain underrepresented in genetic mental health research. This work assesses depressive and anxiety disorders amongst Latino students at Texas A&M University. We hypothesize female birth sex and U.S. nativity will be risk factors for these disorders in the Latino population.

Methods: Participants (N=727) in the AGGIES Pilot Study completed an online survey and provided a saliva sample. Clinical diagnoses for agoraphobia, generalized anxiety disorder, major depressive disorder, panic attacks, social phobia, and specific phobia were determined using The World Health Organization Composite International Diagnostic Interview Short Form (CIDI-SF). Chi-squared tests and t-tests were utilized to compare the effects of sex and country of origin.

Results: Consistent with broader trends, females showed higher prevalences of all anxiety and depressive disorders compared to males. No significant differences in the prevalence of these disorders were identified across generations of immigration.

Discussion: Studying anxiety and depressive disorders in Latino populations is necessary due to the unique sociocultural factors that impact this group. Future research will investigate these phenotypic

variations and analyze genetic data in addition to developmental exposures to elucidate how these factors contribute to mental health disparities, informing culturally sensitive interventions.

25. Mapping Graft-to-Host Connectivity in the Injured Cervical Spinal Cord Following Transplantation of Neural Progenitor Cells

Elizabeth Jaime (Texas A&M University) and Hannah Thomas (Texas A&M University)
Independent Research Project
Research Advisor: Jennifer Dulin

Neural progenitor cell (NPC) transplantation is a promising therapeutic strategy for spinal cord injury (SCI), as NPCs are able to mature into functional neurons and glia when transplanted into the injury site, form new synaptic connections with the host spinal cord, and may help contribute to improvement in motor function after SCI. However, very little is understood about how transplanted neurons can contribute to functional forelimb recovery, and how new graft-to-host neuronal synapses support the recovery of forelimb motor function after SCI. The goal of this project is to discover the cellular mechanisms of NPC integration into the host spinal cord and contributions of grafted neurons to forelimb motor function. The objectives of this project are to identify which subtypes of graft-derived neurons integrate into the area of injury, and work best to establish functional neuronal relays to improve forelimb motor function after SCI. To map the graft-to-host synaptic connections that are spontaneously established after NPC transplantation, we employed pseudorabies virus (PRV), a retrograde polysynaptic tracer which is commonly used to map neural circuits. PRV injection was first optimized by varying the volume of injection, injection sites, and route of injection (intramuscular vs. intraneural). After optimizing PRV delivery for maximal labeling of cervical spinal cord neurons, we performed trans-synaptic tracing to identify graft-derived neurons that synaptically integrate into forelimb motor circuits. Data collected from this project will help understand the types of neurons that best integrate into the spinal cord and functionally contribute to the restoration of forelimb motor movement.

26. Parental Bonding and Risk of Psychiatric Disorders in Latinos

Anushka Ganoo (Texas A&M University)
Independent Research Project
Research Advisors: John Hettema, Shaunna Clark

Background: Psychiatric disorders are influenced by developmental factors such as parental bonding. Limited data exists on how parental care and overprotection influence the risk of psychopathology in Latino populations.

Methods: The AGGIES Pilot Study investigates these interactions among 679 Latino students (ages 18-35) at Texas A&M University. Parental bonding dimensions (care and overprotection) were assessed using a 16-item abbreviated version of the Parental Bonding Instrument (PBI). Psychiatric outcomes assessed included ADHD (ASRS-v1.1), depression and anxiety disorders (CIDI-SF), and OCD. Associations between parental bonding dimensions and psychopathology were analyzed.

Results: Analyses revealed that high paternal overprotection mixed with low paternal care was associated with a higher risk of psychopathology, particularly major depressive disorder (MDD). Conversely, high maternal care and low maternal overprotection were associated with a decrease in psychopathology.

Discussion: Our findings suggest that specific parental bonding dimensions may influence the risk for psychopathology in Latino students. These correlations provide the foundation for future analyses on the interaction between genetics and parental bonding as contributors to psychiatric disorders in the Latino population.

27. Acculturation Stress Among Latino University Students: A Pilot Study for Creating Culturally Inclusive Assessments

Colin Vu (Texas A&M University)
Independent Research Project
Research Advisors: John Hettema, Shaunna Clark

The Aggies Going Genomic for Internalizing and Externalizing Syndromes (AGGIES) Pilot project examines how genetics and environmental stressors influence psychiatric disorders within the Latino community. This study focuses on the prevalence and impact of acculturation, discrimination, and deportation-related stressors, recognizing their potential influence on mental well-being within this population. Latino students (n=614) at Texas A&M University provided saliva samples and completed an online survey assessing discrimination (modified Everyday Discrimination Scale), bicultural stress (adapted Bicultural Identity Integration Scale), and deportation concerns. Participants rated the frequency and impact of each stressor on Likert scales (1 (never) to 5 (always)). Descriptive statistics were used to analyze the distribution of stressor frequency and impact. Independent t-tests and chi-squared tests were used to assess differences in stressor frequency and impact by sociodemographic factors. P-values were adjusted for multiple comparisons using Bonferroni corrections. Acculturation stress was found to be the most endorsed and impactful stressor among those assessed. Significant differences in stressor frequency were observed between groups divided by generation, sex, and race. Notably, stressors related to deportation and external perception of intelligence showed the most variation across these demographic categories. In conclusion, this pilot study emphasizes the importance of culturally inclusive mental health assessment for Latino students. By identifying the significant impact of stressors like acculturation, this research contributes to a more sensitive and informed understanding of mental health within this population. Future analyses will examine correlations between these stressors and psychiatric phenotypes to inform the development of comprehensive assessment tools applicable to diverse populations.

28. Cytotoxicity and Motility Inhibitory Effect of FA-Hep-CuS Nanoparticles on Breast Cancer Cells

Elaina Moss (Texas A&M University) and Subiksha Sankar (Texas A&M University)
Independent Research Project
Research Advisor: Tapasree Roy Sarkar

Triple-negative breast cancer (TNBC) presents a challenge for treatment due to its lack of estrogen, progesterone, and human epidermal growth factor (HER2) receptors. Traditional endocrine or HER2 targeting therapies are ineffective, usually resulting in chemotherapy use. TNBC is aggressive, with high rates of metastasis and recurrence. A key mechanism of metastasis in TNBC is epithelial-mesenchymal transition (EMT), where epithelial cells transform into mesenchymal stem cells, increasing their migratory capacity and risk of distal metastasis. Previous studies have suggested nanoparticles as potential cancer treatments due to their anti-EMT properties. Photothermal therapy (PTT) using near-infrared radiation (NIR) has also shown tumor progression inhibition by ablation of cancer cells through hyperthermia. This study examines novel nanomaterials as potential TNBC treatments. The materials, composed of folic acid (FA), copper sulfide (CuS), and a combination of both (FA-HEP-CuS), were selected for their cancer cell targeting and photothermal transduction abilities. These materials were studied in MDA-231 breast cancer cell lines in vitro to examine their anti-cancer effects on cell viability and motility.

29. Inherent Cytosolic Calcium Variation in Hypocotyl Cells of Arabidopsis Seedlings

Katie Germain (Texas A&M University) and Cerrina Rodriguez (Texas A&M University)
Independent Research Project
Research Advisor: Lawrence Griffing

Calcium signaling is involved in various plant pathways and responses, from the organellar to the systemic level. Spatiotemporal signatures of stimulus-induced calcium waves and the natural calcium oscillations involved in tip growth are well-characterized; however, less is known about inherent cytosolic calcium variations of the plant cell. Here we report variations of cytosolic calcium in epidermal hypocotyl cells of Arabidopsis seedlings that occur naturally, without any stimulus, that we have termed “sparkle.” These calcium waves occur in individual cells and appear to be independent of each other. The most sparkle is seen within ten cells of the root-shoot-junction and decreases in magnitude further up the hypocotyl. Calcium in these cells increases over a minute to approximately 150% and then decreases to the original concentration over the next minute; these waves occur about fifteen times every hour per cell. Treatment with lanthanum, a non-specific plasma membrane calcium channel inhibitor, greatly inhibits and nearly completely abolishes sparkle. Treatment with gadolinium, a putative endoplasmic reticulum calcium channel inhibitor, inhibits the magnitude of sparkle. While inherent cellular calcium variations have been seen in developing cells of other organisms, no such waves have been reported in plants. The function of sparkle is unknown, however, planned experiments regarding circadian rhythm, CAX1/CAX3 mutants, and seedling age influence may provide further insight.

30. Tribolium castaneum Embryonic Microinjection and Inverse PCR

Abby Truman (Texas A&M University)
Independent Research Project
Research Advisor: Zachary Adelman

Tribolium castaneum is a model organism for other Coleoptera species due to their entire genome being available to analyze, their ability to be reared in a laboratory setting, as well as their relatively short generation time and high fecundity. Cas9-based editing is invaluable in the field of genetic engineering and with editing anticipated to be significantly more efficient when expressed directly by the insect within the germline. To accomplish this, a series of transposable element-based insertion were generated with the Cas9 protein under the control of the Vasa promoter; transgenic strains were identified by a GFP marker in the eyes with Cas9 expression documented by Western Blot analysis of both the somatic and germline tissue. To verify the gene editing ability of each strain, we preformed microinjection of Cas9 T. casteneum embryos with synthetic guide RNA targeting the ebony gene, where a knockout results in a dark coloration of the adult cuticle. In addition to screening for somatic mutagenesis, we also outcrossed injected G0 offspring with a previously established ebony strain to identify germline mutations. Inverse polymerase chain reaction (PCR) was also used to demonstrate the integration of the transgene within the genome. Through this research we have found at least two Cas9-expressing strains of T. castaneum.

31. The Prevalence of Obsessive-Compulsive Disorder Symptoms and their Association with Sociodemographic Factors Among Hispanic/LatinX Students.

Evelyn Sanchez (Texas A&M University)
Independent Research Project
Research Advisors: John Hettema, Shaunna Clark

Obsessive-Compulsive Disorder (OCD) significantly impacts individuals' psychological and behavioral functioning, hindering quality of life. Barriers to accessing OCD diagnosis and participating in related research contribute to a selection bias, interfering with adequate representation of Hispanics/LatinXs. This study reports preliminary findings from an OCD screening among Hispanic/LatinX students at Texas A&M University (TAMU) in conjunction with the A&M Going Genomic for Internalizing and Externalizing Syndromes (AGGIES) Pilot study. The objective is to contribute to a culturally competent understanding of OCD in a sample of Hispanic/LatinX students at Texas A&M University. Students were recruited through mass email. After consenting, students participated in an online screening assessing OCD dimensions. The questionnaire measured current and worst-ever OCD symptoms on a Likert scale from "No Distress" (0) to "Severe Distress" (3). Obsessions and compulsions related to contamination, harm, and need for order/symmetry. Data was analyzed using two-sample t-tests and generalized linear models. The TAMU Institutional Review Board (IRB) approved the study protocol. Preliminary findings show that about 60% of participants reported moderate to severe distress for at least one of the six inventory items. Significant differences were not observed concerning sex, nationality, and race. The lowest p-value observed (0.06529) was between the ages 20 and 21. The most prevalent item causing moderate to severe distress was the compulsion of "Checking things more than necessary". This pilot

study provides essential data to enhance understanding of OCD prevalence, aiding in the improved provision of mental health care and research for the LatinX community.

32. Using AI to Develop Intelligent Models for Thermal Management in EVs

Lalit Chinasumala (Texas A&M University)
REU
Research Advisor: Jorge Lara

As electric vehicles increasingly begin to dominate the automotive landscape, the development of efficient thermal management systems has become crucial for ensuring user safety and extending battery life. This research project aims to design and implement an intelligent deep learning model for optimizing EV battery thermal management. The proposed model will integrate multiple input variables, including real-time battery temperature, cooling system flow rates, and vehicle motion parameters, to generate recommended settings for optimal battery performance and longevity.The primary objectives of this study are twofold: first, to maximize battery lifespan through precise thermal regulation, and second, to mitigate the risk of thermal runaway events that could compromise user safety. By leveraging advanced machine learning techniques, this project seeks to create a robust, adaptive system capable of real-time decision-making in diverse operating conditions. This research advances EV technology and thermal management, aiming to improve efficiency, safety, and battery longevity.

