SUMMER UNDERGRADUATE RESEARCH POSTER SESSION ABSTRACT BOOK

Wednesday, July 31, 2019

Interdisciplinary Life Sciences Building Lobby

Morning Session
10:00 AM – 12:00 PM

Afternoon Session
3:00 PM – 5:00 PM

A&M

LAUNCH

UNDERGRADUATE RESEARCH

LAUNCH Undergraduate Research
Summer Poster Session
Wednesday, July 31, 2019
Interdisciplinary Life Sciences Building Lobby

Morning Session
10:00 AM – 12:00 PM

Featured Summer Programs:

1. *Aggie Research Program*
2. *Aggie STEM*
3. *Astronomical Research and Instrumentation (Physics & Astronomy REU)*
4. *CARTEEH*
5. *Chemistry REU*
6. *Cyclotron REU*
7. *Energy and Propulsion REU*
8. *Engineering Undergraduate Summer Research Grant (USRG) Program*
9. *Halliburton Engineering Global Program*
10. *IIT Kanpur/TAMU Exchange Program*
11. *Metrology and Non-Destructive Inspection REU*
12. *TTI Safe-D*

Afternoon Session
3:00 PM – 5:00 PM

Featured Summer Programs:

1. *Aggie Creative Collective*
2. *Atmospheric Science in the Gulf Coast Region (ATMO REU)*
3. *Biochemistry REU*
4. *Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program*
5. *College of Architecture SURE*
6. College of Medicine Summer Undergraduate Research Program
7. *Costa Rica REU*
8. *Glasscock Summer Scholars*
9. *Observing the Ocean REU*
10. *Ocean and Coastal Research Experiences for Undergraduates (OCEANUS) REU*
11. *SURE EnMed*
12. *Summer Undergraduate Research Program in Genetics and Genomics*
13. *U.S. Department of Agriculture Water Quality REU*

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Morning Session
10:00 AM – 12:00 PM

1. Reaching Higher Blocking Temperatures for Single-Molecule Magnets using Borolide Capping Ligands

Jesse Martinez (Baylor University)
Chemistry REU
Research Advisor(s): Michael Nippe, Caleb Martin

As technology continues to develop greater storage capabilities are needed, but the current method for storing data is reaching its peak of efficiency and density. This need for innovation has made chemists turn their sights towards single-molecule magnets (SMMs), molecules that can retain magnetization in the absence of an applied magnetic field. An effective SMM would need to have strong magnetic hysteresis, the responsiveness of the SMM to magnetization, along with a high blocking temperature, the highest temperature that magnetic hysteresis is still observed. A hard drive using SMMs would be able to read or write data on each molecule present in the disk, rather than each, much larger, grain of metal. Currently, flash drives can store up to 256 GBs, but with SMMs an average sized flash drive could store up to 25,000 GBs. Certain SMMs have achieved a blocking temperature of 20 K by promoting axiality throughout the molecule using CpMe4H capping ligands along with improving magnetic exchange coupling provided by a N23- radical bridging ligand. The SMMs with the highest blocking temperatures of 80 K are dysprosium metallocene complexes that have vibrational modes shut down by added steric bulk on the capping ligands, blocking suboptimal pathways towards magnetic relaxation. Our research plans to improve upon this set precedence by using dianionic pentaphenyl borolide capping ligands to further promote the magnetic exchange coupling and/or axiality of the synthesized SMMs. This would lead to an even higher blocking temperature and promote all other favorable traits mentioned prior.

2. Morphological and Electronic Properties of Diacetylene-thiol Assemblies on Au(111) Surfaces

Andrew Brown (Louisiana Tech University)
Chemistry REU
Research Advisor(s): James Batteas

Self-Assembled Monolayers (SAMs) are incredibly versatile in chemistry. One of their many uses is in organic solar cells, working towards increasing the efficiency of these low-cost alternative to traditional solar cell designs. One type of molecule which has been studied as conductive monolayers is diacetylene. Previous studies have shown that the thiol-terminated diacetylene cannot form organized structure on Au(111) substrates. In this study, 1-Dodecanethiol (C12) were implemented to assist the self-assembling and the local ordering of the diacetylene thiol islands. Fourier-transform infrared spectroscopy (FTIR), scanning tunneling microscopy (STM), and atomic force microscopy (AFM) collectively, elucidate the structural and electronic properties of the diacetylene-thiol Islands. A thorough understanding of the diacetylene islands on surfaces will guide the rational design for future organic solar cell applications.

3. Synthesis of a Tetrahedral Poly Pincer Core for the Development of Novel Organometallic Network Materials

Ashley Braaksma (Rose-Hulman Institute of Technology)
Chemistry REU
Research Advisor(s): Oleg Ozerov

This poster focuses on routes to novel organometallic network materials. Presented here is work focused on synthesis of a tetrahedral poly pincer core. The targeted core consists of four POCOP-type pincer complexes arranged in a tetrahedral fashion around a silicon. The metalation of these cores will allow for the cores to be linked together to create 3D organometallic networks using known organometallic transformations. Two routes of synthesis for the poly pincer core were explored. The "core first" route focuses on the synthesis of the pincer units simultaneously around silicon followed by sunsequent metalation of the pincer units. The alternate "pincer first" route consists of the synthesis of the monomeric, pre-metallated pincer units that are later installed onto the silicon core. Synthetic methods and challenges will be detailed for each route. The end goal of this project is to develop a new type of organometallic network material and to explore the properties of the new materials against existing metal-organic materials. Potential applications for the new network may include catalysis, gas uptake, and self-healing material.

4. Synthesis of Biorenewable and Biodegradable Polymers from Glucosamine

Crystal Chi (Texas A&M University - Kingsville)
Chemistry REU
Research Advisor(s): Quentin Michaudel

It takes nearly 1,000 years for plastic bags and 450 years for plastic bottles to decompose in a landfill, which leads to an ever-increasing accumulation of pollutants over time. Plastic debris severely damages wildlife and is also linked to increased risk of cancer development, birth defects, and endocrine disruption. According to a study published in *Science Advances* by Geyer and coworkers, the mass production of plastics that began six decades ago has already generated about 8.3 billion metric tons globally. Of that, 6.3 billion metric tons became waste and only 9% has been recycled. The low percentage of recycling is due to high processing costs, contamination during sorting processes, and limitations on the number of times a plastic can be recycled without losing its quality. While biodegradable plastics have been synthesized, they are not commonly utilized because of high production costs and poor mechanical properties. Another problem is that standard plastics are made from hydrocarbon monomers such as ethylene and styrene that are directly derived from fossil fuels, which are finite resources. In an effort to address these problems, we aim to synthesize biorenewable oxazoline monomers from glucosamine, an inexpensive dietary supplement produced from the hydrolysis of crustacean exoskeletons. Subsequently, step polymerization of this oxazoline monomer and specific diols will afford the desired polyacetal polymer. The biodegradable properties of the resulting polymer will be studied.

5. Sequestration of Phenols from Water using Poly-α-olefins with Phase Anchored Polyisobutylene Sequestering Agents

Ethan Quinn (Seton Hill University)
Chemistry REU
Research Advisor(s): David Bergbreiter

Water pollution is one of the biggest problems society is facing today. As the world has industrialized, pollutants have been introduced into water. The most common method for purifying water utilizes activated charcoal to remove organic impurities. While activated charcoal is efficient for removing many organic contaminants, it is energy intensive to regenerate, as it needs to be heated to over 800 oC. An alternative method of water purification is to use liquid-liquid extraction using green solvents that are nontoxic, nonvolatile, and recyclable. Benign solvents such as poly-α-olefins (PAOs) can remove nonpolar contaminants from water. Nonpolar contaminants such as hexane, benzene, dichloromethane, dichloroethane, and dichlorobenzene are sequestered at high efficiency by simply using PAO's, but polar contaminants have lower extraction efficiency. In order to sequester polar contaminants, such as phenols, dyes, perfluorooctanoic acid (PFOA), nitrobenzene, tetrahydrofuran, and triethylamine from water, PAO anchored cosolvents which can donate or accept hydrogen bonds are used. Hydrogen bond accepting end groups tested include imidazole, pyridine, pyrrolidine, morpholine, N-methyl pyrrolidinium salt, and catechol. This work focusses specifically on removing phenols. Bisphenol-A (BPA) could be extracted at efficiencies >99% using a PIB cosolvent that was terminally functionalized with an imidazole group. PIB species were tested for extraction efficiency of phenols using three different molecular weights PIB450, PIB1000, and PIB2300. For example, 0.2M of functionalized PIB450 in PAO432 removes >99% of a 520 ppm BPA solution. Additional contaminants that have been tested using the PIB-imidazole cosolvent include PFOA, chlorophenols, catechol, and nitrophenol.

6. Porous Graphitic Carbon

Jessica Glynn (Barnard College)
Chemistry REU
Research Advisor(s): Lei Fang

Porous Polymer Networks (PPNs) are considered for a panoply of processes such as water purification and desalination, gas storage and separation, semiconductivity, and catalysis. This project attempts to use a bottom-up synthetic method to generate a porous graphitic carbon material. This synthesis focuses on the key features of porosity, electrical conductivity, and solution processability. The detail is drawn to the chemical reactivity of the graphitic edge structure, which is thought to enable its polymerization.

7. Waste-Free Aerobic Oxidation Catalysis via Hypervalent Iodine Intermediates

Kailyn Cohen (Ursinus College)
Chemistry REU
Research Advisor(s): David Powers

Sustainable aerobic oxidation reactions must overcome two inherent challenges imposed with molecular oxygen: (1) a stable triplet ground state and (2) the disparate four-electron reduction of O_2 and two-electron oxidation of substrates. For this reason, aerobic oxidation is commonly limited by slow reaction kinetics. In order to bypass these challenges, our group recently utilized the autoxidation process of acetaldehyde to intercept hypervalent iodine reagents and accomplish a wide range of oxidase catalysis including: olefin functionalization, carbonyl α-oxidation, oxidative dearomatization, and aerobic C-H amination chemistry. Here, we sought out to create a waste-free aerobic oxidation method by utilizing ozone, an atmospheric pollutant, as the oxidant towards aryl iodide reagents. Thus far we have demonstrated the oxidation of 2-iodobenzoic acid to 2-iodoxybenzoic acid (IBX), a commonly used organic oxidant toward alcohol oxidation.

8. Utilizing a Metastable Polymorph of Vanadium Oxide as an Active Electrode for Hybrid Capacitive Deionization

Nayid Jana (University of Puerto Rico at Cayey)
Chemistry REU
Research Advisor(s): Sarbajit Banerjee

About 97% of the water on Earth is contained within oceans. Given looming crisis at the food-water-energy nexus arising from increasing populations, desalination processes have assumed great importance as a means of increasing the availability of freshwater for populations in need. Hybrid capacitive deionization (HCDI) represents a relatively underexplored mode of desalination. As opposed to other methods such as distillation or reverse osmosis, HCDI removes the minority phase (salt ions), from the majority phase (water), which can potentially bring about energy savings. An HCDI cell consists of a cathode, which intercalates oppositely charged ions upon application of a potential, and an anode. The cathode material used in our project is a tunnel structured metastable polymorph of V_2O_5, ζ-V_2O_5, which is able to accommodate a wide diversity of cations at high concentrations within interstitial sites with complete retention of the framework. To synthesize ζ-V_2O_5, β-$M_xV_2O_5$ phases are first prepared where M is Ag or Cu. The Ag- and Cu-ions are subsequently leached, resulting in the desired tunnel-structured ζ phase, as verified by using powder X-ray diffraction. Topochemical modification of β-$Ag_xV_2O_5$ produced phase-pure ζ-V_2O_5, albeit at a smaller scale, whereas synthesis and topochemical modification of β'-$Cu_xV_2O_5$ were optimized to prepare ζ-V_2O_5 at multigram scales. Preliminary HCDI measurements are being performed to examine the ability of ζ-V_2O_5 to facilitate desalination as a function of total dissolved solids, alkalinity, total hardness, pH, and conductivity. Subsequent measurements will focus on a design of viable HCDI systems that can be rapidly scaled to meet freshwater needs.

9. Anisotropic CsPbBr3 Perovskite Nanorods for Luminescent Solar Concentrators

Maya Costales (Carleton College)
Chemistry REU
Research Advisor(s): Matthew Sheldon

All inorganic cesium lead halide perovskite nanocrystals with composition $CsPbX_3$ (X= Cl-1, Br-1, or I-1) have gained considerable attention due to their outstanding photophysical properties including high photoluminescence quantum yields (PLQY), narrow emission linewidths, and tunable band gap across the entire visible spectrum. These qualities make all inorganic perovskite nanocrystals major candidates for use in Luminescent Solar Concentrators (LSCs) for light harvesting applications. LSCs make use of fluorophores such as organic dyes or quantum dots to waveguide incoming light towards a photovoltaic (PV) cell by means of absorption and reemission. While a conventional LSC achieves light trapping through total internal reflection, our proposed structure utilizes aligned dipole-emitting nanorods to concentrate incoming light towards the PV. The high PLQY of $CsPbBr_3$ is expected to decrease non-radiative losses and increase the overall efficiency of an LSC system. Based on preliminary theoretical studies, we believe that perovskite nanorods would be an ideal material for solar concentration.

10. The Development of Glucose-based Poly(urethane urea)s Through Emulsion-templating

Ximena Barrutia (Smith College)
Chemistry REU
Research Advisor(s): Karen Wooley

This project highlights the production of a naturally-derived mechanically-robust superabsorbent porous polymeric network to tackle global water resource challenges. With the increase in human population, water pollution, and insufficient access to safe and affordable water supplies, a growing demand in freshwater has attracted attention from the scientific community. Previously, homogeneous, highly porous polymeric materials with good permeability and functional group tenability were reported as a potential solution due to their effective water uptake, storage and purification. Numerous hydrogel-based polymers have been developed and demonstrated to exhibit high water absorbency in addition to their biocompatibility and tunable biodegradability. Nevertheless, their fragile nature limits their water-uptake capacity. Polymeric networks incorporated in high internal phase emulsions (PolyHIPE) materials were reported to address this issue with improved mechanical behavior and water absorbency. Inspired by these findings, a new class of environmentally-friendly polyHIPE is being developed to incorporate a glucose-based polymer within an emulsion-templated poly(urethane urea)s via interfacial step-growth polymerization. This presentation will highlight the synthetic processes to prepare glucose-based polyHIPE materials, followed by the investigation of their physical and structural properties, and water absorbency, by utilizing a variety of thermal and spectroscopic techniques.

11. Hot Electron Emission for Electrical Current Generation in Plasmonic Optoelectronic Devices

Gabriel Vázquez Lizardi (University of Puerto Rico at Cayey)
Chemistry REU
Research Advisor(s): Matthew Sheldon

Plasmonic nanostructures can control light below the diffraction limit which can leads to applications such as photosensor, photocatalyst and photovoltaic devices. Geometry and size play a major roll on the interaction between the particle and the incident photons. Also, irradiation of light on plasmonic nanostructures leads to the creation of high energy electrons (hot carriers) that may be extracted. In our work, we deposited spherical gold nanoparticles by centrifuging on an indium tin oxide (ITO) surface, due to its high absorption of light on the visible region. Two optoelectronic devices were made considering two extractions mechanism: thermionic emission and tunneling. For the thermionic emission the gold nanospheres were used as an anode and the ITO was used as a cathode. The hot carriers generated on the gold nanospheres travel through a vacuum to the cathode producing an electrical current. Meanwhile for the tunneling device, the ITO with the gold nanospheres were covered with an aluminum oxide (~4nm) layer followed by a gold film (~100nm). The hot carries generated on the gold nanospheres tunneled to the gold film to produce an electrical current. Previous optoelectrical devices are build consider periodicity which lets to important properties but are harder to achieved. In our work, we build simple optoelectronic devices which are easy to achieve and can be implemented on larger devices.