33. A Potential Therapeutic Inhibits Liver Fibrosis in Mice

Trevor Martinez (Texas A&M University)
Beckman Scholars Program
Research Advisors: Richard Gomer, Darrell Pilling

Liver fibrosis is a group of progressive diseases with few treatment options. These diseases are the result of liver damage leading to the recruitment and activation of immune cells and later to the formation of scar tissue-like lesions that disrupt tissue structure and function. Sialic acids are located on the ends of some glycoproteins and are cleaved off by enzymes called sialidases/neuraminidases such as NEU3. NEU3 can remove the sialic acid from a glycoprotein resulting in the release of active transforming growth factor beta-1, or TGF-beta 1, which potentiates fibrosis. Sialidase inhibitors such as 2-acetyl pyridine, or 2AP, attenuate lung fibrosis by directly inhibiting NEU3, inflammation, TGF-beta 1 activation, and thus fibrosis. To study the effects of 2AP on liver inflammation and fibrosis, young male and female mice were injected twice a week for six weeks with carbon tetrachloride, CCl_4, and injected with 2AP every other day for the last three weeks. Liver sections were then stained with antibodies for Kupffer cells, T cells, neutrophils, inflammatory and resident macrophages, lipid content by Oil Red O staining, and fibrosis with Picrosirius red staining. Injections of 2AP significantly reduced inflammatory Mac2 macrophages, both in the accumulation around the vessels and in the liver tissue. 2AP also reduced neutrophil numbers, S100A8 positive cells, in female livers. 2AP injections also reduced CCl_4-induced liver fibrosis. There were no significant differences in Kupffer cells, T cells, resident liver macrophages, or lipid content. This data suggests 2AP may be a potential treatment for liver inflammation and fibrosis.

34. Alcohol and Cannabis Use in Latino College Students: Trends in Foreign-Born Status in the AGGIES Study

Ujwal Boinpally (Texas A&M University)
Independent Research Project
Research Advisors: Shaunna Clark, John Hettema

The A&M Going Genomic for Internalizing and Externalizing Syndromes (AGGIES) Study aims to increase Latino representation in genetic studies of mental health by leveraging the Latino student population at Texas A&M. Studies conducted in previous generations of Latinos established the Latino Paradox, a phenomenon where Latinos farther removed from immigration to the US are more likely to have worse health outcomes than Latinos that have migrated to the US more recently. However, this work is dated, and it is unknown if these trends are present in current Latino students, specifically regarding alcohol and cannabis use. We hypothesized that foreign-born Latinos would have better substance use outcomes than US-born Latinos. To evaluate this, AGGIES participants (N=618) completed an online survey, which included questions on their alcohol and cannabis use, including ever and current use, age of onset, and substance use disorder risk categories. Linear regression was used to determine if foreign-born status was related to alcohol and cannabis use. There were no significant associations between foreign-born status and alcohol use outcomes. Cannabis use showed similar results, except that US-born Latinos were more likely to have ever used cannabis than foreign-born Latinos. Analysis of foreign-born status and alcohol and cannabis use outcomes serves as a relevant method in generating substance use trends within the Latino college student community. Future research into the current presence of the Latino Paradox will require collecting data on generational status to provide a precise measure of time since immigration.

35. Chasing the Sublime: How to Live Your Life Like an Adventure

Juan Lleras (Texas A&M University)
Aggie Creative Collective (ACC)
Research Advisor: Lowell White

Life adventures are conventionally defined as trips to exotic places or landmark life events such as moving/marriage. Adventures across literature include scouring Middle Earth to burn a ring or executing a bank heist. What if these definitions were redifined? Can everyday people live their life like an adventure without travelling the world or undergoing fantastical events? This research is aimed at understanding practical things everyday people can do to live their life like an adventure. I set out to answer three primary questions: “What is an adventure?”, “How can any person live their life like an adventure?”, and “Why should everyone live life like an adventure?” I conducted an analysis of popular fiction and non-ficiton adventures, alongside analyzing the philosophy and psychology of what constitutes adventures. My research process involved taking notes across peer-reviewed psychology journals, well-established works of philosophy in existentialism and stoicism, autoethnographic anecdotes, and self-help/pop science non-ficiton books. I found a defintition of adventures that aligns with the asethetic philosophy of the sublime, three practical tips anyone can implement to become

more adventurous, and an argument for going on adventures to expand personal identity. Ultimately, this research aims to help anyone in the world trying to embark on a detour from their routine life. In a world where sameness and routine is becoming ever present, finding ways to break out of the mold with adventures might become more important than ever.

36. The Influence of Maize Genetics on Fall Armyworm Microbiome Variation

Arturo Espana (Texas A&M University)
Diversity in Entomology REEU Program
Research Advisors: Julio Bernal, Sanjay Antony-Babu

Maize (Zea mays ssp. mays) was domesticated by Mesoamerican farmers from Balsas teosinte (Z. mays ssp. parviglumis), an annual grass native to the Pacific lowlands of southern Mexico, to increase yields through traditional breeding methods. Over time, artificial selection led to the development of different landraces, each adapted to specific local conditions such as climate, soil, altitude, and pests. Beginning approximately 100 years ago, systematic breeding methods produced inbred and hybrid maize varieties that were bred for enhanced yields under the cover of synthetic fertilizers and pesticides. Thus, while maize landraces are broadly adapted to varying environmental conditions, maize inbreds, and hybrids are characterized by being narrowly adapted to environments enriched with fertilizers and pesticides. Pest damage, particularly from the fall armyworm (Spodoptera frugiperda), is a significant challenge to maize productivity in the Americas and worldwide. I conducted a common garden experiment using seven different maize accessions to investigate how maize genetics affect the diet of the fall armyworm microbiome. The study involved four Mexican landraces (Comiteco, Oloton, Tepecintle, and Tuxpeno) and three Mexican inbred lines (CML-449, CML-451, and CML-494). Across twelve trials, all plants were infested with fall armyworm for six days before being sampled. I hypothesized that the (i) microbial community and (ii) performance (growth, survival, development speed) of fall armyworm larvae will vary significantly depending on whether they fed on maize landraces or inbreds. I anticipate observing significant differences in the microbial community composition and performance of larvae when fed landrace or inbred maize, as diets have been reported to influence the gut microbiota of insects.

37. The Evolution of Calling Songs in Meadow Katydids (Orthoptera: Tettigoniidae)

Isabelle Mendoza (Texas A&M University)
Diversity in Entomology REEU Program
Research Advisor: Hojun Song

The evolution of sound production in meadow katydids (Orthoptera: Tettigoniidae) represents a critical aspect of their communication and mating behaviors. This study investigates the evolution and diversification of acoustic signals within the genera Orchelimum and Conocephalus, two groups of meadow katydids in a phylogenetic framework. By integrating phylogenetic analysis with bioacoustic data, we aimed to identify the patterns that have led to the diversity of calls observed in these insects. We generated phylogenomic data from multiple Orchelimum and Conocephalus species to reconstruct a phylogeny. We then analyzed previously published calling songs from each species, focusing on

parameters such as carrier frequency, pulse rate, and call complexity. Our findings indicate that acoustic traits have undergone significant evolutionary shifts, with distinct patterns of divergence observed across the phylogeny. This study enhances our understanding of the evolutionary mechanisms driving acoustic signal diversification in meadow katydids and highlights the complexity of their communication systems as it relates to sexual selection.

38. The Evolution of Sound in Shield-Back Katydids (Orthoptera: Tettigoniidae: Platycleidini)

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Research Advisor: Hojun Song

Various taxa throughout the animal kingdom use bioacoustic signaling to communicate and attract mates. Singing insects in the order Orthoptera attract females via stridulation. By analyzing their calling songs, we aim to study the evolution of their communication. Using phylogenetics, we sought to analyze the evolutionary relationships between carrier frequencies, wing length, and biogeography in the tribe Platycleidini (shield-back katydids). We used phylogenomic data to create a phylogenetic tree detailing the relationships between select species within this tribe. By using sound recordings of calling songs, we were able to analyze the relationship of these species by comparing carrier frequency, wing length, and geographical distribution. Studying the phylogenetic relationship of species within the Platycleidini tribe allows us to understand the evolution of sound within acoustically communicative insects.

39. Developing a Phylogeny of the Conehead Katydids (Orthoptera: Tettigoniidae: Conocephalinae: Copiphorini)

Lilly Prescott (Texas Tech University)
Diversity in Entomology REEU Program
Research Advisor: Hojun Song

The Copiphorini are a tribe of katydids in the subfamily Conocephalinae. Commonly known as coneheads, these insects are characterized by a protruding cone or horn-like structure between the antennae. It is hypothesized that the horn is used to fend off attacks from predators in species with large horns, but some species' horns are so reduced that they would not be of significance in self defense. As of today, there is no phylogenetic hypothesis that exists for this tribe. We aimed to study the evolution of horn shape in a phylogenetic framework. A phylogenetic analysis was performed using phylogenomic data. A related tribe, Conocephalini, was included as an outgroup. Horn lengths were classified as size categories (short, medium, or long) and assigned shape characteristics (simple or complex). Horn shapes are a defining characteristic in the tribe Copiphorini, and shapes can vary greatly across species. Mapping these traits on a phylogenetic tree allows us to see when and how these traits evolved. Though this is not a complete phylogeny of all species in Copiphorini, it serves as a building block for future phylogenetic work with this tribe.

40. Impact of Nosema (Vairimorpha) ceranae Infection on Queen Bee (Apis mellifera) Behavioral Parameters: Egg Laying Rate, Locomotion, and Retinue Size

Sam Gracia (The University of Texas Rio Grande Valley)
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Research Advisors: Juliana Rangel, Tonya Shepherd

The Western honey bee, Apis mellifera, is crucial for agriculture, pollinating over 90 crops, 80% of flowering plants, and over 130 fruits and vegetables. Maintaining their health is vital due to their role in agriculture, particularly against pathogens like Nosema, a microsporidian parasite. Nosema weakens bees' immune systems, reduces lifespan, causes dysentery, and impairs foraging, affecting colony health and productivity. Nosema can be divided into two species, Nosema ceranae and Nosema apis. While the impact of N. ceranae on colony and worker health is well-studied, its effects on queen bee behaviors remain unclear. Understanding this is essential as queen bees are pivotal for colony productivity, population, and regulation. This study examined the effects of N. ceranae on queen egg-laying rate, locomotion, and retinue size. We hypothesized that infected queens would lay more eggs, move more, and have a smaller retinue. Four observation colonies with sister queens were established, observing uninfected behaviors for six days. Each queen was then inoculated with a sucrose solution containing N. ceranae spores, and the same behaviors were measured. Initial results indicate a decreased retinue size with increased locomotion and egg-laying rate. Data is undergoing analysis, however, it is hypothesized that mobility and egg-laying have significantly increased and retinue size will decrease post-inoculation. Understanding N. ceranae's impact on queen behavior is crucial for grasping its role in colony dynamics and reproductive success. Identifying specific behavioral changes can help researchers and beekeepers better assess colony health and implement effective disease control measures, ensuring honey bee population resilience.

41. Indirect Effects of Plant Growth-Promoting Rhizobacteria Consortia on Herbivore Damage and Arthropod Community in a Corn Field in Texas

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Plant growth-promoting rhizobacteria (PGPR) are known to play a crucial role in sustainable agriculture by improving soil fertility to enhance crop growth, and inducing resistance in plants against infestation by pests. Recent studies have proven that PGPR consortia (i.e., blends) are more effective than single strains in plant growth promotion and resistance to pests. Recently, we developed three PGPR blends (named TX1, TX2, and TX3) made of strains isolated from field crops grown in Texas. In our previous studies, we demonstrated that these three blends promote growth of corn B73, suppress fungal pathogens, and increase the larval mortality of fall armyworm, Spodoptera frugiperda (Lepidoptera: Noctuidae) on corn B73 under laboratory conditions. Additionally, the blends TX1 and TX2 deter oviposition by the insect pest in the lab setting. The objective of this study is to validate the effect of these blends in the field with corn B73, specifically on insect herbivore damage and population, and the wider insect community. In a complete randomized block design of four treatments (plants treated

withTX1, TX2, TX3, and control) replicated six times, sticky traps and sweep nets were used to sample the insect community, while insect damage to corn plants was measured using two damage scoring scales. Results from this study will be discussed in line with the ecological ramification of PGPR in shaping the community of arthropod insects, and the PGPR impact on damage of herbivorous insects in the corn field .

42. Evaluation of Novel Small Molecule's Lethal Effect on Aedes aegypti using a Vial Bioassay

Kaelyn Calma (The University of Texas Rio Grande Valley)
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Research Advisors: Patricia Pietrantonio, Bianca Monteiro Henriques Santos

Mosquitoes present a global risk to human health due to their ability to act as reservoirs for disease-causing pathogens and transmit pathogens to humans and animals upon blood feeding. Increasing pesticide resistance among mosquito populations and predicted shifts in their geographical range due to global warming pose more challenges to control the spread of mosquito-borne diseases. The investigation of a novel molecule's lethal effect on mosquitoes is necessary to develop new methods of control. A modified method of the CDC bottle bioassay was utilized to test the novel molecule's ability to kill females of the mosquito Aedes aegypti Liverpool strain. Fifteen concentrations were tested using 20 mL vials and ten females were placed in each replicate. The placement of the vials in an incubator allowed the mosquitoes to be in favorable humidity and temperature while exposed to the pesticides. I hope to discover the novel molecule is adulticide and expect to observe a dose-response effect that implies the presence of a target site.

43. Species Specific HIPVs Influence Foraging of Both Generalist and Specialist Herbivores as well as Natural Enemies

Anthony Mendoza (The University of Texas Rio Grande Valley)
Diversity in Entomology REEU Program
Research Advisors: Anjel Helms, Julio Bernal

Olfactory cues play an integral role in mediating below-ground interactions where other senses are limited. Herbivore induced plant volatiles (HIPVs) cue natural enemies to the presence of prey and signal to conspecific herbivores the presence of interspecific competition. In this study we evaluate the role of root HIPVs from Diaborica undecimpunctata, a generalist on maize, as well as Diabortica virgifera virgifera, a specialist on maize in facilitating host plant selection by both herbivores and natural enemies. We predict there to be species specific interactions among both the herbivores as well as the natural enemies. For this study we quantify herbivore and natural enemy attraction to volatile cues produced by the roots of maize. Previous literature in cucumber, maize, poplar, and citrus highlights the important functions of root volatiles in mediating predator prey interactions. Through this study we investigate the complex predator-prey interactions driven by maize root HIPVs. These root HIPVs, produced for either generalist or specialist herbivores, have the potential to differentially modulate

these predator-prey interactions within the soil environment. We will highlight the important context of generalist and specialist herbivore specificity within predator prey interactions.

44. Effects of ACE Inhibitors, Lisinopril and Captopril on Aedes albopictus and Culex tarsalis Survival

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Captopril and Lisinopril are Angiotensin Converting Enzyme (ACE) inhibitors used to treat hypertension and heart failure, which affect millions globally. This study examines the effects of these drugs on the survival of female Aedes albopictus and Culex tarsalis mosquitoes, both of which possess an insect analog of the mammalian ACE. The experiment simulates mosquitoes feeding on blood containing the maximum drug concentrations based on human blood pharmacokinetics, as well as tenfold those concentrations. Mosquitoes are raised from larvae to adults, at which point the five-day-old adult female mosquitoes will be used. There are five groups: one control group, which includes just the blood, and four groups which contain the blood plus captopril or lisinopril at either the Cmax concentration or 10x Cmax concentration. After being exposed to the drugs, mosquito mortality will be recorded daily for seven days. Two replicates for each mosquito species will be done for each species to ensure replicability. Data will be analyzed using GraphPad and RStudio to create survival curves through Kaplan-Meier analysis. Initial results with Ae. albopictus indicates no significant difference in mosquito survival between control and experimental groups, suggesting that Ae. albopictus ACE does not play a role in adult physiology related to mosquito survival or that the ACE inhibitors did not effectively inhibit adult mosquito ACE.

45. Prevalence of SARS-CoV-2 in White-Tailed Deer Populations of Texas

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Research Advisors: Gabriel Hamer, Francisco Ferreira

Free-ranging white-tailed deer (Odocoileus virginianus) have been notably recognized as a particular concern for their role as an animal reservoir for SARS-CoV-2 which is largely due to their high densities, social behavior, permissiveness to infections, and synanthropic nature. Because of this, white-tailed deer (WTD) have the ability to maintain, disseminate, and favor unique evolutionary routes of SARS-CoV-2, which can be transmitted back into human populations and increase the possibility of vaccine escape. Despite these concerns, surveillance of SARS-CoV-2 infection in WTD in most of the southern-eastern United States has been insufficient. More specifically, Texas lacks ample information regarding rate of infections of WTD across its counties, emphasizing the necessary action for monitorization. To combat this, we have evaluated nearly 2,000 retropharyngeal lymph node samples from WTD collected from November 2021 through March 2022 from over 200 counties in Texas. Through reverse-transcriptase PCR (RT-qPCR), we are able to quantify the existing RNA from SARS-CoV-2 and organize

infection rates according to ecoregion, county, age, and sex. By collecting valuable information regarding viral prevalence in WTD populations in Texas, our objective is to fill in the missing gaps of information of which has been rather neglected in previous research. Results from this study could emphasize the risk of reverse zoonosis and threats to human and wildlife populations.

46. Phylogeny & Systematics of Acoustic Singing in Oecanthidae

Pedro Solis (The University of Texas Rio Grande Valley)
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Research Advisor: Hojun Song

Oecanthidae, commonly known as tree and bush crickets, are a family of true crickets that have distinct morphological traits and acoustic calling song characteristics. Tree crickets are globally distributed, with 303 species described within four extant subfamilies. Along with their appearance, male Oecanthid songs are recognizable from other orthopterans and are common at night. They sing at frequencies ranging from 1-6 kHz and exhibit different characteristics, such as musical chirps or continuous trills. To investigate how these traits evolved, a phylogenetic context is necessary with as much biological data from the taxa represented as possible. Phylogenomic data from 44 different taxa were generated, with representatives from supertribes Diatrypidi and Oecanthidi. Most of the species are North American Oecanthus crickets, with some outgroups to root the phylogeny. The purpose of this project is to examine the systematics of acoustic communication in Oecanthidae and present a phylogeny to confirm monophyly, reconstruct ancestral character states based on stochastic character mapping, and infer relationships. Ancestral state reconstructions will demonstrate the acquisition of these different characters and contribute knowledge of Oecanthus' evolutionary biology.

47. Targeting RNA Modification Pathways for Novel Fire Ant Pest Control

Liberty Laney (University of Texas at San Antonio)
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Research Advisors: Keyan Zhu-Salzman, Jiaxin Lei

In Texas, the red imported fire ant (Solenopsis invicta) poses significant environmental and economic threats. Traditional pesticide methods are inadequate at controlling fire ant populations and raise concerns of pollution or other unintended ecological effects. Focusing on the molecular processes responsible for fire ant development could reveal a new method of pest management. Our study uses RNA interference (RNAi) to target the expression of the enzyme methyltransferase-like protein 3 (METTL3) involved in N6-methyladenosine (m6A) modification of mRNA. The m6A process is currently understood to be an important post transcriptional modification responsible for the stability, splicing, and translation of mRNA in eukaryotic cells. Recent studies show the role of m6A distribution in insect development and cellular function, suggesting its use as a potential target. By silencing METTL3 expression, we expect a disruption in m6A modification pathways, subsequently inhibiting essential biological processes and reducing the fitness of fire ants. Understanding the specific implications of METTL3 inhibition on fire ant physiology will further our understanding of RNA regulatory mechanisms

in insects and develop new strategies of targeted pest control, offering a promising alternative to conventional methods for invasive species management.

48. Enhancing Plant Systemic Resistance Using Entomopathogenic Nematodes and Arbuscular Mycorrhizal Fungi

Edwin Luna (University of Texas at San Antonio)
Diversity in Entomology REEU Program
Research Advisors: Anjel Helms, Skai Peterson

The increasing reliance on pesticides in agriculture necessitates the exploration of sustainable alternatives for pest management. This study investigates the potential of entomopathogenic nematodes (EPN) and arbuscular mycorrhizal fungi (AMF) in enhancing systemic resistance in plants. EPN and AMF have shown promise in agricultural applications due to their ability to improve plant health and induce systemic defenses. Using cucumber beetle larvae in squash plants as a model system, we examined the effectiveness of EPN and AMF in inducing systemic resistance. The experiment utilized a split-rooting technique on 2-week-old squash plants to explore these effects, focusing on the volatile organic compounds (VOCs) emitted by the plants, which mediate plant defenses. AMF colonization was confirmed through ink and vinegar staining of root tips, ensuring successful fungal establishment. Plant interactions with herbivores and mutualists were assessed through dynamic headspace sampling, comparing untreated control plants with those treated with EPN and AMF. VOC profiles were analyzed using PERMANOVA, while the Random Forest Variable Importance Test identified key compounds classifying the VOC profiles. One-way ANOVA and Tukey post hoc tests determined differences across treatments in VOC emission, larvae mass, and mortality. This study aims to elucidate the role of EPN and AMF in plant systemic resistance and their potential as eco-friendly pest management strategies.

49. Double Knockout of Aedes Aegypti Salivary Gland Genes SGS1 & SGS1b

Emit Morse (University of Texas at San Antonio)
Diversity in Entomology REEU Program
Research Advisors: Zachary Adelman, Daniel Whitefield

Malaria cases and deaths have been at an all time high, reaching 249 million cases and 608,000 deaths in 2022. Plasmodium gallinaceum, the avian malaria parasite, is spread by Aedes and Culex mosquitoes and has a similar life cycle to the human malaria parasite, Plasmodium falciparum. A crucial step in the mosquito becoming infectious is the parasite's invasion of its salivary glands. Previously, salivary gland surface proteins (SGS) have been shown to be important for Aedes vector competence of Plasmodium, with SGS1 protein knockout studies reporting a 64% reduction of Plasmodium in the salivary glands. Here, we create a double-knockout of SGS1 and its paralog, SGS1b, using CRISPR/Cas9 genome editing, high-resolution melt-curve analysis (HRMA) genotyping, and genetic crosses to create SGS1/SGS1b double-knockout mosquitoes. Proteomic analysis of salivary glands and entire mosquito bodies will be performed to validate the absence specificity of SGS1 and SGS1b protein knockouts. What we learn

about SGS genes may be used to help understand the infectious cycle of malaria parasites and future genetic control approaches for eliminating avian and human malaria.

50. Identifying Small Icebergs Off the Western Antarctic Peninsula Using Machine Learning

Nayana Venukanthan (Cornell University)
Observing the Ocean: REU
Research Advisor: Andrew Klein

In recent decades climate change has intensified disturbance to global ecosystems, including coastal systems which are especially vulnerable to temperature increases. The Western Antarctic Peninsula (WAP) is one such region that has experienced a rapidly changing climate which has induced dramatic sea-ice losses and accelerated glacial retreat, making it a significant area of interest in polar oceanography. Of particular interest is the behavior and dynamics of icebergs, which can have significant impacts on ocean circulation and carbon fluxes through their movement, meltwater, and disturbance of benthic ecosystems, i.e. iceberg scouring. Through computer vision, the branch of machine learning that trains computers to interpret and understand images, we strive to obtain a comprehensive understanding of small iceberg distribution surrounding the WAP. Deep learning models will be trained on Sentinel-1 synthetic aperture radar (SAR) images to detect small icebergs (up to ~1km) in coastal WAP waters. ArcGISPro is used for image preprocessing, model training, and validation. The raw Sentinel-1 images were preprocessed with orbital correction, thermal noise reduction, gamma-nought radiometric calibration, and application of a Lee filter for despeckling. Approximately 1600 icebergs were identified under varying conditions from 10 images spanning 2015 to 2024 for model training. Based on recent work in SAR iceberg detection, the trained deep learning model is expected to detect icebergs fairly accurately, with different deep learning models having variable performance. Future research will involve applying the developed models to the Sentinel-1 image archive covering the WAP to quantify iceberg concentrations.