12. A New Bimetallic Manganese Carbonyl Complex with an Unique Structure Suggesting Great Potentials for Electro-reduction Chemistry

Hao Nguyuen (Texas A&M University)
Independent Project
Research Advisor(s): Marcetta Darensbourg

Manganese carbonyl complexes have been extensively studied in the past decade because of their catatlytic capability for electrochemical and photochemical reduction of CO2. Challenges for using these catalysts are their stability and conversion efficiency. From the first approach by Chardon-Noblat and co-workers in 2011 replacing rhenium in the novel Lehn's catalyst (fac-Re(bpy)(CO)3Cl) by manganese, a number of innovative ligands other than the traditional diimino bpy derivatives has been investigated to optimize the catalytic activity and preparation. In 2017, Darensbourg and co-workers opened a new route for the study of metal carbonyl catalysts by their discovery of a stable bimetallic complex featuring redox active N2S2 metallodithiolates ligands. Due to the variety and the versatile binding ability of the N2S2 ligands, the structural, electronic, and catalytic properties of complexes with these ligands become unpredictable, yet fascinating to researchers. In this project, a nascent bimetallic manganese complex bearing the bio-inspired tetradentate ema ligand (ema = N,N'- ethylenebis(2-mercaptoacetamide)) has been synthesized and characterized by infrared spectroscopy, X-Ray diffraction, and mass spectroscopy. The solid-state structure of this compound not only reveals a different geometry from the previously reported nickel complex with ema ligand, but also suggests a potential for a prodigious electro-reduction chemistry due to two amide carbonyl groups. These two labile groups help recover the original structure after the catalyzing process, hence solve the catalyst stability problem. Moreover, the bimetallic system is potentially able to take on two electrons from each identical manganese center, which significantly enhances electro-reduction ability.

13. 3D Printed Biopolymer-based Hydrogels for BZ Reaction Studies

Savannah Cooper (Texas A&M University), Maggie Nino (Texas A&M University),
Ivie Izekor (Texas A&M University)
Aggie Research Program
Research Advisor(s): Zhengdong Cheng

Our objective is to create self-oscillating hydrogels using a novel Belousov-Zhabotinksy (BZ) system. BZ reactions occur when an organic substrate is oxidized in the presence of a strong acid and a metal catalyst resulting in chemical waves that can be converted to mechanical energy when incorporated into a polymer matrix. Our BZ system is unique because previous research focused on synthetic polymer matrices whereas our system contains a gelatin matrix. We are 3D printing our biopolymer-based gels because this technique allows us to control the size and shape of our hydrogels; however, the gelatin needs to be reinforced before it can be effectively printed, so we employed another biopolymer called kappa-carrageenan, a carbohydrate derived from seaweed. Furthermore, we used iron as the metal catalyst instead of the usual ruthenium. Our choice of metal catalyst and biopolymers makes our system a more eco-friendly and economically viable option than traditional BZ systems. Also, our choice of biopolymers and the ability to create shapes of specific dimensions makes our research a good prospect in the biomedical field for modeling oscillating phenomena such as cardiac arrhythmia and migraines. We have determined a reliable recipe for 3D printed gelatin and BZ reactants that results in distinct wave patterns. The waves were analyzed through various software, and a dominant frequency for each gel was determined. Currently, we are only testing circular gels, but we plan to test different shapes. Furthermore, we are testing variables to achieve consistent movement in our gels.

15. Additive Manufacturing of Chopped Carbon Fiber Reinforced Epoxy Composites

Caleb Schurman (Texas A&M University)
Army Research Lab (ARL)
Research Advisor(s): Frank Gardea, Mohammad Naraghi

Typical additive manufacturing (AM) of plastics uses thermoplastic extrusion to create a part. These parts usually display anisotropic material properties, voids between rasters, and possess inferior mechanical properties as compared to injection molded parts. Carbon fiber (CF) reinforced epoxies provide increased mechanical strength and elastic modulus over thermoplastics, however, it becomes difficult to use these CF/epoxies for additive manufacturing since they remain liquid in their uncured state, leading to the loss of form of the printed part. Manipulating the rheological properties of CF/epoxy may allow for the printing and retention of shape necessary for AM of structural parts. The goal of this research is to develop an epoxy reinforced system with the appropriate pot life and rheological properties such that the resulting printed part will not only retain its shape but will show enhanced mechanical performance over traditionally manufactured chopped CF/epoxy composites. Initial material properties and fabrication parameters, such as neat epoxy viscosity, weight percent of chopped carbon fiber and carbon fiber aspect ratio, were varied to control the composite rheological properties. Mechanical characterization was performed to determine the strength and elastic modulus of the printed samples.

16. Development and Implementation of Quantum Algorithms for Transport of Subatomic Particles

Sournav Sekhar Bhattacharya (Texas A&M University)
Independent Project
Research Advisor(s): Shikha Prasad

The use of quantum computers in kinematics simulations of subatomic particles has been limited, if at all attempted. Here, we explore and assess the ability of quantum computers to achieve higher quality results in finding travel times of subatomic particles such as neutrons and photons. The main ability of a quantum computer that may provide this increase in fidelity, or accuracy can be the energy sampling procedure. In order to find the travel time of a particle, its energy must be sampled. This distribution of energies is expressed as a probability distribution. In order to extract the energy of a given particle, the energy must be randomly chosen from the given probability distribution. Classical computers use pseudo-random number generators, however quantum computers theoretically allow a purely random distribution, although noise and errors are significant and hamper the accuracy of the results. We formulate several methods by which this error can be mitigated, while evaluating them against classical algorithms. These include simple algorithms with quantum subroutines that involve the Hadamard gate, and simply measuring. Additionally, we explore methods using structures such as trees to mitigate errors, and evaluate these against classical algorithms that try to simulate the same distribution. All our quantum algorithms are run on a variety of IBM-Q quantum computers ranging from 5-qubit to 14-qubit machines, and are made to scale up to an arbitrary number of qubits.

17. Platooning: A Way Forward for Automation

Cara Stolz (Texas A&M University)
Texas A&M Transportation Institute, Safe-D
Research Advisor(s): Anthony McDonald

This summer I will be helping Dr.McDonald with his research on platooning failures. Platooning, or automated vehicles traveling in a formation that follows a designated lead car, is a promising opportunity for the future of automation on roadways. It's benefits include reducing fuel consumption, shorter commutes, and less traffic congestion, as well as the most important benefit- the potential for fewer collisions. On the other hand, this system poses challenges, such as the network of vehicles being hacked by an outside computer, or drivers becoming inattentive due to reliance on the automation. Driver inattention will be an especially important focus of our research, specifically the ways it can affect the manual takeover of an automated vehicle. We aim to develop a model for driver behavior during platooning failures, in other words, when the vehicle issues a takeover request, but a collision occurs anyways. We will be looking at factors such as whether or not the threat is perceived to be critical, and silent versus alerted failures. This will help us determine the way that drivers are thinking in these moments, prior to collision. Knowing how they're thinking and making decisions, based on both qualitative and quantitative data, will allow us to develop a model that can potentially be used in future simulations.

18. Verification of Slope Analysis Instrument Through Combination of Digital Image and Calibration

Aaron Kim (Texas A&M University)
Texas A&M Transportation Institute, Safe-D
Research Advisor(s): Avelar Raul

The digital image processing technology is widely applicable in intelligent transportation networks as there are far-reaching applications and benefits with the help of evolving computer vision techniques related to efficiency and safety in transportation. TTI has image analysis tools currently used to leverage photograph databases for data collection. One metric of interest is the side slope in the roadside. Manual methods to measure the slope require site visits and cannot be applied as a network-level measurement in addition to their time-consuming and tedious methodologies. The objective of this research is to verify the slope measurement performance of the image analysis application currently used by TTI. This research investigates and validates the recently developed tool that uses 2D image data for measuring slope and other field geometric data. These data are needed to improve roadway safety. This application requires reasonable calibrations of measuring instruments and image data from sources such as Google Earth Pro, RID View, or any imagery database with a consistent view or available metadata. This study suggests a new slope measurement method that uses digital image data. The experiment result proves that this proposed technology is good to be used to measure roadway slope.

19. Countermeasures to Detect and Combat Inattention While Driving Partially Automated Systems

Quincy Sorenson (Texas A&M University)
Texas A&M Transportation Institute, Safe-D
Research Advisor(s): Thomas Ferris, Carolina Rodriguez-Paras (PhD Candidate)

With the growing trend of automation-assisted driving, the safety of human-machine interaction systems needs to be supported. This study aims to investigate different displays, giving takeover cues to grab the driver's attention, when a possible automation failure is imminent, to facilitate takeover of manual control of the vehicle. Physiological data, driver performance and subjective measures can provide insight into how quickly and competently a driver takes over from automation. While analyzing these measures, complex and simple visual, auditory, or tactile displays will be tested to see which best draws the driver's attention back to the primary task (driving) from a secondary task. Human subjects will participate in a driving simulation of a partially automated vehicle. Discrete events used throughout the driving scenario simulate automation failures while the driver concurrently performs a secondary task. Display takeover cues will then be used to get the drivers' attention. The physiological measures, such as heart rate and skin conductance, will be collected to indicate stress and workload. Driver performance, including lane deviation and speed control, will be collected continuously to give insight into how competently the driver takes over. Subjective measures, including from exit interview questionnaires, will then be collected and used to understand subjects' feelings about task difficulty and display effectiveness. Using data collected, including secondary task performance, we can compare the advantages and disadvantages of the different display modalities (visual, auditory, and tactile) and encodings (simple and complex) to understand effects of display features on reaction time, driving safety, and workload.

20. Pavement Markers and Markings at Low Water Crossings

Tim Gochnour (Virginia Tech)
Texas A&M Transportation Institute, Safe-D
Research Advisor(s): Adam Pike

Low Water Crossings (LWCs) are water crossing structures used on low average daily traffic (ADT) roads that may be crossed/driven over during low flow conditions but become flooded, and sometimes unusable, during higher flow conditions. LWCs pose several benefits such as having low maintenance, low cost of construction, and minimal hydraulic and hydrological effects on the environment. However, at LWCs, there is a worry of traffic safety that needs to be addressed when excess water from the river or stream flows over the crossing and can potentially flood the road. This flooding, when it reaches a certain level, can lift cars and put people in their cars in danger if they drive through this water. With the use of low-cost countermeasures at these LWCs, such as pavement markings and markers, drivers can be alerted of dangerous flooding levels, potentially saving their lives. This study focuses on the visibility of these pavement markings and markers at different flood depths and different turbidity levels of the water which are both known to impact visibility. The turbidity levels tested include <10 Nephelometric Turbidity Units (NTUs) for clear water, 100 NTUs, somewhat murky water, and 250 NTUs, very murky water. These turbidity levels are measured at each of the test flood heights of 1.5 inches, 4 inches, and 5.5 inches, with a dry test as well. Each test is also conducted during the day and at night as during the night time the lighting is strictly from the headlights of the car while the day time has the sun as the light source.

21. Disparities of Disasters: The Spatial Nature of Infrastructure Disruption

Miguel Esparza (Texas A&M University)
Urban Resilience Lab
Research Advisor(s): Ali Mostafavidarani

The objective of the proposed framework is to model the spatial interdependencies among hazard, social, and built environment attributes that influence the resilience of communities in disasters. While the existing literature informs about factors affecting hazard exposure, social vulnerability, and built environment vulnerability, the spatial interdependencies among these principle community resilience elements are not known. Assessment of spatial interdependence is particularly important to: (1) examine the spatial variation of "risk hotspots" in communities and spatial scale of risk hotspots; and (2) devise a spatially-embedded and integrated resilience classification indicator for analyzing spatial variability of resilience in communities.The spatially-embedded clusters, based on the contiguity and the similarity of the vulnerability and exposure, identify the vulnerable regions in the community based on multiple social and physical attributes affecting the household's well-being. These spatially-embedded clusters of the vulnerable sub-groups provide an efficient way of prioritization of service recovery during the disasters and produce insights on the intervention plans for service interruptions in future events.

22. Evaluating Lane Recognition Models by Cross Referencing with Open Source Databases

Kevin Eastin (University of Texas Rio Grande Valley)
Texas A&M Transportation Institute, Safe-D
Research Advisor(s): Sivakuvar Rathinam

Converted open source lane recognition databases back and forth from one to the other in an effort to cross reference the testing and training data to re-evaluate the accuracy results published by those respective algorithms. Not only converted, but combined these databases in an effort to create an AI with data from Hong Kong, Beijing, and Berkley, with the hope that this new database could yield a more adaptable and effective lane recognition AI.

23. Safety Analysis of Autonomous Car Following Model

Hannah Rebello (San Diego State University)
Texas A&M Transportation Institute, Safe-D
Research Advisor(s): Alireza Talebpour

With the rise of automation in transportation, much is still unknown of the influence of autonomous vehicles on traffic safety. While Autonomous vehicles (AV) have been analyzed from the perspective of optimizing flow, and certain automated technologies such as ACC (adaptive cruise control) and CACC(connected adaptive cruise control) have been simulated to support platooning to examine the impact of automation on car-following models, few models look at a single drivers' reactions and behavior when following an AV. This project focuses on the driver behavior when following a single, automated vehicle of constant acceleration and deceleration rates simulated along a two-lane roadway with fixed speed limit and eight stopping intersections. The simulation tests the braking behavior of drivers following human and autonomous operated cars. The data was collected by Aman Sharma under the guidance of Dr. Talebpour for 48 individuals following either an automated vehicle or a human driver (modeled from 4 driving trajectories of experienced drivers). This research paper compares the safety of humans following an AV versus a human driver. The object of this paper is to fit a model that analyzes driver following behavior with that of autonomous driver following behavior. The intelligent driver model (IDM) was used to assess the difference in parameters (such as acceleration rate and headway distance) and a genetic algorithm was used to test the fitness levels of found parameters. The difference in parameters were analyzed to compare the safety of the two car-following scenarios: humans following humans and humans following AV.

25. A Synthesis of the Air Quality Impacts from Port-based Sources Specific to the Port of Houston

Alexander Yu (University of California, Riverside)
CARTEEH
Research Advisor(s): Ann Xu

Ports, such as the Port of Houston-Galveston (POH), are a major focus from an emissions perspective due to their large impact on local and regional air quality. There are many different methodologies in assessing port emissions, and oftentimes there are data gaps that affect the accuracy of those assessments. Ocean-going vessels (OGV) often have data gaps in IHS Fairplay and AIS (automatic identification) databases which incorrectly report ship parameters such as engine power and vessel speed. Considering the prior data gaps and both updated emission factors, and load profiles to accurately model individual emission contributions, it is possible to create a more comprehensive and modern overview of port-related emission sources. An overview of emission sources unique to the POH is necessary to assess and analyze the impact of the emissions originating from the POH and the concentrated industrial activity surrounding the POH Authority. This study will use a literature synthesis to analyze the differences in port emission inventories and apply the findings to the POH. Ocean-going vessels (OGV), harbor-craft, cargo handling equipment (CHE), drayage activity, locomotive and rail-ports, and stationary sources (such as refineries) are the main emission sources at the POH. Within the POH authority, OGVs pollute the most compared to any other source. The POH is home to a quarter of the United States' harbor-craft fleet with an extensive barging industry. These findings are important in the context of understanding the POH's contribution to measured air quality in the region and also have implications for the general conformity.

26. New Opportunities to Mitigate the Burden of Disease Caused by Traffic Related Air Pollution: Antioxidant-Rich Diets and Supplements

Jillian Barthelemy (Texas A&M University)
CARTEEH
Research Advisor(s): Haneen Khreis

Ambient air pollution is a growing concern for public health, especially traffic-related air pollution (TRAP). TRAP is associated with many adverse health effects ranging from asthma incidence, to cardiovascular diseases, to premature mortality and years of life lost. When TRAP enters the body, it can trigger oxidative stress and cause disruptions in the redox sensitive pathways of the body. Oxidative stress is one of the key pathways that links TRAP to the associated adverse health effects. Until we can ultimately reduce levels of TRAP and human exposure to an acceptable limit, other more practical strategies to reduce the burden of disease are warranted. A potentially promising strategy to combat these effects is to increase antioxidant intake in order to reduce the effects of the oxidants that are responsible for causing oxidative stress. Emerging research suggests that an increased consumption of antioxidants in diet or as supplements may reduce the effects of TRAP. This project investigates the effectiveness of antioxidant-rich diets and antioxidant supplements as a means to mitigate adverse health effects. A literature review was conducted to analyze the existing literature regarding antioxidant interventions in order to make recommendations for public health practitioners, clinicians, policy makers, individuals, and future researchers.

27. How Emerging Technology and Its Integration is Advancing Our Understanding of Exposure to Traffic-related Air Pollution

John Medeiros (Texas A&M University)
CARTEEH
Research Advisor(s): Haneen Khreis

Air pollution has been associated with numerous negative health effects such as cancer, cardiovascular and respiratory diseases. In addition, there are emerging studies linking new effects such as Arthritis, ADHD and Alzheimer's disease to air pollution. In order to accurately study and quantify these associations, air pollution must be accurately measured and modeled at the exposure assessment stage. There are numerous techniques used to do this, with the most common being measurements from federal reference monitors along with dispersion or land-use regression models. However, these methods are often insufficient for measurement and mapping because of their inability to consider human mobility patterns and accurately detect the high spatiotemporal variability of air pollution, specifically traffic-related air pollution. Therefore, this stage is often not given the proper attention it deserves, which can negatively affect the quality of exposure assessments. In order to remedy this, there is a current rise in the popularity of low-cost and mobile sensors, along with new approaches to modelling techniques. This rise in monitoring methods has led to an increasing number of studies combining these technologies together in an attempt to generate improved spatiotemporal resolution of traffic-related air pollution maps. The goal of the project is to investigate how these studies are utilizing and integrating these technologies together and highlight their performance as it relates to improving air pollution monitoring, modeling and exposure assessment for health effects analyses.

28. CARTEEH Graph Database as a Research and Data Discovery Tool

Kathleen Weil (Georgia Institute of Technology)
CARTEEH
Research Advisor(s): Ann Xu

Data communication plays an essential, yet under-utilized role in academic research by providing context that can inspire questions, ideas, and analyses and lead to exploration and innovation. For the Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH), contextualizing information in its data hub is inefficient and limiting with no method for finding gaps in research. To organize CARTEEH's flow of information and automate the process for developing new questions, methods, data sets, models, visualization, and more, the data hub was translated into a graph database that prioritizes the connectivity of information. The visualization and simple querying features were tested in hypothetical research use cases to demonstrate the discovery power of the database. By visualizing the flow of information within and between research publications and models, the graph database presents a guide for the research process and identification of subject areas in need of new or improved data sets, models, or papers.

37. Additive Manufacturing of Biomass Materials for Infrastructure Construction

Chelsea Kobea (Texas A&M University), Kremena Mavrodieva (Texas A&M University),
Preston Knowles (Texas A&M University)
Aggie Research Program
Research Advisor(s): Abhinav Bhardwa

The construction industry faces significant challenges with respect to environmental sustainability. Cement production is reported by CICERO to be responsible for roughly 8% of global CO_2 emissions, releasing 0.9 tons of CO_2 for every ton of cement produced. In an attempt to eliminate this problem, a new class of biomass-based building materials has recently begun development. These new materials often consist of domestic agricultural waste products and fungal species along with a few variable additives. The fungal species grow their mycelia throughout the material to act as a binder 'glue' to strengthen the material. Additive manufacturing, a production technique widely used for constructing items with particularly complex shapes, presents a promising alternative to reduce material wastage. 3D printing has recently become a viable approach to industrial-scale production due to rapid improvements in precision, repeatability, and material range. Currently, products using this feedstock are prepared using the molding process. This research will analyze the printability of these biomass-based materials using the material extrusion process. Initial test results indicate that printability of this new material is mainly dependent on mixing duration and mix composition. This study will use iterative testing to investigate various mix compositions and mixing durations that facilitate printability without having any adverse effects on interconnective fungal growth.

38. Effect of Material Composition of Cementitious Materials on Printability for Construction Scale 3-D Printing Applications

Nehemiah Hein (Texas A&M University), Mike Kerby (Texas A&M University),
Kyle Cook (Texas A&M University)
Aggie Research Program
Research Advisor(s): Abhinav Bhardwaj

Extrusion-based 3-D printing of cementitious materials is a revolutionary technology that could have a profound impact on the safety and production of the construction industry. The effect of material composition on mechanical properties remains an important research question for this emerging technology. This study investigates the effects of material composition on the mechanical properties (such as tensile strength, flexural strength, and compressive strength) of 3-D printed samples. An electric caulk gun was used to mimic the layer by layer 3-D printing process. Different compositions were tested to identify the best extrudable composition. The extrudable material was prepared using a blend of Type I Portland cement, Class F fly ash, silica fume, superplasticizer, and water. Additionally, different nozzle designs were tested to obtain good extrudability of the cement paste. It is expected that the material composition will have an important effect on the mechanical properties of the printed samples. Currently, testing is underway for these samples.

49. A Review of Web Resources for Coding Internet of Things (Iot) Devices

Aamir Fidai (Texas A&M University), Rayan Tejani (Allen Academy)
Aggie STEM
Research Advisor(s): Robert Capraro

The Internet of Things (IoT) technology has found wide acceptance in agricultural, transportation, medical, supply chain and logistic industries. While the implementation of IoT devices in industrial settings has proven to be beneficial for the manufacturers, suppliers and service providers, the general public has also greatly benefited from their direct and interactions with IoT. The researchers believe that the time is ripe for IoT devices to make their way into K-12 and post-secondary classrooms as instructional devices. Researchers also believe that the plethora of available online resource for coding IoT devices can serve a great purpose in making IoT instructional devices a reality in STEM (science, technology, engineering and mathematics) classrooms. But the overabundance of online resources for coding IoT devices can become overwhelming for a STEM instructor planning to introduce IoT instructional devices in their classroom. The researchers believe that there is a need for categorization and classification of available online resources for coding IoT devices. In this study the researchers provide a concise list of available online tools and resources for coding IoT devices while classifying those resources according to shared characteristics. These characteristics include platform, intended audience, cost, coding environment, supported IoT devices, documentation, license and permission. The results of this study will provide a taxonomy of web resources for coding IoT devices which will benefit academic STEM professional decide on the best IoT devices for instructional purposes.

50. Visual Programming Languages: A Systematic Literature Review

Aamir Fidai (Texas A&M University), Gabriel Fula-Pinto (Texas A&M University),
Joseph Gibson (Texas A&M University), Eunyoung Kim (Texas A&M University)
Aggie STEM
Research Advisor(s): Robert Capraro

In the recent years the ability to code (previously known as programming) has become an essential quality of successful STEM (science, technology, engineering and mathematics) students and professionals. Traditional methods of teaching and learning coding or programming often require students to pick a computer language, learn its syntax and practice writing code in a text based environment. This syntax-focused method has shown to be a hurdle in students' success in acquiring effective coding skills. With the advent of visual programming languages in the 1980's and their acceptance during the 1990's seemed to promise their widespread use both in academic and professional settings. But, despite the ease of use provided by visual programming languages they are still do not enjoy the same level of reverence as their text-based counterparts. The researchers believe a lack of empirical evidence supporting the efficacy of visual programming is to blame. In this study the researchers present the preliminary results of a systematic literature review assessing the effects of visual programming languages on students' coding and other STEM related abilities. The researchers plan to perform a meta-analysis of the quantitative evidence found through this systematic literature review alongside the results from the qualitative studies. The findings from this systematic literature review will inform academic and researcher practices and help with curriculum design focused on valuable coding skills.

51. Localised Magnetic Fluid Finishing of Freeform Surfaces

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S N Bose Fellowship (Indo US Science and Technology Forum - IUSSTF) & Halliburton Engineering
Global Program
Research Advisor(s): Satish Bukkapatnam

Surface finish of machined and fabricated components is critical, as it determines performance, durability and service life. For example, aerospace and biomedical implant industries employ parts with complex pre form geometries that are hard to access and demand stringent surface–finish specifications. Traditional methods such as the use of rotating machinery with or without abrasive materials suspended in slurry, are characterized by uncontrolled finishing forces and are ineffective to give desired uniform surface finish on complex and hard to reach surfaces. Magneto-rheological finishing, magnetic abrasives finishing, magneto rheological abrasive honing are used for nano-finishing due to their advantage of providing precise control of downforce to achieve better results. The methods however rely on external mechanisms to apply the needed downforce and to induce relative motion between work-piece and abrasive magnetic field. The present investigation uses the principles of magnetic concentration and electro permanent magnets to create spatio-temporal variation of magnetic field, thereby altering the rheology of abrasive loaded magnetic fluid and generating sloshing action at target location producing localized polishing on freeform and hard to reach geometries. It is aimed to optimize this magnetic fluid polishing setup using computational-mechanistic models in combination with experiment to achieve magnetic fields ≥ 0.5 T and to polish 3D printed metal components. Current investigation demonstrated that saturation magnetization is more critical than permeability in the choice of EPM; FEM simulations indicated improved performance using tapered core with hemispherical head. Simulation has shown that the field generated depends on current density in the windings.

52. Review on Wireless Power Transfer

Nikhil Kilari (Indian Institute of Technology Tirupati)
IIT Kanpur/TAMU Exchange Program
Research Advisor(s): Hamid A. Toliyat, Farid Naghvi

My works revolves around wireless power transfer technology. In the near future WPT is a booming sector where almost all the automobiles become electrified. As a summer intern I learned basics of this technology and worked on simulating the WPT coils.

53. Quantifying Cognitive Ability, General Well Being and Work Performance in Everyday Life Using Wearable Devices

George Hadjiantonis (University of Cyprus)
Halliburton Engineering Global Programs
Research Advisor(s): Theodora Chaspari

During the last decade there was a substantial innovation and growth of popularity of wearable devices. Taking advantage of the data they collect, we can gain better insights into our human nature. This study is conducted to quantify self-regulation from bio behavioral signals in daily life, captured by wearable devices. The data was collected from 213 participants in total, during their work hours. All of the participants were nurses during their shift, who are involved in an intensive and demanding job. Physiological and acoustic measures were taken from chest- and wrist-based sensors, as well as microphones installed in the rooms of the hospital. Self-reports were also collected from the participants on a daily basis. We used models based on dynamical systems to quantify one's self-regulation with respect to the collected physiological and acoustic indices. The proposed self-regulation measures are examined for their association to the self-reported scores. Results showcase self-regulation of breathing and resting heart rate to be correlated with tobacco use and cognitive ability at -0.17 and -0.21, respectively. Alcohol consumption and self-regulation of breathing rate are correlated at -0.12. Moreover self-regulation of number of steps and sleep efficiency appear to be correlated with tobacco use at -0.18 and -0.22. Regarding the acoustic measures, jitter, shimmer and F0 are correlated with cognitive ability at -0.18, -0.16 and -0.22, respectively. Implications of this study can help us better interpret bio-behavioral signals and understand human behavior and emotions in real-life.

54. A Machine Learning Approach to Identify the Micro Structural Properties of Additively Manufactured Components

Ravi Bindiganavile Narasimhan (Indian Institute of Technology Tirupati)
Halliburton Engineering Global Program
Research Advisor(s): Satish Bukkapatnam

Current work is based on using micro- milling to locally probe into the material structure. While the experiment is performed, we record the data corresponding to the vibrations, acoustic emission, and force using appropriate sensors mounted. In the current study, we hypothesize that the micro structures change as we change the process parameters via which the components are fabricated using an additive manufacturing (AM) process. We have three process parameters laser power, scan speed, and dwell time. For each of the components printed with the AM process, we record the data and analyze by using a machine learning algorithm called random forest. Micro scratches have been made on different components and the acoustic data has been analyzed to get a relationship between micro structure and acoustic emission data.

55. Tracking the Dynamics of the Melt-pool in a Laser-based Directed Energy Deposition Process Using High-speed Imaging

Aakash Aakash (Indian Institute of Technology Tirupati)
Halliburton Engineering Global Program
Research Advisor(s): Satish Bukkapatnam

Laser Directed Energy Deposition (L-DED) is a promising metal 3D printing method but at present, the process is quite stochastic and uncertain. It is imperative to have better control of the process. We have used high-speed imaging to capture the phenomenon taking place near the melt pool for the coaxial L-DED setup. In the setup, powder streams from the nozzle, as it impinges onto the targeted portion of the surface, it is melted using a high power laser. The molten metal deposits and quickly solidifies to progressively build the desired shape. A lot more activities happen here, i.e., the molten material splashes, there is a gaseous material cover, some material vaporizes, and some material does not even melt and ricochets away. A custom program making use of OpenCV is used to identify, count and track the spatter coming from the melt pool. The information retrieved about the spatter can be used as one of the inputs for the closed-loop control.

56. Parameter Identification of Porous Media, Carbon-Graphite, Tilting Pad Air Bearings

Andy Alcantar (Texas A&M University)
Energy and Propulsion REU
Research Advisor(s): Luis San Andres

As the demand for high speed and precision turbomachinery increases interest in gas bearings as potential solutions has also increased. The aim of this research is to determine the characteristics of porous carbon, tilting pad air bearings under static load and dynamic force excitation. Several measurements taken include the supply air volumetric flow rate, supply air pressure, film temperature and pad displacement under static loads, as well as stiffness, added mass, and damping coefficients for a range of excitation frequencies. The test was conducted at 100 psig with a rotor speed of 6 krpm and a maximum load of 500 lbf. The setup included four tilting pads centered to the rotor which was attached to a variable frequency drive (VFD) motor. The tilting pad air bearing used spherical pivots which were placed on a nested stack of two Belleville washers. Each Belleville washers added spring stiffness to the system and the nested stack added the springs in parallel. Based on the static load vs displacement data obtained, hysteresis was found and is likely due to the nested Belleville washer stack. By determining the bearings dynamic force coefficients, accurate rotordynamic models can be determined for stable operating speeds.

57. Layer-by-Layer Polyphosphazene Coatings For Biomedical Applications

Jeremy Zheng (Texas A&M University)
Aggie Research Program
Research Advisor(s): Svetlana Sukhishvili, Victoria Albright

Polyphosphazenes (PPzs) are a class of flexible, inorganic-organic hybrid polymers that are attractive biomaterials due to the ease of tunability of their glass transition temperature, wettability, and degradation rate. This work explores polymer coatings of ionic polyphosphazenes with trifluoroethoxy or trifluoromethylphenoxy as fluorinated groups and carboxylatophenoxy or sulfophenoxy as ionic groups. The goal was to develop an understanding of the effect of charge density, binding strength, and fluorination on film properties including growth, swelling, and hydrophobicity. All PPzs enabled electrostatic, layer-by-layer deposition with cationic molecules ranging from small molecules (polymyxin B) to long polymer chains (branched polyethylenimine). Dry thicknesses of films during layer build up was measured with spectroscopic ellipsometry. As expected, films with sulfo-containing PPzs exhibited more linear growth than carboxy-containing PPzs. Wettability, a crucial biocompatibility characteristic, was assessed via static contact angle measurements. To mimic the response of the coatings to physiological environment, swelling tests were performed and determined the swelling ratio was dependent on the degree of fluorination and binding strength. Hemocompatibility was then tested using the American Society for Testing and Materials' modified hemolysis test. We found that sulfo-containing PPzs caused hemolysis of only ~2% of blood cells, an improvement over carboxy-containing PPzs, which exhibited ~3% hemolysis. Thus, by adding 20% fluorinated groups, the toxicity can be reduced to ~1%. Altogether, these findings showing how the properties of coatings can be controlled by the composition of PPzs, which can lead to creating biocompatible coatings for a multitude of purposes.