51. Evaluating Strongylocentrotus purpuratus Larval Size Differentiation through Assessment of Total Protein

Rebecca Newell (CUNY Bernard M. Baruch College)
Observing the Ocean: REU
Research Advisors: Marie Strader, Amy Tan

Rising ocean temperatures resulting from climate change has led to overgrazing of kelp forests by purple sea urchins, Strongylocentrotus purpuratus, and increases in pathogenic microbial production along the pacific coast of North America. Thus, it is critical to understand how and when exposure to increased temperature and higher microbial load affects development of S. purpuratus. During their larval stage, S.purpuratus in previous research has exhibited shifts in morphology as a consequence of exposure to temperature and microbial load, which can impact the larvae's ability to respond to predation pressures through visibility, evasion and encounter rate, and to produce successful progeny. This study aims to investigate the time point of their morphological differentiation during development through rearing

them under differing temperature and microbiome conditions: sterile Artificial Seawater (ASW) v. filtered ASW from adult tanks, and 14ºC v. 18ºC ASW. To understand appearance differentiation, S.purpuratus's larval size will be quantified by measuring body length and width at 45 hours/4 days/7 days post fertilization - major points of larval development. To examine the extent of differentiation, total protein content of their larvae will be assayed to determine if larger larvae are the product of larger or excess cells. Through studying the larval development of S.purpuratus by size differentiation as a consequence of exposure to abiotic/biotic components, we can better understand the morphological resilience of marine organisms and the broader implications of ecosystem health.

52. Examining the Correlation Between Phytoplankton Abundance and Environmental Parameters using Time Series Data from the Field

Kalyne Oliver (Indiana Wesleyan)
Observing the Ocean: REU
Research Advisor: Darren Henrichs

As primary producers, phytoplankton form the base of the marine food web. Therefore, the composition of the phytoplankton community within the ecosystem affects the food supply for higher trophic levels. There are various environmental parameters acting upon phytoplankton, including temperature and wind direction. The initial environmental parameter examined was temperature, based on previous lab experiments. These prior experiments showed temperature impacts the abundance of various types of phytoplankton. This project addresses the question: do the results in the lab provide insight into the relationship between phytoplankton and temperature in the field? Time series data of phytoplankton counts and temperature were used to identify potential correlations from field data. Phytoplankton counts were obtained from an Imaging FlowCytobot, which is located along the coast in Port Aransas, TX. The environmental time series data came from various buoys in the Texas Automated Buoy System along the Texas Coast. To test for relationships between environmental parameters and phytoplankton, the data were time-lagged various numbers of days. The change in phytoplankton abundance in response to changes in temperature is not instantaneous and requires the use of time-lagged data. In addition to observing the correlation with the full time series, seasonal data were also used to determine correlations. After observing weak correlations with temperature, other environmental parameters were analyzed. This includes wind direction and salinity. The observed correlation could give insight into how higher trophic levels may respond to changes in phytoplankton communities.

53. Mining the Abyss: Understanding Particulate Metal Concentrations in Deep-Sea Mining Plumes

Isabelle Boysen (Marymount Manhattan College)
Observing the Ocean: REU
Research Advisor: Jessica Fitzsimmons

The global shift towards lower carbon emissions has led to a rising demand for metals to build green technologies, such as electric vehicles and wind turbines. To meet this demand, deep-sea mining has

emerged as a potential metal resource, as it allows for extraction of metal-rich polymetallic nodules from deep-sea abyssal plains. However, the environmental impacts of deep-sea mining remain poorly understood. To address this, mining companies are doing prototype mining operations to test their equipment while scientists collect environmental samples. One such company, The Metals Company (TMC), performed a pilot nodule collection test in Fall 2022 in the eastern Clarion-Clipperton Zone of the Northern Subtropical Pacific Ocean. The Fitzsimmons Lab at Texas A&M University is contracted by TMC to investigate the impacts of this pilot mining operation on multiple chemical parameters in the water column. Here, we evaluate the concentrations of particulate metals within the midwater and benthic plumes generated during mining operations. These plumes, comprised of unwanted mining effluent, have the potential to spread particles for tens of kilometers, which can disrupt filter-feeding organisms or supply enrichments of toxic metals into deep-sea ecosystems. We assessed metal concentrations through a total digest of particles captured on filters, followed by metal quantification via inductively coupled plasma mass spectrometry (ICP-MS). Our results showcase high concentrations of particulate material introduced via deep-sea mining plumes. The particulate metal concentrations, once paired with data from ecotoxicologists measuring toxicity thresholds of deep-sea ecosystems, can be directly used to inform deep-sea mining policy.

54. Early Environmental Exposure Shapes Sea Urchin Larval Immunity and Development

Sidney Pasternak (Oberlin College)
Observing the Ocean: REU
Research Advisors: Marie Strader, Amy Tan

Organisms respond to climate change mediated environmental stressors through phenotypic plasticity, how organisms alter their traits in response to the environments, during early development. Here, we are testing if early environmental conditions impact larval response to immune challenges in purple sea urchins (Strongylocentrotus purpuratus) and whether early exposure to the adult microbiome primes the larval immune system to resist later pathogen infections. Additionally, we examine how heat stress interacts with these conditions and if it compromises the larval immune system. Larvae raised under ambient and elevated temperature were exposed to sterile artificial seawater and adult urchin bacteria-exposed water. At seven days post-fertilization, the larvae were exposed to a pathogen (Vibrio spp.) and were sampled at 0 and 24 hours post-infection. Larval images from all conditions were analyzed by counting pigment cells and measuring body length. Pigment cells contribute to body coloring, and play a key role in immune defense by migrating and absorbing bacteria to prevent infections. Larvae exposed to bacteria are expected to show more resilience during infection due to a primed immune system. However, this may result in a tradeoff between immune system development and growth, leading to more pigment cells but smaller larval size. Larvae in warmer water are expected to be larger but with a less developed immune system due to heat stress. By understanding how the conditions experienced during early development impact later stage phenotypes, we can determine how populations of sea urchins and their delicate ecosystems are shifting in our changing climate.

55. Subantarctic Mode Water Influence on South Pacific Productivity

Alyssa Lawton (Texas A&M University)
Observing the Ocean: REU
Research Advisor: Peter Morton

The Southern Ocean (SO) surrounding Antarctica encompasses several regions divided by temperature, salinity, biological diversity, and nutrient concentrations (e.g., nitrogen, phosphate, silicate, and iron). Forming along these fronts, Subantarctic Mode Water (SAMW) sinks and flows northward just below the bioactive surface waters, influencing up to 75% of primary production in the Pacific Ocean south of the equator. To investigate the impact of SAMW on southern Pacific phytoplankton, samples were collected in 2021 from 30-60°S along 150°W - the path of formation, subduction, and northward transport of SAMW. These samples targeted the bioactive waters in the upper 1000 meters and were analyzed for nutrient concentrations and biological parameters, showing that SAMW consists of both nutrients from its formation waters and remineralized nutrients from degradation of settling organic detritus. To supplement these natural observations, a series of incubation experiments were conducted at sea, where surface seawater was amended with key nutrients (including silicate and iron) or a small volume of subsurface water (including SAMW), simulating the upwelling and mixing of subducted nutrient-rich waters. The incubations were monitored over 4-6 days for changes in the nutrient concentrations and biological parameters. In general, incubations conducted south of the SAMW formation were most responsive to additions of iron, while incubations north of the area were most responsive to iron and silicate. This combined approach of comparing natural changes over distance (along the SAMW path) and changes from artificial enrichments over time will help us understand both the nutritional value of SAMW and the biological sensitivity of surface waters to nutrient additions in the Southern Pacific Ocean.

56. Developing An In Situ Method for Microplastic Detection and Quantification

Ruth Olawumi (University of Wisconsin)
Observing the Ocean: REU
Research Advisor: Darren Henrichs

When plastics are improperly disposed of, natural processes such as exposure to sunlight, weathering, or wind, break them down into pieces small enough for accidental consumption, inhalation, and absorption into skin. When they end up in human bodies, they have been proven to disrupt several organ systems. Since the discovery of plastic fragments in oceans, researchers have used methods like Fourier-Transform Infrared Spectroscopy or Raman Spectroscopy to learn more about them. However, these methods have limitations: such as 1) requiring human interaction and 2) being restricted to lab settings. This project explores using Imaging FlowCytobot (IFCB) instruments, which do not have these limitations, to quantify microplastics in marine environments. Use of the IFCB coupled with a machine learning approach for image identification were used to identify and quantify microplastics in seawater samples. Microplastic concentrations will be compared at different depths of the water column and in the incoming versus outgoing tide. Microplastic control samples were created in the laboratory and run through an IFCB to create a training dataset for the machine learning model that is used to automatically identify microplastics in the field. 151,263 images comprising 129 categories of phytoplankton and one

category of plastic were used to train the model to 91.7% accuracy. Training was stopped to prevent over-fitting but can resume if the model is observed to be insufficiently trained and additional image data are available. It is hypothesized that microplastics will be in higher concentration at shallower depths and in the outgoing tide.

57. In Their Symbiont Era: Identifying Microbial Communities in Maui Shallow-Water Corals Impacted By Wastewater

Grace Mathis (University of Mary Hardin-Baylor)
Observing the Ocean: REU
Research Advisors: Jason Sylvan, Makeda Mills

Nutrient pollution and ocean acidification may act synergistically to harm shallow-water coral health by disrupting coral host and symbiont interactions. Zooxanthellae, endosymbiotic algae in coral tissues, provide essential nutrient products from photosynthesis to the corals. When stressed, zooxanthellae may be expelled, increasing risk of coral bleaching and disease. Coral hosts also rely on a stable prokaryotic population for nutrient cycling and pathogen resistance. In the Kahekili Herbivore Fisheries Management Area (KHFMA) of Maui, Hawaii, scleractinian corals are exposed to high nutrient concentrations and decreased seawater pH from sewage treatment plant wastewater entering the reef through submarine groundwater vents. This study compares microbial communities in KHFMA corals at varying proximities to a vent site. Coral tissue, mucus, and reef water samples collected in summer 2023 underwent DNA extraction. The 16S rRNA gene was amplified using V4-V5 primers 515F-Y and 926R. Characterizing the prokaryotic associations and interactions will enhance our understanding of their roles in coral health and resilience in reef ecosystems impacted by nutrient pollution. We also optimized the PCR protocol with SYM_VAR_5.8S2 and SYM_VAR_REV primers, which have increased specificity for the Internal Transcribed Spacer 2 (ITS2) region of Symbiodinium. By assessing Symbiodinium clade diversity at sites near and far from the vent, we aim to uncover unique zooxanthellae responses to stressors and coral recruitment of zooxanthellae in nutrient-polluted areas. This study may aid in developing improved methods to promote coral success for future conservation and restoration efforts.

58. Assessing Whether Surface Drifters Cluster At Temperature Fronts

Julianne Huesby (University of Minnesota Duluth)
Observing the Ocean: REU
Research Advisor: Spencer Jones

A temperature front in the ocean is the boundary between two different water masses of different temperatures. Temperature fronts are associated with strong, vertical currents that provide vertical transport for heat, tracers, and nutrients within the surface layer of the ocean, which can enhance primary production and increase carbon uptake. These vertical currents are strongest at the submesoscale level of about 0.1-10 km and it is therefore essential for future oceanic and climate change research to understand temperature fronts. In 1979, the National Oceanographic and Atmospheric Association (NOAA) started the Global Drifter Program (GDP) which deployed devices,

called drifters, that float in the ocean and take measurements of surface currents, sea surface temperature, and atmospheric pressure at sea level. This project is therefore focused on quantifying what fraction of drifters gather at temperature fronts. We will utilize NASA's sea-surface temperature data along with NOAA's GDP data in the North Atlantic Ocean to find the locations of drifters and to calculate whether a temperature gradient occurs at those locations. Once we have that data, we will compare those locations to the same number of random locations in the North Atlantic to see if drifters are randomly associated with temperature fronts. Our expected result is that the majority of drifters do cluster at temperature fronts and, if the project is successful, it will provide valuable data about the convergence of water masses from which vertical velocities may be estimated in the future.