58. Prevention of Skin Graft Infection by Layer-by-layer, Biocompatible Polyphosphazene Nanocoatings

Christian Frey (Texas A&M University)
Aggie Research Program
Research Advisor(s): Svetlana Sukhishvili, Victoria Albright

Infections of skin grafts remains a challenging problem with ~30% of skin grafts failing due to bacterial infection. One approach to solve this problem is to create skin grafts coated with antibacterial polymer coatings that can prevent infection as it begins. Here, we explore the layer-by-layer (LbL) deposition of the antibiotics polymyxin B and gentamicin with polyphosphazenes (PPzs) containing carboxy and trifluoroethoxy substituents in order to create a stimuli-responsive drug release platform. As a substrate, electrospun fibers of polycaprolactone and collagen will be used. Assembly of these biocompatible coatings onto fibers will be shown with Scanning Electron Microscope (SEM) imaging while characterization of thickness of coatings will be conducted on a model flat substrate (silicon wafer) and tracked with spectroscopic ellipsometry. To tune degradation time of the antibacterial coatings, poly[di(carboxylatophenoxy)phosphazene] (PCPP) of a variety of differing molecular weights and fluorination degrees will be explored. In order to test the antibiotic content retained after the long-term exposure to a saline-like environment, coatings will be exposed to phosphate buffered saline (PBS) for different time intervals at decreasing pHs and measured with ellipsometry or imaged with SEM and tested against biomedically relevant bacterial strains. Using the varying molecular weights or fluorination degrees of PCPP, the degradation time of films can be adjusted in order to degrade depending on the time frame needed for each individual skin graft to heal. Moreover, the tunable manner in which these films release antibiotic could lead to controlled release of antibiotics in various implants, stents, and skin grafts.

59. In-Situ Mechano-Electrochemical Testing of Structural Supercapacitor Electrodes

Zach Powell (Texas A&M University)
Independent Project
Research Advisor(s): Dimitris Lagoudas, Jodie Lutkenhaus

Structural energy and power combines the structural and energy storage functions of a system into a single multifunctional material. Such materials can replace traditional, monofunctional materials, such as body panels of an electric vehicle, to simultaneously provide support for mechanical loads and energy storage. To characterize the multifunctional nature of the material, both mechanical and electrochemical properties are equally important and are studied independently and uncoupled. However, studying the mechano-electrochemical coupling of materials designed for structural energy storage is vital, since the energy storage capabilities may be affected by mechanical loading, and vice versa. However, such studies have been limited by the lack of specialized experimental instrumentation. Previous studies on structural electrode materials have shown an inherent trade-off between mechanical and electrochemical properties. Therefore, the outcome of a coupling experiment is expected to show similar trade-offs. In this study, a custom instrument is used to perform cyclic voltammetry under uniaxial tension. The mechano-electrochemical coupling of multifunctional nanocomposite structural supercapacitor electrodes consisting of reduced graphene oxide (rGO) and aramid nanofibers (ANF) is tested. Cyclic voltammograms of composite samples under different tensile strain states are acquired and the capacitance retention is evaluated as a function of strain for varying loadings of ANF. This study shows that there is minimal electrochemical degradation until mechanical failure, which indicates that rGO/ANF nanocomposites are suitable for structural energy storage.

60. Derivation of Velocity Dispersion in Galactic Globular Clusters Using Proper Motions from Gaia DR 2

Jenny Quinn (Texas A&M University)
Independent Project
Research Advisor(s): Louis Strigari

Kinematics of globular clusters are a useful tool to understand Milky Way formation and can be used to probe the dark matter content of our galaxy. These clusters of stars usually reside in the centers of galaxies, which we believe can be attributed to the distribution of dark matter throughout our galaxy. Our work examines various stellar kinematics of globular clusters in the Milky Way using data from Gaia DR2. After isolating stars that are members of the globular cluster, we use proper motions and radial velocity of the stars to derive a profile for the cluster's velocity dispersion. We compare our results to those obtained from previous literature and find that they agree. Future work will include the application of the science done this summer to analyze the dark matter distribution of the Milky Way.

61. Two Natural Scenarios for Dark Matter Particles Coexisting with Supersymmetry

Reagan Thornberry (Texas A&M University)
Independent Project
Research Advisor(s): Roland Allen

We describe two natural scenarios in which both dark matter weakly interacting massive particles (WIMPs) and a variety of supersymmetric partners should be discovered in the foreseeable future. In the first scenario, the WIMPs are neutralinos, but they are only one component of the dark matter, which is dominantly composed of other relic particles such as axions. (This is the multicomponent model of Baer, Barger, Sengupta and Tata.) In the second scenario, the WIMPs result from an extended Higgs sector and may be the only dark matter component. In either scenario, both the dark matter WIMP and a plethora of other neutral and charged particles await discovery at many experimental facilities. The new particles in the second scenario have far weaker cross-sections for direct and indirect detection via their gauge interactions, which are either momentum-dependent or second-order. However, as we point out here, they should have much stronger interactions via the Higgs. We estimate that their interactions with fermions will then be comparable to (although not equal to) those of neutralinos with a corresponding Higgs interaction. It follows that these newly proposed dark matter particles should be within the reach of emerging and proposed facilities for direct, indirect, and collider-based detection.

62. Kinematic Substructure in the Galactic Stellar Halo with Gaia Dr2 6D-solutions

John Maner (Texas A&M University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jennifer Marshall

Galactic formation models predict that merger events play a significant role in the formation of stellar halos. The remnants of these merger events should still be present in the form of stellar streams or moving groups. This work aims to identify such substructures in the solar neighborhood with the pristine Gaia DR2 6D dataset. A kinematic selection criterion is imposed on the data before performing phase space analysis to identify stream candidates. The structure of the highly complex angular momentum-energy phase space has been analyzed to reveal stellar streams and moving groups likely associated with early merger events.

63. Cepheid Identification and Analysis in M33

Carrie Drake (Whitman College)
Astronomical Research and Instrumentation REU
Research Advisor(s): Lucas Macri

Cepheid variables are the primary method for determining distances to spiral galaxies, calibrating the luminosity of white-dwarf supernovae and enabling a precise and accurate determination of the expansion rate of the Universe. This was recently measured with a total uncertainty of 1.9%, but its value is 9% larger than expected from the current cosmological model. In 2006, two thousand Cepheids in the nearby spiral M33 were identified using difference imaging from data obtained at the Canada-France-Hawaii Telescope by Hartman et al. For the first time, this project presents an analysis of these objects using point-spread-function photometry. We used a catalog of 564 Cepheids in M33 (Pellerin & Macri 2011) to identify many of those stars in our images and derive tight relations between their period of variability and mean brightness, among other properties. We then used those relations to identify additional Cepheids and augment the sample. This analysis provides data that will improve our understanding of how these stars' properties, such as chemical abundance, influence their period-luminosity relation and their calculated distances. This knowledge will decrease the systematic error in the current measurement of the hubble constant and will help resolve the aforementioned discrepancy between its measured and expected value. Finally, as our measurements are the first to be determined using the same photometric filters as the Large Synoptic Survey Telescope (LSST), they will help to improve automated procedures that will identify new Cepheids among the billions of objects to be discovered by LSST.

64. How Universal is the Universal R-Process Pattern?

Jessica Myron (Texas A&M University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jennifer Marshall

The rapid neutron-capture (r-)process, is responsible for the creation of about half the elements heavier than iron in the Universe. However, the nature and astrophysical site of the r-process is still strongly debated. For metal-poor stars enhanced in r-process elements ([Eu/Fe] > 0.3), a very robust (universal) abundance pattern has been detected for the elements from Ba to Hf, matching that of the Solar system r-process abundance pattern. This project uses spectral synthesis to determine the abundances of neutron-capture elements in a sample of metal-poor stars not enhanced in Europium ([Eu/Fe] < 0.3), to determine if this universal r-process abundance pattern extends to this group of stars and further characterize the production of neutron-capture elements in the early Universe.

65. From pETSI to ETSI: The Continued Development of the Exoplanet Transmission Spectroscopy Imager

Allison Glantzberg (The College of New Jersey), Sam Hudson (Hiram College)
Astronomical Research and Instrumentation REU
Research Advisor(s): Darren DePoy, Luke Schmidt

The Exoplanet Transmission Spectroscopy Imager (ETSI) is an astronomical instrument designed to measure the atmospheres of exoplanets that orbit bright stars (brighter than 12th magnitude) on small telescopes (1-2 meters). Both ETSI and a previous prototype (pETSI) are made of commercial parts. Several key changes were made to the prototype including upgrading the prism and optimizing the location of some optical components. During observation, light goes through the telescope and enters ETSI where it travels through long-pass and multi-bandpass filters and is then collimated with a 200 mm focal length lens. The collimated light is dispersed by an equilateral prism into 5 distinct bands for each star in the field of view. These bands are focused by a 105 mm focal length lens and captured by an SBIG STF-8300 Charged-Coupled Device (CCD). A series of images taken during transit are used to identify absorptions and emissions associated with the atmospheric features of an exoplanet by looking for a relative change in color between the 5 bands during the transit. ETSI was used to observe exoplanet transits on the 0.9m telescope at McDonald Observatory and preliminary reduction shows improved results over pETSI. In the future, a customized version of ETSI, along with a custom data reduction pipeline, will be able to conduct the first large survey of exoplanet atmospheres, performing preliminary ground-based follow up of Transiting Exoplanet Survey Satellite (TESS) targets so that astronomers can identify the best candidates for more precise observations using the James Webb Space Telescope (JWST) and large ground-based telescopes.

66. Preparing for the 2019 ETSI Run- Exoplanet Modeling and Target Selection

Anna Sage Ross (Northern Arizona University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Darren Depoy, Mary Anne Limbach

The field of exoplanet discovery and characterization is currently dominated by space telescopes. While space telescopes provide some of the most interesting and precise data of exoplanets to date, usable time on these instruments is precious and expensive. This vastly slows the rate at which new exoplanet discoveries can occur. The Texas A & M astronomical instrumentation group seeks a solution to this problem through the development of ETSI, an Exoplanet Transit Spectroscopic Imager, which can be attached to an existing ground-based telescope to observe exoplanet transits and detect features such as Na, TiO, H2O, and Rayleigh scattering in exoplanetary atmospheres. My task this summer was to find the best observable transit targets for six nights in which we used ETSI to observe at McDonald Observatory, and to model their atmospheres using Python and Exo-Transmit. These models help to determine what the ETSI data should reflect once reduced. These models showed that key spectral features should be observable within the bandpasses used in ETSI. I worked with my advisors to determine an observing schedule for the ETSI observing run along with other details about the sky for those nights, and then assisted in the observation of our targets. Weather conditions prevented the observation of every target, however, we were able to retrieve good data that will be analyzed to enable the team to determine the effectiveness of ETSI in its current configuration and write a proposal for funding of a true ETSI instrument.

67. The Progression of ETSI and TCal

Leo Barba (Texas A&M University)
Independent Project
Research Advisor(s): Jennifer Marshall, Darren DePoy

I present both ETSI (Exoplanet Transmission Spectroscopy Imager) and TCal (Traveling Calibration) projects and how they progressed over the span of a year. Both instruments had great improvements in which helped make them more robust than before. ETSI has the ability to measure the atmospheric composition of exoplanets in nearby stars. With the recent transition of the instrument from the prototype (pETSI) to ETSI, better data can now be taken as a result of upgrades made to the instrument such as changing the prism and the focal length. TCal has the ability to calibrate several 1-8m telescopes up to a certain standard to place them on a common photometric baseline since most surveys require follow-up observations. TCal scans showed great improvements throughout the past year due to an upgraded enclosure, table, and photon detector.

68. Determining Proper Motions and Orbital Parameters of Draco and Boötes I Dwarf Galaxies.

Ryan Webster (The University of Arizona)
Astronomical Research and Instrumentation REU
Research Advisor(s): Andrew Pace

This project used astrometric data from the second data release of the Gaia mission to measure the proper motion (PM) and orbits of the Draco and Boötes I dwarf galaxies. The astrometric data was supplemented with deep photometric data from the MegaCam instrument on the Canada France Hawaii Telescope (CFHT) and spectroscopic data from several literary sources. Through a combination of stellar parallax, proper motion, and location on the color magnitude diagram, we identified and removed many foreground Milky Way stars from the sample. For the remaining stars, we utilized a Gaussian mixture model to measure their astrometric properties, therefore measuring the movement of their host dwarf galaxy. We found Draco's average velocity to be -292.14 ± 0.5 km/s with a PM in RA of 0.00 ± 0.02 km/s and a PM in DEC -0.15 ± 0.02 km/s. For Boötes, we found an average velocity of 102.31 ± 0.9 km/s with a PM in RA of -0.37 ± 0.07 km/s and a PM in DEC of -1.07 ± 0.06 km/s. From these phase space measurements we used the Python package Galpy to find the pericenter, apocenter, and eccentricity of each galaxy. Both Draco and Boötes come fairly close to the Milky Way (pericenters of 41 ± 3 kpc and 42 ± 5 kpc respectively) while Boötes had a comparatively large radial orbit.

69. Narrowing the Uncertainty on the Local Group Mass Estimate

Odelia Hartl (University of Oregon)
Astronomical Research and Instrumentation REU
Research Advisor(s): Louis Strigari

We use a modern cosmological hydrodynamic simulation, IllustrisTNG, to gauge the systematic uncertainties of galaxy masses when derived with the Timing Argument. We use these results to estimate the uncertainty on the mass of the Local Group. We apply a similar method used by Li & White (2007) with the Millennium Simulation. While the Millennium Simulation follows Dark Matter particles and thus reconciles only gravitational effects, the IllustrisTNG simulation also accounts for gas processes and follows the evolution of both Baryonic and Dark Matter particles. With the use of the updated IllustrisTNG simulation and revised values for Local Group properties, we are able to update the uncertainty in the estimated mass of the Local Group. We apply appropriate data cuts to study a sample of isolated galaxy pairs, representative of the Milky Way and M31. We compare the ratio of the true mass and the mass derived through the Timing Argument. We define the true mass as the sum of the two galaxy masses, where the simulation interprets the mass of each galaxy as the sum of all particle masses which are bound to the sub halo. The largest simulation by Volume and particle number, TNG300-1, we find the median of the ratio to be .99, with the 5% and 95% points on the distribution separated by a factor of 3.2. In comparison to Li & White (2007) where they derived a median probability of $5.27*10^{12}$ M$\odot$ and a lower bound of $1.81*10^{12}$ M$\odot$, with our results we find the median probability of the Local Group mass to be $4.12*10^{12}$ M$\odot$ with a lower mass estimate of $1.86*10^{12}$ M$\odot$.

70. Photometric Calibration Checks of UVOT Data From the Neil Gehrels Swift Observatory

Nicole Crumpler (Duke University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Peter Brown

In this poster we aim to refine the calibration of Ultraviolet Optical Telescope (UVOT) data from the Neil Gehrels Swift Observatory. Swift's conception as a gamma-ray burst mission has made it a prolific detector of supernova explosions (SN). In this era cosmological research, high-precision measurements of Type Ia SNe are vital for measuring distances and constraining cosmological parameters, thus we must be careful to limit the uncertainty in SN light curves through careful calibration of Swift data with ground-based telescope observations. We compare Swift magnitude measurements of companion stars in SN fields with data from the Katzman Automatic Imaging Telescope (KAIT), the Carnegie Supernova Project (CSP), and the AAVSO Photometric All Sky Survey (APASS) DR9 Catalogue. We also compare Swift UVOT observations of sibling SN fields, instances in which two SNe occur in the same host galaxy, to check for temporal consistency within the Swift data. We restrict the uncertainty in Swift measurements to below 0.05 magnitudes, based on the upper limit of the weighted mean residuals calculated by subtracting the Swift measured magnitude from the ground-based telescope magnitude. We use Markov-chain Monte Carlo linear fitting to conclude this offset is not correlated with magnitude or B-V color. These calibration checks will improve the accuracy and confidence in exploiting this exceptional data set for SN physics and cosmology.

71. Giant Magellan Telescope Multi-object Astronomical and Cosmological Spectrograph (GMACS) Miniature Prototype

Evan Kelly (Texas A&M University), Cole Mason (Texas A&M University),
Leonardo Bush (Texas A&M University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jennifer Marshall, Darren Depoy

The Giant Magellan Telescope (GMT) is an extremely large telescope being constructed in Chile. The Giant Magellan Telescope Multi-object Astronomical and Cosmological Spectrograph (GMACS) is an instrument for the GMT that is currently in development at the Texas A&M Munnerlyn Instrumentation Lab. The goal of GMACS instrument is to spectroscopically observe very faint targets that currently can only be viewed by direct imaging. During this project, we built a 1/6 scale model of the GMACS which will be used to educate visitors on the design and capabilities of the instrument as well as serve as a physical representation. The model was designed using 3D modeling software and constructed using 3D printing technology and stock hardware.

72. Characterizing the Neutron-Capture Element Abundances of CEMP Stars

Carla Quintero (Humboldt State University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Terese Thidemann Hansen

In this project a sample of 15 Carbon-Enhanced Metal-Poor (CEMP) stars, which also, show enhanced abundances of neutron-capture elements are analyzed. All stars have been found to be in binary systems, and it is believed their peculiar abundance patterns are the result of mass transfer from their more evolved binary companion. However, the nature of neutron-capture process required to create the signature observed in these CEMP stars is not well understood. This project aims to classify the neutron-capture processes, by determining the abundances of Barium and Europium in the sample stars, as this ratio can be used as a proxy for the neutron flux during the neutron-capture process in which the elements formed. Combining the derived abundances with the orbital information for these binary systems will thus provide strong constraints on the neutron-capture element nucleosynthesis model calculations.

73. Analyzing Disintegration of Prince Rupert's Drops using High-Speed Photography

Tyler Stamps (University of Arkansas), Hannah Belle Lane (Texas A&M University)
Metrology and Non-Destructive Inspection REU, USRG
Research Advisor(s): Dinakar Sagapuram, Shwetabh Yadav

Prince Rupert's drops, tadpole-shaped glass drops, are rapidly solidified from a molten state, resulting in unusual properties. The head of the drop is so tough that it can withstand several tons of pressure without fracture. In contrast, the thin tail can be broken by hand, which causes the entire drop to disintegrate into fine powder in just a few microseconds. In this study, we use high-speed photography (~ 50,000 frames per second) to capture the disintegration behavior of Prince Rupert's drops. We measured the fracture wave propagation speeds which typically exceed one kilometer per second. These drops are produced by dropping a molten blob of soft glass (104 COE) into three different quenching media: water, oil, and brine. The medium alters the cooling rate and affects the residual stress state within the drop and the fracture behavior of Prince Rupert's Drops will be discussed.

74. Determining Which Universal and Situational Factors Contribute to Risk Inequalities During Infrastructure Service Disruptions

Natalie Coleman (Texas A&M University)
USRG
Research Advisor(s): Ali Mostafavi, Amir Esmalian

The increasing frequency and intensity of natural disasters have resulted in almost inevitable infrastructure service disruptions – repeatedly seen through Hurricane Harvey (2017), Hurricane Florence (2018), and Hurricane Michael (2018). Without access to these critical lifelines, people are unable to have the necessary resources to recover from the disaster impact. The standard infrastructure resilience model primarily focuses on the functionality and restoration of the physical systems. However, community leaders could also overestimate or underestimate the disaster impact if they do not understand the social dimension tying the relative exposure and dependence individuals have for infrastructure services. This calls for a paradigm shift in the understanding and mitigation planning of the disaster impact. Therefore, the research will support the creation of an equitable infrastructure service model, which is needed to integrate both the physical and social dimensions of a community. The model should (1) account for disaster characteristics that disrupt infrastructure systems, (2) differentiate the design and utilization of infrastructures services, and (3) understand the societal needs and expectations of community residents. The objective of this research is to determine which social characteristics are most influential to the disaster experience on a universal and situational level by using empirical data collected regarding the previously mentioned natural disasters. The application of the research is to help community decision makers with addressing risk inequalities and making proper infrastructure investment.

75. How Content Ownership and Reuse Beliefs Vary Across Photo Sharing Services

Michaela Matocha (Texas A&M University)
USRG
Research Advisor(s): Frank Shipman

The purpose of this study is to explore potential differences between social norms regarding content reuse on four common services for sharing photographs. These distinctions can inform the implementation of updated community guidelines, online terms of use, or for legal policies regarding photo reuse. Using a series of surveys administered to the users from the three most used photo sharing sites (Instagram, Imgur, and Flickr, in that order) and Facebook, significant distinctions between the implicit social norms of these sites can be observed and defined through their users' opinions. Sites' survey participants were split into two groups, one focused on social connections (Facebook and Instagram), and one focused on photo collection curation (Flickr and Imgur). The social connections group tends to be less concerned with reuse and more concerned with maintaining a public persona, and the photo collection group tends to be more concerned with photographer ownership. Facebook stood out as its users have created a space where the subjects of photos are considered to ultimately have the say on the reuse of a photo. These distinctions were attributed to the demographic and culture of the site as well as the functionality built into the site itself, as dictated by the users. Overall, participants' views of reuse show that the social climate of the internet is not as homogenous as one might expect. These results imply that existing social norms of sites must be taken into account when designing service policies, and policies must be made broad enough to consider the entire range of services affected.

76. Determining the Differences in Aflatoxin Levels According to Different Processing Procedures in Cottonseed Meals

Sophia Hassan (North Carolina Agricultural and Technical State University)
USRG
Research Advisor(s): Janie Moore

Aspergillus flavus produces aflatoxins that contaminate the Gossypium hirsutum (cotton) seed, a crop that is massively produced in the state of Texas. This study seeks to determine the differences in aflatoxin levels according to the different processing procedures in cottonseed meals. 350 grams of cotton seeds were delinting both mechanically and chemically. The product of both processes were tested for Aspergillus Flavus, as well as their aflatoxin levels.

77. Installation and Commission of TAMUTRAP Through Mass Measurement of Stable Isotopes

Margaret McDonough (University of Dallas)
Cyclotron REU
Research Advisor(s): Dan Melconian

Texas A&M University's Cyclotron Institute recently built a Penning trap, coined TAMUTRAP, in order to test the current constraints on the weak interaction as it is described by the Standard Model. This summer, we removed the 90mm-diameter prototype trap and installed the two times larger, full-sized Penning trap. We commissioned the new trap by demonstrating its ability to measure the masses of stable isotopes to better than 50 parts per billion. These mass measurements enabled us to characterize and optimize operation of the trap to ensure proper ion manipulation before the complications of the planned beta decay experiment which will use short-lived radioactive ions. Mass measurements were performed using the time-of-flight ion cyclotron resonance technique: various radiofrequencies are applied to excite the ions in the trap, and when the applied frequency matches the resonant frequency of these ions, they accelerate and we observe a shorter time of flight to the micro-channel plate detector upon their exit from the trap. By analyzing the time of flight of the ions as a function of frequency, we determined the resonant cyclotron frequency of the ions, from which we deduced their masses to better than 50 parts per billion, in agreement with their known values. Agreement with current literature values will be demonstrated.

78. Production of X(3872) in Ultra Relativistic Heavy Ion Collisions

Matt Sibila (Ohio Northern University)
Cyclotron REU
Research Advisor(s): Ralf Rapp

The X(3872) particle, discovered in 2003 by the Belle collaboration, is of particular interest due to its structure being either a tetra-quark bound state or a molecular state. Its structure can be understood via an investigation of its production yields and spectra in Ultra Relativistic Heavy Ion Collisions (URHICs). We calculate the yields with a statistical hadronization model evaluating at either chemical freeze-out or kinetic freeze-out. The calculation is further extended with a rate-equation approach with its temperature-dependent hadronic width, accounting for its off-equilibrium production. Furthermore, the transverse-momentum spectra can be evaluated from a blastwave description.

79. Machine Learning: Potential Application for Particle Identification

Parker Adamson (Angelo State University)
Cyclotron REU
Research Advisor(s): Sherry Yennello, Mike Youngs

In this project we examined the potential use of machine learning to significantly decrease the time required to analyze FAUST (Forward Array Using Silicon Technology) data without sacrificing the quality and confidence of the results. Networks of varying structure were first trained using SRIM which simulated perfect, 2%, and 5% detector resolution FAUST data. Each trained network was then tested on data disjoint from its training set of each resolution. Under the same procedure we trained and tested neural networks on real experimental data which had been identified using the traditional linearization method. This project establishes the validity and some constraints to the ultimate goal of this research, which is applying one network trained on data from a detector and then applying the network to further data from both that detector and other detectors, through the use of transfer learning, to expedite the analysis process.

80. Extraction of Bismuth from Nitric Acid Media Using 1-octanol and Hydrophobic Liquid Binary Mixtures

Amy Vonder Haar (Montclair State University)
Cyclotron REU
Research Advisor(s): Charles Folden, Evgeny Tereshatov

At-211 is a promising nuclide for cancer treatment with a 7.2 h half-life and 5.9 MeV alpha particle emission. It is produced in a cyclotron accelerator by irradiation of metallic bismuth in the reaction Bi-209$(\alpha, 2n)$At-211. However, prior to the radiotherapy, astatine must be separated from the target. In order to perform this separation, the bismuth behavior under astatine separation conditions must be understood and therefore is of medical relevance. To address this issue, the extraction of the radioactive tracer isotope Bi-207 (half-life of 32.2 y) from varying concentrations of nitric acid into an array of organic solvents is examined in this work. Bi-207 is used in the place of Bi-209 due to the increased sensitivity the radioactivity of Bi-207 provides while maintaining the same behaviors in solution. The organic solvents used include 1-octanol and hydrophobic liquid binary mixtures consisting of combinations of DL-menthol, methyl anthranilate, ibuprofen, lidocaine, and Proton SpongeTM. For each solvent, the partition of Bi-207 between aqueous and organic phases has been measured and summarized in distribution ratio curves as a function of initial nitric acid concentration. The shape of these curves provides insight into the mechanism and efficacy of extraction. The results of this work will be presented.

81. Measurement of Proton Quenching Factors in p-terphenyl

Miriam Matney (Rice University)
Cyclotron REU
Research Advisor(s): Gregory Christian

The organic scintillator p-terphenyl ($C_{18}H_{14}$) is fast, bright, and provides excellent pulse-shape discrimination (PSD). These properties make p-terphenyl a versatile scintillator for use in neutron detectors. In order to characterize the scintillation efficiency of p-terphenyl for more accurate data collection, it is important to understand the amount of quenching as a function of particle energy. Quenching accounts for molecular de-excitation that does not result in the production of light in the scintillator. In this work, quenching factors were measured via a monoenergetic proton beam from the K150 cyclotron at the Texas A&M University Cyclotron Institute at several energies from 3 MeV to 15 MeV. A 15-mm x 15-mm x 25-mm crystal of p-terphenyl was coupled to a photomultiplier tube and irradiated with a proton beam under vacuum. The quenching factor was determined by the relationship between the incident proton energy and the measured proton energy.

82. Production of Nuclei on the Proton Dripline with MARS at the Texas A&M University

Isaiah Richardson (Old Dominion University)
Cyclotron REU
Research Advisor(s): Brian Roeder

Proton-rich nuclei at the proton dripline have been produced at beam energies of >77MeV/u at facilities such as GANIL and NSCL at Michigan State University. At Texas A&M, our goal is to produce these proton-rich nuclei at energies around 40 MeV/u with beam from the K500 cyclotron, and separate these nuclei using the Momentum Achromat Recoil Spectrometer (MARS). We used a spectrometer simulator, LISE++, to devise an experiment with a ^{40}Ca beam at 40 MeV/u on Be, Al, and Ni targets to determine how to optimally produce ^{35}Ca and ^{36}Ca. We tuned MARS to the parameters LISE++ predicted to see how much of these exotic nuclei we could produce in experiment. The products were detected with a ΔE vs. E Si telescope to determine the yield of each isotope. It was concluded that at this energy, the Ni target had the highest production rate for the nuclei close to the proton dripline. The comparison between the experimental production rates and the production rates LISE++ predicted will be presented.

83. Computing the Momentum Distribution of Nucleons in the Core of a Neutron Star Using Chiral Effective Field Theory

Javier Rufino (University of Texas at San Antonio)
Cyclotron REU
Research Advisor(s): Jeremy Holt

Neutron stars are the densest observable objects in the universe with a mass and radius ranging between 1~2M⊙ and 9-14km. Neutron stars consist primarily of neutron-rich nuclear matter in a background of ultra-relativistic electrons and maintain their stability against gravitational collapse due to the support from quantum mechanical degeneracy pressure and nuclear interactions. In this work we investigate the single-particle nucleon momentum distribution in neutron-rich matter up to twice nuclear saturation density. We compute from chiral effective field theory two- and three-body nuclear forces the first- and second-order contributions to the nucleon self-energies, from which the single-particle momentum distributions of protons and neutrons can be computed. We explore the dependence of the momentum distributions on the density and isospin asymmetry and compare to recent experimental results.

84. Influence of Symmetry Energy Density on Isovector Giant Dipole Resonance

Iain Bisset (Colorado School of Mines)
Cyclotron REU
Research Advisor(s): Shalom Shlomo

Past comparison between theoretical predictions and experimental results for the centroid energies, E_{CEN}, of isoscalar and isovector giant resonances of multipolarity $L = 0 – 3$ for a wide range of spherical nuclei have established constraints on the nuclear matter (NM) values of the incompressibility coefficient (K_{NM} = 210-240 MeV), effective mass (m^*/m = 0.7-0.9), and enhancement factor (κ = 0.25-0.70) of the energy weighted sum rule (EWSR) of the isovector giant dipole resonance (IVGDR). However, no constraints on the symmetry energy (J) and its first and second derivatives (L and K_{sym}) were established. Using the Hartree-Fock based Random Phase Approximation method and the subset of the 33 Skyrme interactions used prior that satisfy the established constraints, we determine the E_{CEN} and electric polarizability, $α_D$, of ^{40}Ca, ^{48}Ca, ^{90}Zr, ^{116}Sn, ^{144}Sm, and ^{208}Pb. We calculate the Pearson linear correlation coefficient between properties of NM and the E_{CEN} and the $α_D$. This is done with the goal of investigating the influence J and its derivatives have on the IVGDR. We also compare the results to experimental data to determine constraints on the symmetry energy density.