59. Carbon Capture Potential and Ocean System Interactions of Carbon Dioxide Removal Methods

Victor Nguyen (University of North Carolina at Chapel Hill)
Observing the Ocean: REU
Research Advisor: Shuang Zhang, Shihan Li

Ocean acidification, where increased CO2 concentrations in the atmosphere increase the presence of hydrogen ions in the ocean and lowers pH, poses a significant threat to marine ecosystems and has economic implications that can adversely affect human communities. Carbon dioxide removal (CDR) methods have gained increased attention as a potential way to sequester atmospheric CO2 and mitigate ongoing global warming and ocean acidification. While previous research onto specific CDR methods such as direct air capture (DAC), ocean alkalinity enhancement (OAE), and enhanced rock weathering (ERW) exists, further research is required to analyze the long-term effects of each CDR method on the ocean and atmosphere. Using the interactive Long-term Ocean-atmosphere Sediment CArbon cycle Reservoir model (iLOSCAR), experiments using combinations of Representative Concentration Pathway (RCP) emission scenarios and additional CDR fluxes (DAC, OAE, ERW) simulated impacts of each CDR method on the ocean and atmosphere in the next 500 years. Preliminary results show that DAC reduces atmospheric CO2 concentrations more than OAE or ERW but is less efficient in increasing the pH of the ocean to mitigate ocean acidification. Additionally, a combination of realistic reduction of fossil fuel burning and CDR deployment has potential to contain global surface warming within less than 2.0°C in accordance with the Paris Agreement. Future research into the costs of each CDR method should be considered, but overall comparison of each CDR method over long timescales warrant discussion for future field trials and tests.

60. Lead Isotope Ratios in Aerosols over the South Pacific Ocean

Cory Ryder (University of Tampa)
Observing the Ocean: REU
Research Advisor: Franco Marcantonio

Lead (Pb) isotope ratios can be used to trace the movement of natural and anthropogenic emissions of Pb throughout the atmosphere and oceans. Here we focus on Pb isotopes ratios delivered by

atmospheric aerosol particles. Although much is known about the delivery of aerosol Pb to northern hemisphere ocean waters, much less is known about the supply of aerosol Pb to the waters of the southern hemisphere, in particular the South Pacific Ocean. The South Pacific Ocean is an important area to explore the Pb geochemical cycle because, given its remoteness, this region has likely been the least impacted with Pb from human activities. Here, we intend to use the fingerprinting capability of Pb isotope ratios to research how Pb makes its way into the atmosphere and waters of this remote region of the world. First, we will determine the continental source of the Pb, be it natural or anthropogenic, being delivered to our sampling sites. Then, we will compare the Pb isotope ratios of aerosols with those of surface seawater and sediment samples to determine cycling of Pb from air to water to sediments. Our analyses will shed light on the chemical processes, such as scavenging and lability, that drive the geochemical cycling of many trace metals.

61. Nickel Dissolution and Hydrogen Uptakes in Different Electrolytes

Jackson Martin (Texas A&M University)
Materials Science Online Research Experience for Undergraduates
Research Advisor: Michael Demkowicz

Our objective is to optimize an electrolyte for future research on nickel hydride formation [1]. Preliminary work must be completed to find electrolyte solutions capable of minimizing corrosion while simultaneously maintaining a high hydrogen uptake. Corrosion damage will be quantified by finding the thickness dissolution rate, a theoretically linear process that can be interpolated out to different charging times. A standard for sufficient hydrogen uptake has already been set in atomic parts per million (appm) [2]. In order to assess the hydrogen uptake coming from each electrolyte, samples of 99% pure, annealed nickel (Ni) foils will be charged in an electrochemical cell. Each electrolyte will be made up of DI water, a high concentration of glycerol, and basic/ acidic components [3]. Each solution using an acid will be scanned with FTIR to prevent using electrolytes with acrolein formation, due to reactions between glycerol and strong acids [4]. Charging will take place for around 1 hour at an overpotential of 600 mV. This will be done with a 3-electrode setup at a constant overpotential of 600 mV [2]. These bulk samples will be charged for times ranging between 1-48 hours to find the rate of hydrogen absorption with respect to time. Melt extraction of each sample will be used to the hydrogen concentration of each bulk sample. Corrosion damage from each electrolyte will be measured on nickel nanofilms with thicknesses ranging under 1 micron. These films will be deposited on silicon wafer substrates, using electron beam evaporation at AggieFab facilities. Although the exact thicknesses of these films will be found later with Rutherford backscattering spectrometry (RBS), they will be initially approximated at 500 nm. Charging will be done with nanofilms the same way as bulk foils in the same electrolytes to create a full picture of the effect of each solution on nickel. However, this will be done in a bottom mount electrochemical charging cell to target only the side with nickel deposited on it.

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62. Thermal Management of Axial Flux Permanent Magnet Motors in Next-Generation Aircraft

Harry Lance (Hendrix College)
Undergraduate Summer Research Grant Program (USRG)
Research Advisor: Dion Antao

Resistive heating in Axial Flux Permanent Magnet Motor (AFPM) stator coils is a significant limiting factor in motor power output. Contributing to the Department of Energy's Aviation-class Synergistically Cooled Electric-motors with iNtegrated Drives program, the goal of this project is to develop a highly efficient AFPM thermal management system (TMS) to optimize AFPM power density for applications in next-generation aircraft. This project proposes a TMS that facilitates heat transfer across heat sink interfaces (pumped with 85% ethylene glycol-15% water mixture coolant) with AFPM stator coils. A thermal energy storage (TES) component provides a buffer, or thermal capacitance, for the TMS, enabling the design of a power dense TMS optimized for the specific flight profile. To evaluate heat transfer across the heat sinks, thermocouples will be used to measure "simulated" winding and coolant temperatures, and pressure transducers will be used to measure pressure drop across heat sink inlets and outlets. Steady-state (600 W) and transient power-inputs will be tested with varying coolant flow rates (i.e., 2, 2.5, 3 lpm), coolant inlet temperatures (i.e., 30℃, 55℃), and TES conditions (i.e., no TES, dehydrated, hydrated) to model take-off and cruise during flight. For expected results, coolant temperature for each test should be less than its boiling point of 135℃, and as coolant flow increases, the pressure drop across the heat sinks is expected to increase as well. In addition, the hydrated TES material is expected to reduce the thermal load during plane take off, achieving U+8776 20 °C decrease in peak winding temperature.

63. Optimizing Manufacturing Processes Using Vision AI Models

Noah Lane (Texas A&M University)
Undergraduate Summer Research Grant Program (USRG)
Research Advisor: Satish Bukkapatnam

One of the current trends in manufacturing is the adoption of increased automation, taking human workers out of laborious and repetitive tasks while increasing efficiency and reducing costs. This paper takes a look at one part of that automation, creating a warning program that watches a can seaming process and notifies an operator whenever something goes wrong. There are many quickly moving parts in a can seamer which can produce six hundred seamed cans per minute. A common issue is a lid interlock in the lid stack which, if uncaught can lead to extensive downtime. To make a model that catches interlocks, both a CNN image classification model and a YOLOv8 model are used. As the video is taken in by the model, it separates each individual frame. First, the YOLOv8 object detection model is

used to crop the frame around just the lid stack, then the CNN image classification model is used to determine whether there is an interlock or not. The model uses multiple frames to give the final interlock warning instead of just relying on only one. With that feature, the overall warning model was highly accurate leading to no mistakes in the videos it was tested with. The output video that acts as the notifier for a human operator worked as desired and notified of impending or present interlocks well before they reached the bottom of the lid stack where they create issues. This method of creating a watchdog program is effective and can be used in manufacturing environments instead of human operators who can instead work in more important functions. A strong camera that can withstand the specific manufacturing environment and maintain a good view, along with a high functioning computer which can analyze around sixty frames per second are required. If that is achieved, this type of program can be applied successfully.

64. Comparison of the Perception of Vibrotactile and Electrostatic Feedback

Alex Baker (Texas A&M University)
Undergraduate Summer Research Grant Program (USRG)
Research Advisor: Rebecca Friesen, Paras Kumar

This pilot study investigates the perceptual differences between vibrotactile (VT) feedback and electrostatic(ES) friction modulation as used for the purpose of haptic feedback. The experiment considered variations in frequency and how that affects the perception of amplitude. To accomplish this, a new housing platform was designed and constructed that could both house the voicecoil actuators and allow for greater freedom of lateral vibration while allowing for simultaneous use of ES feedback. The study asked participants to align the perceived intensity of the ES feedback with the VT feedback at the same frequency by modulating the signal amplitude. The actual vibration velocity of their fingers were then measured to quantify the similarity, additionally the subject's preference for feedback type was noted. Interesting trends emerged in the variety of chosen amplitudes, congruences in actual velocity, and differences in perceived intensity.

65. Total and Fine Dust Collection Efficiencies and Pressure Drops for 1D3D Cyclones with 2ad2D Inlets and D/3 Outlets: Simulated Cotton Ginning Processing Operations

Aurora Jiang (Texas A&M University)
Undergraduate Summer Research Grant Program (USRG)
Research Advisor: Michael Buser

Cyclones are common air abatement devices that are widely used in many industries, including cotton gin industry. Cyclones are attractive technologies because of their relatively low capital, installation, and maintenance costs, and high, consistent total collection efficiencies (U.S Environmental Protection Agency, 2003). Over the past 30 years, agricultural particulate matter (PM) regulations have moved away from total suspended particulate (TSP) to PM10 and PM2.5 or fine dust regulations (U.S Environmental Protection Agency, 2016). Most historic and recent cyclone research has focused on TSP collection efficiencies, and there is a critical need in cyclone research to determine and document the

cyclone fine dust collection efficiencies and how these fine dust collection efficiencies can be impacted by larger materials (e.g., cotton burrs, lint, leaf material) being intermixed with fine dust and processed by a cyclone. This research aims to investigate impacting factors on the performance characteristics of 1D3D cyclones with 2D2D inlets and D/3 outlets, focusing on pressure drops (energy consumption), total collection efficiency, and fine dust collection efficiency. The research used relatively large cyclones (barrel diameter of 24-inches). The control variables were inlet material composition, inlet material loading rate, and inlet air velocity. Data analysis was performed through minitab, excel and tableau to find the performance characteristic relationships. The results show that some controllable factors (e.g., material, inlet velocity) have a large impact on cyclone collection efficiency. The results indicate that it's possible and promising to improve cyclone performance while keeping a relatively low pressure drop.

66. PM2.5 and PM10 Stack Sampling Emission Concentration Analysis: EPA Method 201a versus EPA Method 17 Coupled with Particles Size Analysis

Lilly Taylor (Texas A&M University)
Undergraduate Summer Research Grant Program (USRG)
Research Advisors: Michael Buser, Derrick Whitelock

The EPA recently released new annual PM2.5 (particulate matter with an aerodynamic diameter ≤ 2.5 micrometers) standards that will significantly impact various industries in the U.S., including cotton gins. This project uses data from a national PM emission factor development study for cotton gins to determine potential PM2.5 stack sampling errors. "True" PM2.5 emission concentrations were calculated by multiplying EPA Method 17 stack sampling concentrations by the percent less than 2.5 microns determined from the particle size analysis of the PM capture during the Method 17 sampling. These values were compared to the EPA Method 201a stack sampling data to determine the differences between the two methods or errors. The objectives of this project were to determine if there were Method 201a stack sampling errors and estimate the magnitude of errors in gins across the cotton belt. If the calculated errors are positive, then oversampling is occurring. Oversampling can lead to a source (e.g. cotton gin) being over-regulated and forced to comply with more stringent air quality regulatory enforcement than a source where no oversampling or undersampling is occurring. From a health effects perspective, these sampling errors can lead epidemiologists and the regulatory agencies to draw incorrect conclusions about a source's impact on human health, and result in industries spending more money on regulatory procedures.

67. Studies of Photon Absorption in Hot Nuclear Matter

Luke Smith (Seattle University)
Cyclotron Institute REU
Research Advisor: Ranier Fries

The goal of this study was to examine a fluid known as quark-gluon plasma created by nuclear collisions, in particular through simulating probabilistic outcomes of how photons are impacted by its properties. This research was performed using JETSCAPE, a modular framework capable of simulating high energy

ion collisions. For this study in particular, the relationship between the temperature and flow of quark gluon plasma within an area and the absorption rate of entering photons was investigated by varying the direction of the flow and altering the relativistic velocity and temperature of the plasma.

68. Characterization of palpation Forces for Remote Telehealth Thyroid Examination

Noah Kim (Texas A&M University)
Undergraduate Summer Research Grant Program (USRG)
Research Advisors: Cynthia Hipwell, Anzu Kawazoe

Distinguishing objects by touch through a telemedicine glove apparatus involves detecting varying amounts of force. The force applied to a patient's skin during a physical exam of the thyroid can be measured, providing an opportunity to diagnose thyroid disease remotely. Total force is determined by two components, normal and shear force. Measuring both force components is essential to improving the detection of small lumps of the thyroid. By characterizing applied normal and shear force in the palpation movements of the physical exam of the thyroid, this study aims to determine key characteristics for creating a tactile sensing glove. In the measurement of the force, we used a phantom skin mimicking human skin with abnormal thyroid on a force sensor mounted stage and touched with five major palpation motions that are poke, push/pull, asymmetrical, symmetrical, and the finger crawl in the motion of palpation. After three axes of the force were captured by the mounted force sensor, the correlation of normal and shear force was analyzed. The results show a statistically significant correlation between normal and shear force with a moderate correlation strength. This indicates that it is essential to develop tactile sensors that can estimate the effect of the correlation between the shear and the normal forces. Further investigations will be conducted to better understand the correction effect between the two force directions and any variability in palpation touch across different participants.