85. Geometric Analysis of Three-body Nuclei Using Efimov States

Audrey Farrell (Stony Brook University)
Cyclotron REU
Research Advisor(s): Aldo Bonasera

The Thomas theorem describes loosely bound two-body quantum systems that become strongly bound as three-body systems, with a series of excited levels known as Efimov states. Using hyper-spherical geometries to describe two- and three- particle nuclei, we performed fits of total energy to known binding energies in order to determine the weighting of short-range potentials in a given interaction. When applying the appropriate scattering lengths and ranges to the system, we were able to replicate the binding energies of these nuclei with few fitted parameters. With this method we tested various models for different light nuclei and compared which geometries reproduced the binding energy most accurately. Once we had performed enough fits to have estimates of the two-body potentials for systems of neutrons and protons, we extended our model by treating these systems as point particles in order to reproduce binding energies for heavier isotopes. Using this method we can make predictions of which experimentally measured binding energies correspond to Thomas and Efimov states.

86. FAUST 3 Signal Recreation Events

Molly Aslin (Mount Holyoke College)
Cyclotron REU
Research Advisor(s): Sherry Yennello, Mike Youngs

The dual-axis duo-lateral (DADL) silicon detector, used in the Forward Array Using Silicon Technology (FAUST), displays a particularly high position resolution and has previously been seen to minimize a "pin cushion" eect often seen in similar silicon detectors. However, it is estimated that 5 percent of incident protons and 1 percent of incident alpha particles are not picked up by the DADL detector and must be added back manually. Using proton and alpha beams from the K150 cyclotron, we look to see how position on the DADL aects signal resolution. We have isolated some extrema of a DADL detector using a brass mask, which will shield most of the detector with the exception of selected edges and corners. With this, we are able to examine the locations where these contacts prove unreliable and verify how accurate our methods of data input from signal recreation actually are. We have produced position plots for incident particles on the DADL detector and as such, we are able to further characterize the position resolution of the detector.

87. Using Machine Learning to Extract Properties of Systems of Particles

Ellen Gulian (University of Maryland)
Cyclotron REU
Research Advisor(s): Rainer Fries

In nuclear and particle physics, one is often presented with large systems of particles in the final state which emerge from complex dynamical processes. Identifying all the specific processes that led to the creation of the system is challenging with traditional methods of analysis. In our work, we explore the possibility to extract information from systems of particles using machine learning trained with pseudodata from simulations. As a first step, we have created Python code to create samples of systems of particles with various features. Examples of these features are thermal motion of particles (of a given temperature), collective motion of particles (parameterized by a flow field), and decays of particles (from unstable heavier particles of given mass). These systems resemble features seen in experimental data as a result of high energy collisions of protons or nuclei. Using sci-kit learn, we apply random forest and neural network machine learning algorithms to pseudodata created with our simulation code in order to analyze key properties like temperatures and masses of the unstable mother particles. We study the performance of different algorithms and their efficiency in determining the various underlying parameters. Our study is a first step before applying machine learning to more comprehensive simulation codes and eventually to experimental data. If proven feasible, one possible application is to increase our understanding of the hadronization process and the phenomenon of confinement by analyzing experimental data with machine learning.

88. Improved Waveform Analysis Techniques for Gamma Ray Spectroscopy

Eric Lester (Carnegie Mellon University)
Cyclotron REU
Research Advisor(s): Grigory Rogachev

The evolution of primordial Population III stars has never been directly observed. Indirect techniques, such as those used in the nuclear astrophysics community, may provide crucial constraints on the proposed models of these stars. A proposed experiment will use an accelerated beam to investigate the $7Be(\alpha, \gamma)11C$ reaction rate for its contribution to the hot pp-chain. One important facet of this experiment will be the detection of gamma rays from the decay of astrophysically important states around the alpha threshold in 11C. The Texas CsI Array for Astrophysical Measurements (TexCAAM) has been created for this purpose, and this work details the testing and analysis of the CsI array therein. Offline analysis tools for digitized waveforms were developed and tested for potential energy resolution improvements over conventional ADC electronics. Other programs were created to determine angular correlation between successively emitted gamma rays and with an external deuteron signal. This software can be used in future experiments to not only to confirm the population of astrophysically important excited states in the $7Be(\alpha, \gamma)11C$ reaction, but also to constrain the spin and parities of other astrophysically relevant nuclei. Developing results are presented, including a comparative assessment between the methods developed in this work and conventional electronics.

Afternoon Session

3:00 PM – 5:00 PM

1. Hydro-geochemical Processes Driving Arsenic Concentrations in Springs in the Highlands of Costa Rica

Glen Aguilar (University of Guam)
Costa Rica REU
Research Advisor(s): Georgianne Moore, Peter Knappett

In the Costa Rican highlands, communities rely heavily on ground water springs for drinking water consumption. Generally, the water coming from these springs is low in total dissolved solids (TDS) indicating short pore-water residence times. A few of these springs, however, are in or near geothermally active areas. Warmer groundwater temperatures in these areas tend to elevate TDS in the water. Furthermore, geothermal waters commonly contain toxic concentrations of arsenic (As) and fluoride (F), lithium, boron, sodium, and chloride, as well as high pH.. The objectives of this study are: 1) to assess levels of As and F in drinking water source springs as potential human health risks, and 2) investigate the hydro-geochemical processes driving observed concentrations across this region. We hypothesize that in geothermally active areas, a gradation of springs exist from purely fresh, meteoric recharge water with low TDS to geothermal spring water with high TDS. This hypothesis was tested by analyzing primary data from water samples we collected from community drinking water springs and known geothermal springs in Alajuela Province near the Texas A&M University Soltis Center and publicly available data from the area. Published reports found many springs contained As concentrations of 10 µg/L, the World Health Organization's (WHO) drinking water limit . Our samples suggest that F concentrations are below the WHO drinking water limit of 1.5 mg/L in all sampled water sources. Ongoing analysis will help identify the hydro-geochemical process responsible for high As concentrations in springs.

2. Characterizing Soil Carbon Dynamics Associated with Land Uses under Payment for Ecosystem Services Contracts

Andreas Khechfe (Humboldt State University)
Costa Rica REU
Research Advisor(s): Peyton Smith, Georgianne Moore

Payments for ecosystem services (PES) are incentives offered to landowners to protect and provide ecosystem services. Costa Rica has a rich history of sponsoring PES contracts with the goal of increasing forest growth and timber demand, reinstating wildlife corridors and enhancing Carbon (C) sequestration. Soils sequester more than 60% of all terrestrial C, a third of which is stored in tropical soils. Despite their importance in the global C cycle, soils have not been well considered under PES programs. This study analyzes how different land uses under PES contracts sequester carbon belowground via measuring soil carbon pools and CO_2 production. We ran different analyses on soils including measuring permanganate oxidizable carbon (POxC) to calculate the amount of "active" carbon, or carbon available to microorganisms, and measuring how much CO_2 is produced during a laboratory incubation. We also measured in situ soil respiration in a subset of PES sites; a forest plantation, a yuca farm, and, and a tropical montane rainforest. Through these analyses, we expect to see significant differences in the active carbon and soil respiration rates which will help us determine how effectively PES sites are storing carbon in soils. Identifying soil C dynamics in PES systems may reveal a previously unidentified sink of C associated with tropical afforested ecosystems. After this study, we hope to have a better understanding of the effectiveness of PES programs run by NGOs and government programs.

3. Spatiotemporal Chemical Analysis of Surface water and Precipitation in A Pre Montane Rainforest

Charise Culver (Bowling Green State University)
Costa Rica REU
Research Advisor(s): Shankar Chellam

In this study,the chemistry of surface water and rainwater were analyzed within a premontane rainforest of the Penas Blancas watershed in Costa Rica. The parameters of chemistry tested, were pH, dissolved oxygen, turbidity, electrical conductivity and temperature. Water that flows through the watershed isn't influenced by human development; but rather abiotic factors derived from the watershed. Structure,precipitation, elevation, and surrounding geology are factors that impact surface water chemistry. Four sites of streams with varying structures and elevations were assessed for four days each. Sites one and two were pristine water catchments; the howler monkey watershed, and waterfall. The howler monkey watershed stream has significant alluvial material upstream, and the stream beneath the waterfall has bedrock reaches above. The third site is the chachagua river which is in a larger basin that is about 10 times the size of the previous water catchment. The fourth site is the penas blancas river which has an area that is significantly larger than the three other sites. The penas blancas river has volcanic rock deposits throughout and can reach depths greater than 4 feet. Throughout the course of four days the five parameters have shown fluctuations. The temperature has increased as it reaches midday and decreases as evening approaches.Conductivity and pH have been the most consistent throughout the timespan.Turbidity has fluctuated significantly;especially in the howler monkey watershed stream. Further surface water, data analysis and statististics are in progress.

4. Changes in Water and Mass Fluxes of a Pristine Watershed in Response to Rainfall Events and Regional Drought

Daniel Riddle (Utah Valley University)
Costa Rica REU
Research Advisor(s): Peter Knapppett, Georgianne Moore

Small watersheds of first and second order streams are ideal for studying how water and mass fluxes from different sources to a stream change over time scales ranging from single storm events to inter-annual climate phenomena. We studied the fluxes and sources of water and elements within two nested watersheds: the first order Howler Monkey stream and the downstream Rio Chachagua. These watersheds are located within a tropical montane rainforest in Alajuela province, Costa Rica. This region has experienced a serious drought that began in November 2018. During July 2018, we measured volumetric and mass fluxes into a 75 m reach along the Howler Monkey stream. Generally, volumetric discharge along this reach doubles while total dissolved solids (TDS) decreases. This results in an overall increase in mass fluxes of major ions. Building on the findings from 2018, we hypothesize that the drought in 2019 increased the concentration of TDS in soil and ground waters by lengthening the contact time between minerals surfaces and recharge water. The delayed start of the 2019 wet season was accompanied by sporadic storm events, which flushed higher elemental fluxes into the stream compared to those measured during the same time of year in 2018. Combining the two years of data enables us to predict end-members for the waters that supply the watersheds. Understanding the response of these two watersheds to storms and drought will help us predict how future climate change will affect the mass fluxes and volumetric discharge of these watersheds.

5. Year-to-year Variability in Hydrometeorology of a Tropical Montane Rainforest

Melissa Zapata (Lone Star Community College)
Costa Rica REU
Research Advisor(s): Gretchen R. Miller, Georgianne Moore

The rainforests of Costa Rica experienced a severe drought beginning in November 2018 that has only partially abated by July 2019. Although there is considerable research on the effects of drought and plant health, few direct measurements have been previously available to characterize the effects of such a severe drought on a tropical pre-montane transitional forest. This project can help better assess forest response to severe drought. We hypothesize that a decrease in precipitation led to an increase in light availability, enhancing the greenness of the forest canopy and decreasing flows in headwater and second-order streams. To test this hypothesis, long-term meteorological data was collected and analyzed at the Soltis Center site in the northern region of Costa Rica to understand the drought's impact. Flow was measured in two nearby streams, one headwater and one second-order. From January through June 2019, total rainfall occurring was approximately 700 mm, or 38%, less than average. Average streamflow decreased between 2018 and 2019. From February to June, despite the lack of rain, the greenness index slightly increased. Ongoing analysis of incoming solar radiation and fog frequency will help us further understand the relationship between precipitation and forest health.

6. Epiphytic Diversity and Distribution Along Elevation Gradients in a Costa Rican Premontane Rainforest

Olivia Santiago (University of South Florida)
Costa Rica REU
Research Advisor(s): Daniel Spalink

Microclimates formed by abiotic conditions such as temperature, precipitation, humidity, and soil conditions change sharply with changing altitude, providing the ideal settings to study effects of various ecological factors across small spatial scales (1). This study aimed to assess whether vascular holo-epiphytes are specifically adapted to microclimates along an elevational gradient in a Costa Rican premontane rainforest. Therefore, it was hypothesized that epiphytes would be non-randomly distributed along elevational gradients. The community composition of vascular holo-epiphytes along elevational gradients was assessed using a visual ground survey in June and July 2019. Sampling was restricted to primary forests within the Soltis Center de Peñas Blancas and the Pocosol Field Station of the Children's Eternal Rainforest. Three replicates were used respectively at four elevations (400 m, 600 m, 800 m, and 1000 m) for a total of twelve sampling sites. A total of 2996 epiphytes were sampled, representing 75 species across 4 families. The epiphytic distribution, diversity, and abundance was analyzed for significance using statistical software. These results provide insight into understanding niche specificity and endemism of epiphytes, which could have implications for distribution shifts and potential extinction amidst climate change.

7. Morphology and Hydrologic Behavior of Exfiltration Sites in a Small Watershed in Costa Rica

Rua Hamid (Queens College, City University of New York)
Costa Rica REU
Research Advisor(s): Georgianne Moore, Kelly Brumbelow

Water is an essential resource used in Costa Rica's homes, agriculture, livestock, and industry. Primarily found in geological features, more than half of Costa Rica's drinking water supply is groundwater stored in reservoirs/aquifers and discharged by springs (Hidalgo et al., 2015). Costa Rica's complex geology formed by tectonics and volcanism has created unique channels for the storage and movement of groundwater. A 2.2 ha feldspathic andesite/dacite watershed at the Texas A&M Soltis Center San Isidro de Peñas Blancas was investigated springs, their characteristics, and their contribution to streamflow. Forty-six springs were found and classified into four types according to their overall habitat and location of their orifice: (1) all soil, (2) fracture in bedrock, (3) cooling fractures in lava bedding planes, and (4) half soil/saprolite and bedrock. The flowrates of the springs recorded were classified into three magnitudes: (1)>1000 mL/min, (2)500-1000 mL/min, and (3)<500 mL/min. Due to the recent drought in this region, 26% were not responsive to rainfall events less than 28.4 mm. Analysis of our results suggests that early wet season rain events were insufficient to recharge groundwater. The total rainfall during the period of June 17 to July 8, 2019, was only 146.3 mm compared to the past high averages for this period. Chemical analysis of selected springs show a decrease in pH when temperature, ORP and SPC increases which may be due to the minerals and ions in the surrounding soil and rock that may have dissolved into the groundwater while percolating within the watershed.

8. Monitoring the Effects of Drought on Tropical Montane Rainforests of Costa Rica

Kaiya Weatherby (Boston University)
Costa Rica REU
Research Advisor(s): Huilin Gao, Georgianne Moore

Understanding tropical rainforest responses to extreme climate events is critical given the amount of ecosystem services these forests provide for their flora and fauna as well as humans. However, these response mechanisms are not very well understood, especially when it comes to tropical montane rainforests. This study explores the effect of drought conditions on the tropical rainforests of Costa Rica, while taking elevational differences into account. By utilizing various remotely sensed satellite and meteorological datasets available on Google Earth Engine, this study investigates the changes in parameters (such as Enhanced Vegetation Index [EVI], Land Surface Temperature [LST], and Evapotranspiration [ET] from MODIS datasets) that serve as forest health indicators, and draws inferences about the nature of the relationships among these parameters. To analyze the data categorically, the country was divided up into regions classified by drought severity (using the Palmer Drought Severity Index [PDSI] from the TerraClimate dataset), with elevational subregions for each of these PDSI based regions. It was observed that the EVI in all elevation categories and drought regions declines during drought years and rises back up when normal conditions return. Additionally, ET and LST show particularly strong correlation in lower elevations in general, and regions most severely affected by drought conditions have the highest EVI in the highest elevations (and the lowest EVI in the lowest elevations). The observations and inferences made from this study are valuable as they can provide useful information for understanding land-atmosphere interactions under extreme events, evaluating model-based predictions, and supporting management decisions.

9. Kinematic Analysis of Stance Width and Stride Length in a Large-Animal Model of Human Hypophosphatasia Using Motion Capture

Jonathan Kerr (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno

Hypophosphatasia (HPP) is a rare genetic disorder affecting bone mineralization. Clinical presentation ranges from prenatal mortality to mild dental issues. Despite clinical studies and use of small animal models, knowledge of the effects of HPP on the musculoskeletal system is incomplete. To address this gap, an ovine model replicating many features of human HPP was developed. Musculoskeletal defects caused by HPP lead to gait alterations which have not yet been quantified. The present study aims to quantify the stride length and stance width of healthy and affected subjects. A 12-camera VICON motion capture system equipped with three video cameras was used to track the kinematics of two ovine subjects. The location of anatomical landmarks was tracked using 53 retro-reflective markers attached to each subject as they were led through the capture volume at a self-selected speed. Stride length is defined as the distance between collateral front and back hooves at consecutive hoof strikes. Similarly, stance width is defined as the distance between ipsilateral left and right hooves at consecutive hoof strikes. The homozygote had an average stance width of 0.62% and stride length of 0.65% body length while the wildtype had an average stance width of 0.71% and stride length of 0.77% body length. This demonstrates the feasibility of the present method to identify kinematic differences among subjects. Future studies will analyze these and additional parameters for 15 sheep of varying ages, genders, and genotypes to further understand the effects of HPP on the gait cycle.

10. Alternative Water Resources for Bee County Texas

Golnoush Hosseini (Texas A&M University)
Independent Project
Research Advisor(s): David Burnett

The objective of this study is to demonstrate that contaminated water sources can be desalinated and become an effective alternative freshwater source for agriculture in Bee County, since water is often the limiting factor in crop production there due to the high salinity of available water. The county is above the Eagle Ford Shale, hence making it a prime location for oil and gas operations. Pasturelands of coastal Bermuda grass were chosen due to the lack of irrigated land. Due to this lack, a market need is established. By choosing treated produced water for the alternative source for irrigated pasturelands of Coastal Bermuda grass, produced water transportation costs is eliminated, a market is built for produced water, farmers along with oil and gas companies are being benefited, and freshwater usage is minimized for agriculture. An economic model that shows the price of treated water sold to a potential farmer, cost of treatment, avoided cost, profit made by farmer, and a cost comparison for obtaining treated produced water for one year versus two years is designed based on set assumptions. The model is shown by various hypothetical scenarios. These scenarios led to conclusion that using alternative water source can minimize the demand for building freshwater wells for the purpose of irrigation, it can prevent drinking water shortage in the future and, it can remove transportation and disposal of produced water, and it can decrease oil and gas carbon footprints. The project is set to be completed by December of 2019.

11. Brush Use and Displacement Behaviors at a Brush in Angus Crossbred Feedlot Cattle

Xandra Meneses (Texas A&M University)
Texas A&M Animal Behavior and Welfare Laboratory
Research Advisor(s): Courtney Daigle, Rachel Park

Environmental enrichment (EE) provides mental and physical stimulation to animals housed in captivity. Cattle exposed to a brush as EE performed lower levels of stereotypic and aggressive behaviors. While EE can benefit natural behavior expression, the introduction of novel EE can incite competition, unintentionally compromising animal welfare. If EE is to be adopted at the commercial scale, there is a need to understand the level of competition provoked. The objective of the present study was to evaluate patterns of brush displacement behavior by steers provided EE in the form of a cattle brush. Twenty-seven crossbred steers were blocked by weight and allocated to three pens, each containing a mounted cattle brush (n=3 pens with 9 head/pen). Video recordings were decoded from 0800 to 1730 for displacement frequency and brush use frequency and duration for each individual on d0, 1, 2, 4, 8, 16, 32 and 64 relative to brush implementation. Impact of research day on cattle behavior was evaluated using PROC GLIMMIX in SASv9.4. The frequency of displacements initiated ($P<0.0001$) and received ($P<0.0001$) decreased over time, while 96% of cattle used the brush on d0 and d64. The frequency of displacements initiated was positively associated with displacements received (PROC CORR; $r=0.49$, $P<0.0001$), brush usage duration ($r=0.15$, $P=0.03$), and brush bouts ($r=0.26$, $P=0.0001$). Producers who implement cattle brushes as EE can expect increased competition and displacement behaviors on d0 relative to brush installation. However, competition and displacements decrease over time suggesting that cattle brushes do not provoke long-term agonistic behavior.

12. To Reuse or Not to Reuse: From Wastewater to Potable Water in 24 Hours

Jazzmyne Pearson (Texas A&M University)
U.S. Department of Agriculture Water Quality REU
Research Advisor(s): Anish Jantrania, Terry Gentry

In June 2019, Texas A&M University hosted 8 undergraduate students as the third cohort of the USDA-NIFA-sponsored project "Integrated High Impact Extension, Research, and Education (REEU) Program for Undergraduate Students in Water Quality" which focused on onsite wastewater treatment systems. Students examined the efficacy of multiple onsite wastewater systems under normal and non-optimal operating conditions. The students also gained a general understanding of the role of soil for treating onsite wastewater by sampling and analyzing soil water from a septic drainfield. The students measured field parameters including, dissolved oxygen, pH, conductivity, chloride, and nitrate, along with a variety of laboratory parameters including total coliforms, E. coli, and turbidity.Students also studied treatment performance of two proprietary on-site aerobic wastewater treatment technologies and a proprietary on-site water treatment technology to determine possibilities for on-site direct potable reuse. The students analyzed their data and presented the results at the end of the REEU program. This presentation will summarize the program for 2019 and students' scientific observations.

13. Exploring Campus Heritage: The World War I Memorial at Texas A&M University

Jared Labus (Texas A&M University)
College of Architecture SURE
Research Advisor(s): Kevin Glowacki, Andrew Billingsley

In a campus full of rich histories, perhaps one of the most interesting landmarks of Texas A&M's past is the World War I Memorial, currently located in the Corps Plaza. The nine-foot-tall granite monument was originally dedicated in 1924 next to Guion Hall (demolished 1971) as a memorial to fifty-two Aggies who died in the service of their country in World War I. Since then, the monument has moved locations twice before reaching its current location, and more names have been added to the list of "Gold Star Aggies." This project had two objectives: First, to research the monument's history and the details of its dedication, design, and current maintenance. Second, to use photogrammetry to create an accurate 3-D model to serve as a record of the current condition of the monument in case of an unpredictable event such as a natural disaster or vandalism. These two objectives were carried out simultaneously. Detailed photographs of the monument were taken at an early stage of the project so that they could be processed and fine-tuned using Agisoft Metashape software. The research also involved the use of archives in the Cushing Library combined with meetings with historians from Cushing and Evans Libraries and the staff from University Art Galleries. Together, these two portions of the project provide a basis for a new analysis of this important monument of campus heritage and a 3-D model of its current state with detailed textures of its form, reliefs sculptures, and inscriptions for preservation documentation.

14. Developing and Testing a Prototype of Telehealth Booth for a Virtual Behavioral Clinic

Zach Rowley (Texas A&M University)
College of Architecture SURE
Research Advisor(s): Zhipeng Lu, Carly McCord

This study examines a prototype of booth that supports virtual behavioral health counselling session through telemedicine technology. Lack of trained medical staff and doctor has become serious problems in behavioral health field in the USA, especially in rural areas. Telemedicine has the potential to overcome the distance barrier, and create easily accessible, efficient and cost-effective ways to treat patients. Additionally, telemedicine helps protect patient's privacy and dignity. The College of Architecture and the College of Medicine at Texas A&M University (TAMU) have collaborated to develop a booth for the TAMU Telehealth Counselling Clinic. The booth will accommodate the teleconference session between counselor and patient, while ensuring the conversion is not overheard outside the booth in an open-office setting. This study has been divided into three phases in order to test the appropriateness of size, sound-proofing feature, lighting, and ventilation approaches. We have also examined if the booth affects the quality of counselling, and physical and psychological health of counselors. This presentation will report the phase one and two results of the study.

15. Exploring Campus Heritage: The Lawrence Sullivan Ross Monument at Texas A&M University

Cayla Turner (Texas A&M University)
College of Architecture SURE
Research Advisor(s): Kevin Glowacki, Andrew Billingsley

One of the oldest and most iconic monuments at Texas A&M University is the statue of Lawrence Sullivan Ross (1838-1898), which since 1919 has stood in the heart of campus. Ross was a Texas Ranger, Confederate General, the 19th Governor of the State of Texas, and finally, President of the Agricultural Mechanical College of Texas (now Texas A&M University) which was more than enough to warrant a statue in the eyes of the college and the state. The commission for the monument was given to the Italian-born sculptor, Pompeo Coppini and was dedicated by 24th Texas Governor, William Hobby, and Ross's granddaughter. Since then, it has become the center of many university traditions that continue today. However, some of these long standing customs, have been harmful to the statue. Polishing, climbing, paint dumping, and in some cases, vandalism have worn the statue down for a century. In addition to physical damage, his reputation has also come under fire in recent years for his connection to the confederacy and the rumors of his connection to the klu klux klan, calling into question the integrity of this monument; especially in light of several other confederate Coppini statues being removed. Utilizing the extensive database provided by Texas A&M Cushing and Evans library, historians, and campus archivists together with present day observations and documentation, including laser scans and photogrammetry, we can document the statue and find out how the context both the monument and his legacy have evolved in the midst of controversy in the 21st century.

16. Depth of the Cube: Insight into the Analysis of a Shared Form

Jared Thome (Texas A&M University)
Independent Project
Research Advisor(s): Weiling He, James Tate

Despite being among the most primitive geometrical forms, the cube can hold an alarming amount of depth in its possibilities. While many have disregarded it as too basic or simple, others have taken it as a challenge to work within, creating extraordinary designs all based on this deceiving object. However, even though all of these designs relate to the cube, the process varies immensely and thus requires a system to analyze each one. Two ways of distinguishing strategies could be the way in which the cube is approached, whether it is starting with a cube and cutting away or starting from a smaller component and working outward to the bounds of a cube. Some designs boolean out various forms from the cube to explore the relationship of solid and void while others begin from either subdividing the form or filling it up with entirely different ones and looking at the idea of 3D boundaries. These distinctions can be very important in how to approach representing them as well. Cut aways of the cube or subdivisions of the form are best viewed in plans and sections to illustrate the process while those focusing primarily on inherently 3D forms cannot be separated from that view. When it comes to analyzing all of these varied buildings of a shared type it is key to understand the development so as to most effectively illustrate its uniqueness and significance.

17. Low-income Housing in Bryan/ College Station

Franciso Anaya (Texas A&M University), Courtney Ward (Texas A&M University)
Independent Project
Research Advisor(s): James Tate

This project proposes housing models inclusive of working wage families and individuals in Bryan/College Station, Texas. Six percent annual population growth and cost of living increases is limiting, even eliminating, housing options that are attainable to a diverse cross section of the population. The situation is comparable to other university cities around the country and small cities in Texas in close proximity to major metropolitan areas. This project is critical of housing that segregates people based on economic or identity profile. Instead, the project advocates for designs that increase density and privilege collectivity, challenging dominant suburban models based on detached single family houses on subdivided lots which are socially and ecologically destructive. There is a need to redefine how we live, the formation of new subjectivities and communities. As an experiment in the design process, and unique vantage point to evaluate the work, the project is captured in a capriccio scenographic drawing. As the five-week design investigation ends, the studio environment simulates a scaled model of contemporary domestic life. With the drawing, each desk is an individual component that embodies a residential plot. Displaying the organization and relationship of the component to their respective adjacent areas. Establishing a part-to-whole relationship in order to highlight the modern reality of the interaction of neighborhood communities in an urban context. This begins to challenge the recognized community setting and reconsider ways in which shared space and community outreach can be expressed.

18. Characterization of Organic Liquid Scintillation Detectors in the Neutron Sensing Laboratory

Manan Dhir (Texas A&M University)
Independent Project
Research Advisor(s): Shikha Prasad

This work investigates the response of various organic liquid scintillation detectors to fast neutrons and gamma-rays emitted in fission events. Organic fast scintillation detectors can simultaneously respond to gamma-rays and neutrons. Further, these detectors provide a distribution of response which can be related to the incoming particle-wave energy and therefore can enable spectroscopy. We can also use these detectors to measure time-of-flight information for incident neutrons and gamma-rays. This can be used to correlate and know if a neutron and gamma-ray are released from the same decay event. The neutrons and gamma-rays we measure are not shielded. We will present results from 3 different sizes of detectors. We also make comparisons to understand operational characteristics of each of these detectors such as the required input voltage, output charge, linearity of response, and the ability to discriminate between neutrons and gamma-rays. We use different strengths of Cf-252, which is a spontaneous fission source emitting correlated gamma-rays and neutrons. The application of this study is to obtain neutron measurements for security and safeguards.

19. Surface Modification of Two-dimensional Janus Zirconium Phosphate for Pickering Emulsification

Benson Jacob (Texas A&M University)
Independent Project
Research Advisor(s): Zhengdong Cheng

Oil spill is an environmental catastrophe; oil kills sea creatures, contaminates fragile ecosystems, and soil beaches, among other destruction. In today's society, there is an immense need for efficient spill mitigation of inevitable crude oil leakage. We are developing a two-dimensional nanoplates as emulsifiers for encapsulating bulk oil into small oil droplets for further easier in-situ burning and recovery process. In this work we are optimizing the emulsifying procedure by employing the Pickering emulsion. Pickering emulsions are stabilized by our Janus colloidal Zirconium Phosphate (ZrP) nanoplates. The amphiphilic characteristics of ZrP nanoplates, one side hydrophilic and the other side hydrophobic make the surfactant stabilize oil in water emulsions efficiently. This procedure has great applications in oil spill treatment and unlocks a new way for designing emulsion surfactants.

20. Engineer Protease-stable Designed Ankyrin Repeat Proteins (DARPins) as Oral Therapeutics for *Clostridium difficile* Infection

Blake Mitchell (Texas A&M University)
Independent Project
Research Advisor(s): Zhilei Chen, Rudo Simeon

Clostridium difficile is a spore-forming gastrointestinal pathogen that can lead to diarrhea and colitis. The pathology of C.difficile infection (CDI) is primarily due to two secreted toxins, TcdA and TcdB. C.difficile is estimated to cause half a million infections each year. The current standard-of-care for CDI is a combination of antibiotics, mainly metronidazole, vancomycin and fidaxomicine, and suffers a recurrence rate of up to 20%. Our overall goal is to engineer an orally administered, anti-toxin therapeutic for treating CDI. Previously, our lab engineered a panel of designed ankyrin repeat proteins (DARPins) with potent neutralization activity against TcdB using phage-panning and in vitro high-throughput screening. One of these DARPins, U3, neutralized TcdB by blocking its interaction with the Frizzled receptor 1/2/7. Unfortunately, U3 also exhibited poor stability against gut proteases. To improve the protease stability of U3, we first grafted the target-binding residues in U3 to a protease-stable DARPin scaffold, T10-2, that was recently constructed in our lab. This new DARPin, U3-T10-2, exhibited high protease-stability but weaker toxin-neutralizing ability. An error-prone PCR library of U3-T10-2 was generated and subjected to phage panning and high-throughput functional screening. From this library, U3-T showed greatly improved trypsin stability. Further design, replacing two arginine residues in U3-T to glutamine and histidine, yielded U3-T-a. In this study, U3-T-a was cloned into an expression vector and purified from E. coli culture via immobilized metal affinity chromatography. Biochemical and cell biological studies were carried out to evaluate the potential of U3-T-a as an oral protein therapeutic against CDI.