69. The Growth and Consolidation in Stand Alone Emergency Departments in Texas

Harish Sontam (Texas A&M University)
Independent Research Project
Research Advisors: Benjamin Ukert, Daniel Marthey

Over the last decade, the number of freestanding emergency departments (FrEDs) across the country has increased substantially. Most growth occurred in Texas, which, as of May 2023, had 338 FrEDs that were operated independently (62%) or owned by a hospital and commonly referred to as a “satellite” (38%). A growing literature has described the location and pricing of FrEDs in Texas, however, the dynamic development of the FrED market is not well understood. Understanding the viability of these facilities is especially important because independently operated FrEDs are separately licensed and, unlike their hospital-affiliated counterparts, are not certified by the Center for Medicare and Medicaid Services (CMS) to receive reimbursement from Medicare and Medicaid. As such, hospital ownership confers substantial benefits by guaranteeing timely payment from federal and state insurance programs. At the same time, the proliferation of independently operated FrEDs displays potential opportunities to

reap higher payments from private payors and opens the opportunity for surprise and balance billing of commercially insured patients. Nevertheless, non-collection of payment from patients could also lead to the closure of facilities if a substantial proportion of patients do not pay. There are several reasons why freestanding EDs can represent a lucrative business opportunity. First, stand-alone ED payment rates are higher than for other outpatient care settings, and stand-alone EDs can charge facility fees that are common for hospital inpatient care. Second, they limit risk by relying on treating lower severity patients and providing basic services (including imaging and laboratory services), while referring more complicated cases to hospital-based facilities. Given the risk of non-payment (as few insurers covered these entities in the early days) or out of network charges for patients, freestanding EDs must be careful in location choice. In this study, we are the first to comprehensively analyze the universe of stand-alone EDs in the state of Texas. We utilize state licensing data that include information on the opening, ownership type, and closures of facilities from 2010 to 2023. We first describe the growth and geography of FrEDs and then describe the sociodemographic county characteristics, sourced from the American Community Survey, to describe openings. We then illustrate the county characteristics based on the dichotomy of independent vs satellite FrEDs, and finally identify factors associated with FrED closure. We use linear regression models to formalize the relationship between ownership status and county characteristics as well as closures and county characteristics. Preliminary results indicate that, on average, 33 independent FrEDs opened each year, and the majority of FrEDs opened in richer suburban areas of large cities. By May 2023 there were 338 total FrEDs in operation, 127 satellite facilities. Most openings occurred between 2014 and 2016. Between 2010 and 2023, 431 independent FrEDs were licensed to operate in Texas. However, many FrEDs struggle financially and 50% of independent FrEDs closed within 3 years of opening. Among the 214 facilities that closed, more than 20% were in operation for less than one year with up to two subsequent FrEDs sharing the same address in a future year.

70. Saccharomyces cerevisiae based Whole-cell Biocatalyst for Enzymatic Polyethylene Terephthalate (PET) Depolymerization

Lance Nuique (Bowie State University)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisors: Qing Sun, Siddhant Gulati

Polyethylene terephthalate (PET) is one of the most used plastics in the world. PET is used in single-use water bottles, clothing, and packaging. Since breakdown of PET under natural conditions is extremely slow, it accumulates in the environment. While mechanical and chemical treatments can be used to breakdown PET, enzymatic PET depolymerization is beneficial over mechanical and chemical methods because there is less use of toxic chemicals, higher quality of monomers, and high selectivity. The enzymatic depolymerization of PET to its constituent monomers- terephthalic acid (TPA) and ethylene glycol (EG) – requires two-enzymes, PETase and MHETase. Whole-cell biocatalysts, which display PET-degrading enzymes on the cell surface, have shown promising PET degradation capabilities due to reduced enzyme aggregation, and have additional benefits like reusability and improved enzyme stability. However, current whole-cell biocatalysts are unable to achieve complete depolymerization with high efficiency. We developed a Saccharomyces cerevisiae-based whole-cell biocatalyst for PET depolymerization. A trifunctional protein scaffold was displayed on the surface of the yeast cell, and enzymes FAST-PETase and MHETase were bound to this scaffold via cohesin-dockerin interactions. The

enzymes were expressed in Escherichia coli and purified using histag purification prior to binding with the scaffold. The dockerin-tagged enzymes retained activity after binding to the scaffold and showed promising activity on an amorphous PET film substrate. By using this S. cerevisiae whole-cell biocatalyst, PET can be completely depolymerized at ambient conditions without the use of toxic chemicals, opening doors for efficient PET recycling and upcycling to valuable products.

71. Effects of Preconceptual Dual Parental Model of Alcohol Usage on Offspring Epigenetics

Aylin Doganoglu (Gettysburg College)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Michael Golding

Fetal alcohol spectrum disorders (FASDs), which include fetal alcohol syndrome (FAS), partial fetal alcohol syndrome (PFAS), alcohol-related birth defects (ARBD), and alcohol-related neurodevelopmental disorder (ARND), collectively describe developmental, physical and cognitive impairments, which occur as a result of prenatal alcohol exposure (Gomez and Abdul-Rahman 2021). According to the CDC and many other public health organizations, FASDs develop exclusively through maternal alcohol use during pregnancy, which indicates that no consideration has been given to possible paternal contributions to FASDs. Despite ongoing research efforts examining non-genomic mechanisms of paternal inheritance and its effects on the health of the offspring, few studies have examined how paternal alcohol use can influence FASDs. This study takes a unique approach by predicting that dual parental (both mother and father) can cause significant epigenetic alterations in the epigenetic regulation of offspring gene expression.

In our previous studies, we observed an interaction between maternal and paternal alcohol use, with markers of accelerated age-related liver disease in the dual-parental offspring exceeding those induced by either maternal or paternal alcohol use alone. We hypothesize that Maternal, Paternal, and Dual-Parental alcohol exposures alter histone methylation and expression of the inflammatory cytokine Interleukin 6 (IL-6). To test our hypothesis, male and female Mus musculus were treated with either 10% ethanol or control (water) before mating, and their offspring aged 42 weeks. We then used Chromatin Immunoprecipitation, western blotting, and ChIP-qPCR analysis to compare the expression and chromatin profiles of the IL-6 regulatory region between treatments.

72. Microhomology Mediated End Joining, After CRISPR/Cas9-Induced Double-Strand Break in Aedes Aegypti

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Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: William J. Murphy

Aedes aegypti mosquitoes are notorious for their role as vectors of several dangerous diseases, including Dengue fever, Zika virus, Chikungunya, and Yellow fever. These diseases pose a substantial health risk to millions of people worldwide. CRISPR/Cas9 technology has revolutionized genetic manipulation, yet its efficiency in generating precise edits varies across species due to differing repair

pathway preferences. This study aims to clarify the role of Microhomology Mediated End Joining (MMEJ) in repairing CRISPR/Cas9-induced double-strand breaks (DSBs) in Aedes aegypti mosquitoes, by quantifying the frequency and characteristics of (MMEJ) mediated repair events through targeted sequencing and bioinformatics analysis. The findings could provide crucial insights into the prevalence of MMEJ as a repair mechanism, thereby enhancing the optimization of CRISPR/Cas9 applications for controlling mosquito-borne diseases and advancing our understanding of genetic resilience mechanisms in insects.

73. Characterization of Stereotypic Chromatin States at Enhancers Across Multiple Mouse Tissues

Kiera Griffin (Baylor University) and Amber Hsieh (Texas A&M University)
Independent Research Project
Research Advisor: Jerome Menet

The circadian clock, which is initiated by the daily binding of the transcription factor (TF) CLOCK:BMAL1 to DNA, is essential to the rhythmic regulation of gene expression in all tissues. The key to this regulation is the changes in chromatin structure that occur in response to CLOCK:BMAL1 binding at cis-regulatory elements (CREs), i.e., enhancers and promoters. Our lab recently used single-molecule footprinting (SMF) to demonstrate that mouse liver CREs exhibit stereotypic highly-conserved chromatin states reflecting distinguishable organization of TFs and nucleosomes. The goal of this project is to determine whether these chromatin states are the result of TF activity or CRE DNA sequence. To that end, we are adapting SMF to multiple mouse tissues, reasoning that changes in TF activity would generate tissue-specific chromatin states. Specifically, we used public DNase-Seq datasets to identify 19 conserved CREs across different mouse tissues, then designed polymerase chain reaction (PCR) primer pairs for SMF sequencing library preparation. PCR testing yielded functional primers for 14 of the 19 CREs. Next, we tested a new nuclei isolation protocol on 6 different mouse tissues to establish a standardized nuclei purification procedure. Protocol evaluation using Trypan Blue and DAPI stains yielded an increase in pure nuclei obtained as compared to previously-tested protocols. Overall, these developments will enable future research on stereotypic chromatin conformations at CREs and how they relate to DNA sequence versus the binding of TFs such as CLOCK:BMAL1 across a variety of tissues.

74. Effects of Cationic Amphiphilic Drugs (CADs) in Endosomal Escape and Genetic Transformation

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Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Cedric Geoffroy

Genetic transformation occurs when exogenous DNA is inserted into a cell and integrated into the host's genome. It is known that viral vectors cross the cell membrane to deliver genetic material into the cell's nucleus. The Adeno-Associated Virus (AAV) is often used clinically and in research due to its low-toxicity and effectiveness in genetic transformation. Despite the success of AAV as a delivery vector, certain

issues arise in clinical applications, particularly, endosomal entrapment. Cells usually internalize delivery vectors through endocytosis, but these vectors often remain in endosomes instead of reaching the cytosol or nucleus. Consequently, only a few of these molecules reach their intended targets, limiting biological activity. Improving endosomal escape would enable lower viral doses, faster intracellular delivery, and improved transduction and transfection. Small molecule drugs such as cationic amphiphilic drugs (CADs) could be used to induce endosomal escape. CADs are characterized by a hydrophobic aromatic ring and a hydrophilic side chain, and previous studies show they can alter cell membrane permeability based on their chemical-physical properties. We hypothesize that CADs will enhance endosomal escape, thereby increasing the efficacy of AAV in genetic transformation. To test this hypothesis, we tested gene transformation efficiency using three concentrations of AAV particles containing the GFP gene against five FDA approved drugs (Alexidine, Desloratadine, Nortriptyline, Mefloquine, and Perphenazine) at varying concentrations. We calculated the infection percentage and measured GFP expression intensity to determine if CADs enhance gene therapy efficiency. This research aims to improve gene therapy techniques, making them more effective and versatile.

75. Pharmacological Modulation of BMAL1 in Circadian Clock Studies

Christian Hernandez (Texas A&M University Kingsville)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Shogo Sato

Circadian rhythms are regulated by the biological clock within all living organisms. These rhythms control numerous biological functions including sleep/wake cycles, hormone release, and metabolic processes. In mammals the master control center for biological rhythms is located within the hypothalamic suprachiasmatic nucleus (SCN). Circadian clocks can be affected by both internal and external factors. For instance, light serves as an exogenous time cue (zeitgeber), while metabolic regulation is an essential mechanism underlying endogenous clock modification. Notably, the circadian dynamics of clock activity is driven by post-translational modifications such as cyclic acetylation and deacetylation over a 24 hour cycle. This includes alternating periods where specific genes are activated or suppressed. However, this mechanism is prominent only in differentiated cells. Strikingly, recent evidence suggests that undifferentiated cells lose mature clock machinery, resulting in dampened circadian rhythmicity of gene expression. This raises an outstanding question: how does the circadian clock acquire its rhythmicity during cellular differentiation? To address the question, our study has taken a pharmacological approach to determine the role of acetylation of the circadian transcriptional activator BMAL1 in the development of circadian clockwork during skeletal muscle cell differentiation. Given NAD+-dependent histone deacetylase SIRT1 catalyzes the deacetylation of BMAL1, we aim to manipulate the acetylation of BMAL1through pharmacological intervention targeting SIRT1 activity. We hypothesize that enhanced acetylation of BMAL1 will accelerate the emergence of circadian rhythmicity during myogenic differentiation.

76. Uncovering Mechanisms of IKZF1 Protein for Multiple Myeloma Prevention and Treatment

Ella Seletstewa (Northern Arizona University)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Irtisha Singh

Multiple Myeloma (MM) is an incurable blood-based cancer of plasma cells with a host of symptoms that rapidly reduce patients' quality of life. Ikaros, or IKZF1, is a major regulating transcription factor in immune cells and the primary target of the anti-myeloma drug lenalidomide. However, in a healthy plasma cell, the predominantly expressed IKZF1 isoform is shortened by an intronic polyadenylation event (IKZF1 IPA), which lacks the domains required for IKZF1 transcription factor activity. We have engineered MM lines with plasmids to overexpress or knockdown IKZF1 IPA, and have previously found that changing IKZF1 IPA expression affects its full length isoforms. Though IKZF1 IPA is coded to protein, we have had difficulties probing for IKZF1 IPA protein, indicating it may be degraded in MM cells. For a better clue as to the molecular biology of the IKZF1 IPA isoform, we are inhibiting the proteasome to gauge whether IKZF1 IPA is readily degraded in MM cells. We optimized a protocol and dosage for MG-132 treatment via western blotting and imaging. This will inform us whether IKZF1 IPA is degraded, and if inhibiting IKZF1 IPA degradation influences IKZF1 FL levels. Understanding potential mechanisms connecting IPA to FL can be uncovered to aid in diagnosis and care of patients with MM.

77. Mitochondrial Isolation for Respiration Analysis using Seahorse and Implications for Poxvirus Research

Ashlyn Parrott-Price (McNeese State University)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisors: Zhilong Yang, Djamal Brahim Belhouari

Mitochondria play a crucial role in cellular processes, primarily by producing ATP through respiration. Various conditions, including pathogenic infections, can alter or impair mitochondrial function and respiration rates. The vaccinia virus, the model virus to study poxviruses, is an example of a pathogen that promotes mitochondrial respiration to benefit viral replication. Understanding the interaction between vaccinia virus and mitochondria will significantly advance our knowledge of both poxviruses and mitochondrial physiology. The Seahorse analyzer is widely utilized in studying cell bioenergetics and respiration by measuring oxygen consumption rate (OCR) and extracellular acidification rate (ECAR), which indicate ATP production from oxidative phosphorylation and glycolysis, respectively. While Seahorse analyzers are typically used on whole cells from tissue or culture, there is limited documentation on their use on isolated mitochondria. This research project aims to develop and optimize a protocol for mitochondrial isolation that is compatible with the Seahorse analyzer for respiration analysis. The ability to analyze isolated mitochondria would allow us to investigate mitochondrial function and respiration in vitro. The success of this project would enable a closer examination of the vaccinia virus-mitochondria interaction. Our preliminary results are promising, but, with further optimization, we aim to refine our methods to achieve even greater accuracy and reliability.

78. Reversal Instrumental Learning Fails to Reduce Neuronal Activation in Early Alzheimer's Disease

Julia Hunter (Gettysburg College)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Jun Wang

Alzheimer's Disease (AD) is a progressive brain disorder characterized by cognitive deficits in the early stages and dementia in its advanced stages. Beta-amyloid plaques and Tau protein neurofibrillary tangles are implicated as primary contributors to the symptoms of AD, yet the precise mechanisms underlying cognitive deficits and memory loss remain unclear. In this study, we utilized 5xFAD mice, which express human APP and PSEN1 transgenes with five AD-linked mutations, as a model of AD. We used instrumental learning tasks and the Barnes Maze to assess cognitive flexibility in the early stages of AD. ArcTRAP and immunohistological staining techniques were used to identify activated neurons during these behaviors. Our findings indicate that AD animals failed to learn reversed action-outcome contingencies in striatum-dependent instrumental learning tasks but did not exhibit hippocampus-dependent spatial reversal learning deficits in the Barnes Maze. This suggests that striatal function shows deficits in the early stages of AD, preceding hippocampal dysfunction. Additionally, ArcTRAP analysis revealed a higher number of coactivated neurons during reversal and initial learning tasks in 5xFAD mice compared to wild-type mice, indicating an inability of AD animals to inhibit previously activated neurons during the initial learning tasks. Our study provides novel insights into the early onset of cognitive inflexibility in AD.

79. Investigating the Role of a Specific CAF Population in Mammary Tumorigenesis

Chris Teichmann (Austin College)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Tapasree Roy Sarkar

Breast cancer is a leading cause of cancer deaths worldwide, with about 670,000 deaths reported in 2022. The tumor microenvironment is a culmination of cell types including immune cells, the extracellular matrix, blood vessels and stromal cells such as cancer-associated fibroblasts (CAFs), which help in stabilization of the tumor and the development of cancer. CAFs play a crucial role in cancer cell survival, proliferation, and evasion through their release of cytokines and chemokines. By using single-cell RNA-sequencing, our preliminary study showed that a specific CAF population (S100a4+) is increased with the progression of tumor. This study aims to functionally characterize S100a4 CAF population and to investigate the molecular mechanism underlying S100a4+ mediated tumor progression.

80. CFD Modeling of Biofilm Dynamics in a Costa Rican Montane Stream

AJ Jefferson (Lone Star College)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisor: Yinuo Yao

In stream ecosystems, biofilms significantly influence nutrient cycling and water quality by facilitating nutrient uptake and pollutant filtration, while also having the potential to cause nutrient imbalances and harbor harmful microorganisms. Dynamic interactions with environmental factors make biofilms crucial to maintaining ecosystem health and stability. While most existing research has focused on investigating either the microbial activities in biofilm development or the flow dynamics and nutrient transport in streams, the interactions between biofilm development, nutrient availability, and flow dynamics have received less attention. This study investigates the impact of nutrients (e.g., nitrogen, phosphorus), organic carbon, and flow rates on biofilm growth in a stream by performing high-fidelity Computational Fluid Dynamics (CFD) simulations using OpenFOAM solver, bioGroutFoam. The simulation results will be validated against field measurement of biofilm development on a rock in a stream located in a tropical montane forest in central Costa Rica. The validated model will be employed to study the impact of environmental conditions on biofilm development in streams. This approach can be applied to understand the effects of flow rates and nutrient concentrations on biofilm development in natural streams, offering strategies to optimize the role of biofilms on nutrient cycling and water quality.

81. Microbial Respiration Rates and Carbon Dynamics of Native and PES Forests in a Costa Rican Tropical Montane Forest

Jamie Bergeron (Sam Houston State University)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisor: Ashly Smith

The Costa Rica Payment for Ecosystem Services (PES) Program provides financial incentive to landowners who participate in reforestation and sustainable forestry practices. The goal of the program is to promote secondary forest growth and conservation, biodiversity, and carbon sequestration. The rate of nutrient cycling in soil can directly impact the total amount of carbon storage. Soil microbial communities are known to have significant effects on nutrient cycling, carbon sequestration, and soil structure. This study investigates how forest types affect soil microbial activity and physiological composition of the H. Alcherneoides tree in a Costa Rican PES and native forest. In situ soil respiration measurements with temperature and moisture content along with incubations were done using an EGM-5 CO2 analyzer to understand the rate of carbon export in both land uses. Ecoplates were used to calculate microbial functional diversity as it has significant influence on nutrient cycling. Additionally, active carbon, or permanganate oxidizable C, PH, bulk density, and carbon nitrogen ratios were measured to understand the environmental conditions of the soil. Preliminary results show that distance from the trunk had a significant effect on the soil respiration rate, but land use did not show significance. The findings of this study are significant in understanding how the application of the PES program aligns with its intended goals.

82. Strobilation Without Symbionts: Do Carotenoids Induce Strobilation in Non-Symbiotic Cassiopea xamachana?

Jaelyn Rodriguez (Texas A&M University at Galveston)
ACES (Aggies Commit to Excellence Scholar)
Research Advisors Sheila Kitchen, Aki Ohdera

Cassiopea xamachana holds a symbiotic relationship with a photosynthetic dinoflagellate of the genus Symbiodinium. Akin to the mutualism between corals and zooxanthellae, the inhabiting algae maintain a nutritional endosymbiotic relationship with the jellyfish. However, unlike in corals, the symbiont is also a trigger for a metamorphic transition called strobilation. This process transforms the sessile, asexual polyp to the pelagic, sexual medusa, allowing the metamorphosed jellyfish to disperse and mate. Without the presence of these symbionts, Cassiopea remains in the polyp stage indefinitely.

Understanding which cellular cues of the algal symbionts triggers strobilation of the jellyfish will reveal how the jellyfish's development is dependent on its symbiotic partner. Prior work on another true jellyfish (i.e., moon jellyfish Aurelia aurita) found that the ligands retinol and retinoic acid activate the transcription factor RxR, which then induces metamorphosis. In symbiotic Cassiopea, mass spectrometry data identified various highly abundant carotenoids derived from Symbiodinium, which are structurally similar to retinoids. These carotenoids, generally known as warm-colored, liposoluble pigments, are hypothesized to be the ligands that induce strobilation in Cassiopea. Herein, my project addresses the question of are carotenoids sufficient to induce strobilation in Cassiopea.

We have begun exploring this experiment through the testing of the carotenoid β-Carotene, in the form of feeding an E. coli strain that contains a plasmid to produce β-Carotene. Bacterial feeding pellets are pipetted directly into the mouth of the non-symbiotic polyps under the microscope. We are able to feed a group twice-daily and observe for signs of strobilation over the span of two weeks, the natural window of strobilation in symbiotic polyps. As this experiment continues into the summer, we will test 1) how β-Carotene without the bacterial intermediate impacts strobilation, and 2) if another E. coli strain that produces the carotenoid zeaxanthin induces strobilation. This oxygenated carotenoid is also found in Symbiodinium. Improvements on experimental design will also be a focus, introducing plasmid-negative E. coli into the pellet recipe in order to ensure a trustworthy comparison between the subject groups. Refining and altering the pellet ingredients, concentrations, and amount will also be necessary to optimize the protocol for bacterial pellet feedings.

83. Effects of Social Media Anti-Fluoride Campaigns on Students' Perceptions of Fluoride

Hannah Burke (Washington and Lee University)
School of Dentistry Summer Undergraduate Research Program
Research Advisor: Amal Noureldin

Background: Fluoride obtained from sources including fluoridated water, fluoride varnish, and fluoride-containing toothpaste is crucial for strengthening teeth and preventing caries. Despite these benefits, there has been a recent rise in anti-fluoride campaigns spreading misinformation about the dangers of fluoride and promoting fluoride-free products on many social media platforms. Social media is a large

target of anti-fluoride campaigns because of the ease and speed of information dissemination, allowing messages to reach large audiences. College students serve as an excellent model for studying the effect of these campaigns, as many students spend multiple hours a day on social media. Further, college students are at a critical age for developing their beliefs and values, so it is important to examine how these campaigns may potentially influence their future decisions about both personal and public health.

Objectives: To study the effect of the anti-fluoride campaigns on undergraduate and predoctoral dental students' knowledge, attitudes, and perceptions regarding fluoride. Methodology: A 28-item survey was conducted among undergraduates and incoming first- and second-year dental students analyzing their exposure to these campaigns. Based on the results of this study, educators can formulate better teaching strategies to inform students about the benefit and necessity of fluoride in their own lives and the lives of future patients. Additionally, by investigating the social media algorithms, types of anti-fluoride messages, and information dissemination patterns, this study will aid in the development of public health strategies to promote pro-fluoride content and combat anti-fluoride misinformation, particularly on social media.

84. Studying The Link Between Long Term Opioid Use and Pain in Mice

Angelica Requena (Texas A&M University)
School of Dentistry Summer Undergraduate Research Program
Research Advisors: Feng Tao, Joshua Crawford

Opioids have been used to treat a variety of pain conditions such as cancer treatment, diabetes, and more. However, it became evident that long term opioid use led to a number of complications, including increased pain sensitivity; a conflicting issue especially for those who need it for prolonged use due to pain. This condition is known as opioid-induced hyperalgesia and still remains poorly understood. To discover why this is happening, this project will be utilizing multichannel neuronal recording and behavioral testing on freely moving mice in order to understand the effects opioids have on the anterior cingulate cortex and why they occur. These mice will be treated with four different treatment combinations; morphine and butyrate, morphine and saline, butyrate and saline, and saline and saline. Anxiety and depression levels will also be tested in order to observe how opioid-induced hyperalgesia is linked to other comorbid neurological disorders.

85. The Challenge: Clearing Whole Mouse Eyes for Microscopy

Sufiyan Sabir (Texas A&M University)
School of Dentistry Summer Undergraduate Research Program
Research Advisor: Kathy Svoboda

Over the last 10 years, tissue clearing methods have advanced the understanding of three-dimensional relationships in tissues and organs. However, existing protocols struggle to preserve fluorescence or maintain tissue's structural integrity. Intact eyes have only been described in a few publications, many with reports of lost fluorescent markers. The tissue clearing method, termed PEGASOS, was developed by Dr. Hu Zhao at the TAMU College of Dentistry and has shown exceptional promise in retaining

fluorescent markers across various tissues, but its application to ocular structures remains unexplored. The clearing method was optimized to illustrate the 3-D spatial interactions and organization within various hard and soft tissues. This investigation aimed to apply these solvent-based tissue clearing methods specifically to create the optimal protocol for clearing eyes while maintaining fluorescence markers for specific cells. In addition, this experiment included in-situ and enucleated eyes obtained from transgenic mice that carried specific fluorescent cell markers. The challenge was to optimize the time, temperature, and solvent concentrations to obtain a reliable protocol for future experiments. The results of this study will enhance the understanding of ocular structure and function, providing valuable insights for future research.

86. Optimal Sites for Insertion of Infrazygomatic Miniscrews for Subjects with Different Growth Patterns, Gender, and Growth Status

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Research Advisor: Shivam Mehta

In contrast to more invasive orthodontic interventions, infrazygomatic miniscrews (IZ) offer a minimally-invasive option to facilitate distalization, intrusion, and retraction of maxillary dentition. However, information regarding the optimal location for the insertion of IZ is scarce. The objective of this study was to quantitatively analyze the infrazygomatic region in subjects with different skeletal pattern, gender, and growth status using Cone-Beam Computed Tomography scans (CBCTs). 718 CBCTs were evaluated for 4 main groups I)Non-growing male, II)Growing male, III)Non-growing female, IV)Growing female with three subgroups a)Hyperdivergent, b)Hypodivergent, and c)Normodivergent. Buccal alveolar bone thickness and interradicular distance were measured between three sites: (1) the second premolar and first molar(U5-U6), (2) the mesiodistal roots of the first molar(U6), and (3) first and second molars(U6-U7). These measurements were performed at 3 levels above the occlusal plane: 5mm(5OP), 8mm(8OP), and 11mm(11OP). The results showed that males had significantly thicker buccal alveolar bone than females at 5OP and 8OP ($p<.001$). Males had significantly more U6 interdental root distance at 8OP than females ($p<.001$), while females had more distance at U6-U7 ($p=.003$). Buccal alveolar bone height was greater for males at U6-7 than females ($p=.021$). Hypodivergent subjects had significantly thicker buccal bone than hyperdivergent ($p=.005$), as well as more interdental root distance ($p=.003$), while hyperdivergent subjects exhibited higher buccal alveolar bone height ($p=.012$). Optimal insertion site for IZ is between U6-7 due to thicker buccal alveolar bone. The interradicular distance is decreased in hyperdivergent and thus, caution should be exercised while using IZ to prevent injury to roots.

87. The Impact of Surface Geology on Export of Dissolved Inorganic Carbon in Tropical Rainforest Highland Streams in Costa Rica

Emily Vanderworth (Texas State University)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisor: Peter Knappett

Globally, major rivers export approximately 0.9 Tg/yr of particulate organic carbon (POC) and 0.38 Tg/yr of dissolved inorganic carbon (DIC) annually, mainly as bicarbonate from silicate weathering. Half this bicarbonate precipitates, while the rest exsolves to the atmosphere as CO2 gas. These processes, regulated by new silicate rock exposure and global temperatures, form a terrestrial thermostatic-feedback loop by regulating atmospheric CO2 levels. However, physical weathering of pyrite can lead to CO2 release rather than sequestration. This study quantifies DIC export from watersheds with different bedrocks in a tropical volcanic landscape in Costa Rica. We analyzed 30 stream samples across three surface geology types (ignimbrites, distal, and proximal lavas), ranging in elevation from 60 masl to 1400 masl. We measured temperature, pH, alkalinity, turbidity, major ions, silica, and sulfate concentrations. Rock samples were analyzed using X-ray fluorescence to estimate pyrite content. Our preliminary results show that median alkalinity (as HCO3-) in streams crossing ignimbrite, distal and proximal lava deposits were 52.64 mg/L, 64.79 mg/L, and 60.96 mg/L, respectively. Variations in alkalinity among these geology types suggest differences in weathering processes and the influence of bedrock composition on carbon export. Additionally, average stream temperature (Celcius) and pH ranged from 18.5 to 28.3 and 5.43 to 8.39, respectively, indicating varying DIC transport capacity. Ongoing work will produce cation and anion concentrations which will help to understand the chemical reactions that are driving differences in DIC export across these terrains.

88. The Significance of Hieronyma alchorneoides in Maintaining Labile Sugars: A Comparison between Two Different Land Uses in Costa Rican Rainforests

Rowan Tsao (University of British Columbia)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisor: Georgianne Moore

This study investigates how Hieronyma alchorneoides root biomass, distribution, and sugar content affect soil labile sugar quantities in tropical montane forests of Central Costa Rica. High rainfall in these forests causes nutrient loss and carbon export, counteracted by tree root structures, exudates, and soil aggregates, which enhance soil carbon storage. Glucose, a labile carbon form, is crucial for soil microorganisms that increase soil organic matter turnover and carbon sequestration. We compare soil samples from a Payment for Ecosystem Services (PES) plantation and a native forest. Soil samples were collected at varying distances along H. alchorneoides roots to measure root biomass, sugar content, litter biomass, and soil sugar content in macroaggregates and homogenized soil. The anthrone method (Yemm and Folkes, 1954) and a spectrophotometer were used for sugar content analysis. We hypothesize that root biomass increases with distance from the trunk and that soil sugar content is proportional to root sugar content, with larger soil aggregates containing higher sugar concentrations. By evaluating differences between PES and native forests, we aim to understand the efficacy of

management practices for carbon capture and restoration, highlighting soil aggregates' role in retaining water-soluble sugars, and the importance of plant biomass in facilitating this process.

89. Impacts of Atta Cephalotes Bioturbation on Physical and Chemical Soil Properties

Anastasiia Pestereva (University of Central Florida)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisor: Felipe Aburto

In the native and plantation forests of Costa Rica, leaf-cutter ants (atta spp.) serve as ecosystem engineers by cultivating fungi and displacing deeper soils to the surface, a process described as bioturbation. As areas of the plantation forest increase, it is unknown how these ants affect biogeochemistry of soil. This study focuses on analyzing physical and chemical properties of mounds versus non-mounds. In addition, we tested the feasibility of using Near InfraRed spectroscopy (NIR) by matching known total carbon and nitrogen values against a model prediction. Soil cores of ten centimeters were collected from three sites in the plantation forest where nest and non-nest areas were selected. Laboratory experiments were performed to obtain bulk density, moisture, particle density, porosity, texture analysis, and pH of the soils. There was a higher bulk density and lower moisture content in nest mounds compared to non-mounded soils. All samples are composed of large amounts of sand while bioturbation affected soils have a higher clay content in comparison to unaffected soils. Chemically, we expect non-nest soil to have higher carbon and nitrogen contents as most organic matter resides on the surface. This study will increase data on C and N stocks of leaf-cutter ant nests, increasing the confidence level of models used to predict soil properties from NIR spectra. The broader impacts of this research constitute in understanding how leaf-cutter ants affect biogeochemical processes in the plantation forest soils.

90. Identifying the Effects of Land Use Change on Soil Respiration Rates and Organic Carbon Accumulation Across Aggregate Sizes in a Tropical Montane Forest

Keegyn Fields (University of Kentucky)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisor: Salvatore Calabrese

The Payment for Ecosystem Services (PES) program in Costa Rica exists to incentivize landowners to utilize portions of their land for forest plantations, supporting both reforestation and economic interests. By converting pastureland to forests, there can be an increase in carbon (C) sequestration both above and below ground. However, the role of aggregate size on the protection and cycling of organic carbon has rarely been explored in this context. Aiming to illuminate the impact of soil structural organization on carbon sequestration, the objective of this work was to investigate aggregate size distributions, respiration rates, and soil organic carbon (SOC) across land uses. Soil samples were collected alongside Hieronyma alchorneoides trees, in both a PES plantation and native forest, near the Texas A&M Soltis Center in the Alajuela province of Costa Rica. These samples were dry-sieved to determine aggregate distribution. Soil respiration (µg CO2-C/g soil/hour) was measured in incubated

aggregates after 24 hours. Additionally, each aggregate class was analyzed for SOC contents. Early results show a significant effect of aggregate sizes on respiration rates, but little evidence for differences between land uses. Additionally, high tree-to-tree variation in the native forest compared to homogeneity in the PES site suggests the more homogenized succession of PES forests may lead to less variability between trees. SOC analysis is expected to strengthen relationships in the data. Future applications of the collected data will allow for a deeper understanding of the relation between land use, aggregate distribution, and C cycling within aggregates.

91. Stream Scaling and Hydrological Variability in Costa Rican Montane Watersheds

Henry Anderson (Whitman College)
Costa Rica REU: Ecohydrology of Tropical Forests
Research Advisors: Tony Cahill, Kelly Brumbelow

Understanding hydrological behavior in Costa Rican watersheds is crucial for effective flood control and sustainable water management. Because flow characteristics of streams vary with geological regime, location, stream order, and other geographical conditions, rating scales must be tailored to characterize each riparian system accurately. The Rio Peñas Blancas watershed, located near the Texas A&M Soltis Center, is an ideal study area to examine stream behavior within tropical pre-montane transitional forests in Costa Rica, particularly during the rainy season. Using a V-notch weir and water level loggers, depth was continuously gauged at three locations, forming nested watersheds of 3 hectares, 214 hectares, and 792 hectares, respectively. By periodically surveying these streams using standard USGS stream gauging methods, rating curves were constructed to correlate stream stage and discharge over time. Regional precipitation, atmospheric pressure, and site elevation data were collected to adjust measurements accordingly. Early results suggest scaling across individual storm events, base-flow recession curves over varying time intervals, and precipitation lag time distribution between upstream and downstream survey locations. The compiled rating curves offer valuable predictive data for future hydrological research in the region. However, significant changes observed in streambed morphology between 2018 and 2024 reflect the dynamic nature of pre-montane streams, requiring continuing work on calibration of any rating curves at these locations. Further expansion of these curves to additional locations within and beyond the watershed will enhance our understanding of streamflow dynamics across Costa Rican watersheds and reduce uncertainties in hydrological predictions.

92. Description of Mosquito Communities in South Texas

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Diversity in Entomology REEU Program
Research Advisors: Gabriel Hamer, Yuexun Tian

Mosquitoes are important vectors of disease-causing pathogens that affect humans and other animals. However, different mosquito species vary in their ability to transmit pathogens. For example, Aedes (Stegomyia) are vectors of dengue and Zika virus, while many Culex spp. mosquitoes transmit West Nile virus. Furthermore, the habitats, which include aquatic for immature mosquitoes, are influenced by

various factors, such as temperature, rainfall, and climate change. As a result, there have been shifts in their distribution which influences mosquito-borne disease-transmission. Some mosquito-borne pathogens have resurged in recent years, such as in 2023 when there was a confirmed case of malaria reported in Cameron County, Texas, highlighting the need to enhance our understanding of mosquito communities in South Texas. The objective of this study is to describe mosquito communities in South Texas using morphological identification and molecular barcoding. Samples were collected from Estero Llano Grande State Park with a CDC light trap using carbon dioxide entrapment. To date, 146 mosquitoes have been identified, with the most prominent genera being Ochlerotatus (n=53), Aedes (n=45), and Culex (n=18). A subset of these samples will undergo PCR and Sanger sequencing to verify the morphological identifications. The results from this study will inform about risks of human and other animal exposure to mosquito-borne pathogens.

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