21. Disease-modifying Neuroprotective Effects of the Synthetic Neurosteroid Ganaxolone on Traumatic Brian Injury in Mice

Wesley Thompson (Texas A&M University)
College of Medicine Summer Undergraduate Research Program
Research Advisor(s): Samba Reddy, Victoria Golub

Neurosteroids are key endogenous molecules in the brain that affect many neural functions, most of which consist of neuronal inhibition via interactions with the GABA-A receptor. Traumatic brain injury (TBI) brings about a myriad of issues beyond the initial brain damage, one of the most serious being post-traumatic epilepsy (PTE). However, there are few effective disease-modifying drugs for PTE. Given the promising antiseizure and protective effects of the synthetic neurosteroid ganaxolone, in this study we sought to investigate ganaxolone's potential to attenuate TBI and post-traumatic epileptogenesis. TBI was induced in adult mice using a controlled cortical-hippocampal impact (CCI) paradigm to model a severe TBI. Ganaxolone (5 mg/kg, sc) was administered twice daily for 21 days, and a series of neurological and behavioral tests were conducted at varying intervals up to 120 days post-TBI. Epileptic seizures were monitored by a video-EEG system for the same period via implanted electrodes in the brain. Compared to control TBI mice, the ganaxolone-treated mice displayed significantly better outcomes on a standardized health scale, as well as on specific tests designed to assess the sensorimotor function. Ganaxolone-treated mice showed significantly less anxious behavior in the open-field and elevated plus-maze tests compared to controls. Finally, the drug-treated group demonstrated significantly reduced memory impairment in the NORT test when compared to untreated TBI controls. EEG recordings are in progress to ascertain PTE development. These early results indicate that ganaxolone has a disease-modifying neuroprotective effect on TBI-induced cognitive and behavioral dysfunction, which are frequently observed comorbidity of PTE.

22. Determination of Ovarian Cancer Therapeutic Effect of Natural Products

Youngjun Park (Texas A&M University), Mike Ryu (Texas A&M University)
Independent Project
Research Advisor(s): Dongin Kim, Changsun Kang

Ovarian cancer is one of the leading causes of death of women in the United States of America. Thus, its urgent treatment must be considered. The purpose of this study is to test the cancer therapeutic efficacy of natural product on ovarian cancer cell. To do it, ovarian cancer cell line (A2780) was used and 10 extracted samples from different natural products were treated with $3*10^4$ cells that were seeded into 96 well plates. Treatment time was 24 hours and treatment concentrations were from 0.001 to 1000 μg/mL of each sample in order to validate dose dependent cell killing efficacy of each sample. The cell viability was validated by using a cell counting kit 8 (CCK) assay. Among the 10 natural products, 4 samples, Red Bell Pepper UFRT, Pretreated Jalapeno UFRT, Acid Treated Green Coffee UFRT, and Acid Treated Green Coffee NFRT, showed significant decrease in cell viability at high concentration doses. Therefore, these products have shown significant cancer cell growth inhibition that might have potential uses for anticancer therapy in the future.

23. Epigenetic Attenuation of the Long-term Neuropatholgoical Effects of Acute Organophosphate Exposure in Rats

Gianni Calderara (Texas A&M University)
SURE EnMed
Research Advisor(s): Doodipala Reddy

Organophosphate (OP) exposure causes persistent seizures, brain injury, and long-term neurological morbidity, and sometimes death if seizures do not subside with typical benzodiazepine treatment. If one survives this neurotoxic crisis, there is usually damage to the brain and chronic neurological dysfunction. Epigenetic therapeutics are emerging as potential treatments for the maladaptive processes found in OP-induced chronic morphological effects including neuroinflammation, neurodegeneration, and aberrant neurogenesis. In this study, we investigated the effects of vorinostat (SAHA), a potent HDAC inhibitor, on chronic neuropathology in a rat model of OP intoxication using the nerve agent soman (GD). Midazolam (2 mg/kg) was given to control seizures in all animals, and SAHA (50 mg/kg; twice daily for 21 days) was given to half the cohort as additional treatment. At 3-months post-exposure rats were perfused, and their brain slices processed for NeuN (principal neurons), PV (inhibitory interneurons), and DCX (newborn neurons) immunohistochemistry. Quantification of cell populations within the hippocampal regions CA1-CA3, DG, and DH were performed using an unbiased stereology protocol. OP exposure caused extensive neurodegeneration of NeuN(+) principal neurons and PV(+) interneurons in many brain regions. SAHA treatment significantly prevented loss of NeuN(+) principal neurons and PV(+)interneurons in the hippocampus subfields. Similarly, SAHA also prevented the OP intoxication-induced reduction in DCX(+) neurogenesis in the hippocampus. These results provide striking evidence of neuroprotection by the HDAC inhibitor SAHA against the long-term neurological consequences of acute OP exposure, confirming the therapeutic potential of epigenetic therapy for OP intoxication.

24. Pre-Design Activities

Ryan Garza (Texas A&M University), Shannon Sumner (Texas A&M University)
SURE EnMed
Research Advisor(s): James Tate

We're working with the Navasota Theatre Alliance, a grassroots non-profit that serves the public through performances, events, and educational programming. They're a progressive congregation in a rather conservative portion of Texas, challenging preconceptions and divisions between various groups with the promotion of community involvement. The Navasota Theatre Alliance is in the pre-design planning phase of the new Black Box facility. They've challenged us to envision an organization strategy and architectural identity that promotes an engaging, open, and inclusive interface in the community. To begin the pre-design phase, we created a detailed digital site model, that helps us situate the proposed theatre within its specific context. From there we sought input using surveys. Our initial questions provoked responses that expressed familiarity and frustrations with the existing theatre, but also aspirations. Once we evaluated their goals and priorities, we created a spatial analysis and benchmark document that's helping us prepare for schematic design. This includes analysis of comparable facilities and institutions, and their organization processes in order to explore potential programming options viable for the NTA. When managing public interest design, there is a level of practicality expected, even in the early stages. Visuals also help communicate the different programming behind certain spaces, and the variety of activities that can take place within. Through the multitude of options and possibilities presented and explored through various pre-design activities, we've narrowed the options down to a set of core programmatic spaces that will lead us into the design stage.

25. Khmoc Nakry, a Ghost's Story of the Cambodian Genocide

Grace Hough (Texas A&M University)
Aggie Creative Collective
Research Advisor(s): Lowell Mick White

The scholarly discourse regarding genocide literature has gone down since 1945, overlooking modern events like the Cambodian Genocide in the Khmer Rouge Killing Fields. Written as a creative thesis, Khmoc Nakry, a Ghost's Story is a historical novella of the Khmer Rouge occupation in Cambodia between April 1975 and January 1979 told through the eyes of a ghost who follows a young girl during the later years in a forced-labor camp. The project seeks to add literary material and discussion to the Cambodian Genocide subject and Cambodian-American Literature. Through the ghost and the little girl's teenage daughter forty years later, this novella questions how childhood wartime trauma disseminates through indirect witnesses and later generations, many of whom can only hear the first-person accounts and not experience the horrors themselves. This project explores the culture of Cambodia and the attempted destruction and perversion of it during this terrifying period which further damaged the efforts of international groups and later generations to connect to the heritage. The numbers can never be properly recorded, but it is estimated that around 2.5 million Cambodian citizens lost their lives while their country's history and culture suffered a brutal attempted murder alongside her people. Spiritual beliefs, old folktales, ancestral spirits, ghosts, demons. All suffered. Today's survivors deal with PTSD and other health issues in the aftermath. As the children of the Killing Field's grow older, they find the strength to sit down and share their stories, whether by themselves or through proxies like their own children.

26. Gender Discrimination and Neighborhood Cohesion: A Possible Coping Mechanism

Chloe Harrison (Texas A&M University)
Glasscock Summer Scholars
Research Advisor(s): Adrienne Carter Sowell, Gabriel Miller

Gender discrimination is still an ongoing problem. Experiencing gender discrimination can have a negative impact on one's mental health, it can cause stress and mental distress for the individual (Grollman 2015). It important to examine how people cope with the added stress of facing gender discrimination. Coping works to alter or handle the meaning of the situation from which stressors occur or to not allow stress to go out of a manageable reach (Pearlin 1989). I think neighborhood cohesion, more precisely one aspect of neighborhood cohesion which is social networks, act as a coping mechanism to alleviate the stress that comes with experiencing gender discrimination. African Americans cope with racial discrimination through social networks, i.e. racial/ ethnic identities have been shown to help an individual cope with racial discrimination (Brondolo et al. 2009). Social networks already function as a coping mechanism for racial discrimination, so then the question arises of if it could work as a coping mechanism for gender discrimination. I plan to explore whether social networks can impact the relationship between experiencing gender discrimination and the mental distress that is caused by the stress of experiencing discrimination.

27. The Influence of Threat on the Efficiency of Goal-Directed Attentional Control

David Lee (Texas A&M University)
Department of Psychology
Research Advisor(s): Brian Anderson

Anxiety has consistently been found to potentiate attentional capture by physically salient stimuli, which could be due to enhanced distractor processing, impaired goal-directed attention, or both. At the same time, a recent study demonstrated that a threat manipulation reduces attentional capture by reward-associated stimuli, suggesting that anxiety does not increase distractibility or otherwise interfere with the control of attention generally. Here, we experimentally induced anxiety via threat-of-shock in the adaptive choice visual search task to examine whether the experience of threat influences goal-directed attentional control. Participants chose to search through one of two task-relevant colors on each trial, where searching through the less abundant color would be optimal for maximizing performance. Performance was evaluated with and without the threat of unpredictable electric shock. Under threat, participants were more optimal in their visual search and missed fewer targets. Performance improvements were demonstrated on trials that the optimal target color switched, demonstrating that threat is beneficial in appraising and adapting to changes in the environment. Our findings demonstrate that threat can facilitate the efficiency of goal-directed attentional control and are at odds with an antagonistic relationship between anxiety and the control of attention.

28. Disposition of Sexual Assault Evidence Collection Kits When Using the Non-report Option

Gina Mancino (Texas A&M University)
Independent Project
Research Advisor(s): Nancy Downing

The Violence Against Women Act reauthorization of 2013 requires states to fund medical forensic exams (MFE) despite whether patients involve law enforcement (LE). States have discretion regarding anonymous sexual assault evidence collection kit (SAEK) options, non-report options, or both options. Patients may demonstrate reluctance to report for myriad reasons, including perpetrator fear, unknown repercussions, and difficulty processing the event. The non-report option allows patients time to process the trauma before engaging with LE. In Texas, patients delaying reporting can select an anonymous or non-report SAEK option. Anonymous SAEKs use a kit number or pseudonym for release to a crime lab through LE to maintain patient privacy during reporting. Contrastingly, the Texas Department of Public Safety picks up non-report SAEKs for storage at a centralized location. At the time of this project, non-report SAEKs were stored for two years before being destroyed, unless a patient reported to LE. We will present data regarding number and disposition of non-report SAEKs in Texas from 2016 to 2018. In 2016, Texas collected 402 non-report SAEKs; 17 SAEKs were released for crime lab processing; 346 SAEKs were destroyed in 2018. There was an 81.25% increase of released non-report SAEKs from 2016-2017, and an 89.66% increase from 2017-2018. This project involves contacting LE jurisdictions to learn the disposition of the 17 SAEKs released in 2016. We will examine charges filed, arrests made, cases prosecuted, and prosecution outcomes, if applicable. Results will inform understanding of the non-report option, serving to inform policies and legislation in other jurisdictions.

29. Development and Analysis of *Peromyscus maniculatus* Induced Pluripotent Stem Cells to Produce Disease Resistance in the North American Deer Mouse

Gabi Hinojosa (University of Texas Rio Grande Valley)
Summer Undergraduate Research Program in Genetics and Genomics
Research Advisor(s): David Threadgill

Peromyscus mice are hosts for ticks carrying major diseases in North America such as Lyme Disease and Hantavirus. Efforts are underway with the goal of applying genome editing technology to produce disease resistant Peromyscus strains and introducing these strains into the environment. Reproductive manipulation of Peromyscus through embryo transfer has been achieved, but successful production of live pups at birth is still lacking. Previously, Peromyscus fibroblasts were collected from embryos, cultured and reprogrammed into induced pluripotent stem cells (iPSCs) using Sendai Virus carrying the reprogramming genes Myc, Sox2, Oct3/4, and Klf4. The objective of this study is to optimize the growth and analyze the quality of the iPSC by testing different medias, karyotyping, and aggregating the iPSCs with laboratory C57BL/6 Mus musculus embryos to eventually create a disease resistant interspecies chimera. C57BL/6 mice were chosen to aggregate iPSCs due to their similar developmental timing to Peromyscus, well characterized reproductive manipulation, and conspicuous post-copulatory plug. Future work lies in engineering the Peromyscus iPSC to make them resistant to carrying Lyme disease and breeding the interspecies chimeras with Peromyscus mice to transmit the disease resistance to subsequent generations.

30. Hybridization in Bats? The Status of *Myotis oxygnathus*

Kaci Martin (Clemson University)
Summer Undergraduate Research Program in Genetics and Genomics
Research Advisor(s): William Murphy, Nicole Foley

Hybridization and adaptive introgression are reported by a growing number of studies in diverse taxa. Swarming behavior, where large male biased, multispecies assemblages form for mating during autumn, is thought to promote hybridization in bats. Despite this, few studies have examined hybridization in bats to date. Previous studies have suggested Myotis myotis and Myotis blythii, two morphologically similar sister-species of bats, hybridize where they occur in sympatry in Europe. Myotis oxygnathus has been described as a putative subspecies of either M. blythii or M. myotis, or a hybrid intermediate of the two species. To address this, 151 sequences from the mitochondrial hypervariable region of M. blythii and M. myotis were collected throughout their ranges, including both areas of sympatry and allopatry. A Principal Components Analysis (PCA), haplotype network, and a neighbor-joining tree showed M. blythii and M. myotis did not form distinct monophyletic groups, indicating potential evidence for hybridization. Furthermore, the addition of 67 M. oxygnathus sequences showed that they clustered with M. blythii. These data suggest M. oxygnathus is either a subspecies of M. blythii or potentially a hybrid intermediate of M. myotis and M. blythii. Further work exploring nuclear genomic DNA is required to determine the specific status of M. oxygnathus and to further explore potential hybridization, including its genomic impact on these three taxa. Given evidence for adaptive introgression of immune genes among other hybridizing mammal species, understanding its prevalence in bat species may have important consequences for understanding the evolution of their exceptional immunity and viral tolerance.

31. Identification of the Probabilistic Parameters During *C. elegans* Male Mating Behavior

Luca Henze (The University of Texas at El Paso)
Summer Undergraduate Research Program in Genetics and Genomics
Research Advisor(s): L. Rene Garcia, Yufeng Wan

C. elegans male mating behavior is stereotypical and contains well defined steps. However, there is high individual variability at multiple levels of the behavior. We hypothesize the mating model is a probabilistic program, which generates the variability and allows for the regulation of behavior at different conditions. To demonstrate and identify the probabilistic parameters of the mating model, we took videos of fluorescing males mating with non-fluorescing hermaphrodites. Those males are expressing calcium sensor GCaMP in mating-related muscles, which allows us to analyze both posture and muscle activity changes during mating. We developed a software called NAWA to automate the analysis of the videos. From the 60 videos we analyzed, we measured and quantified the probabilities of body postures changes during the different steps as well as their correlation with the muscle activity changes. Further analysis of these data may help us identify probabilistic parameters that are regulated in C. elegans male mating behavior.

32. Development of in vivo CRISPR/Cas9-mediated Knock-in Strategies to Illuminate the Monarch Butterfly Brain Clockwork Circuitry

Mandy Eckhardt (Austin College)
Summer Undergraduate Research Program in Genetics and Genomics
Research Advisor(s): Christine Merlin

The circadian clock has evolved as a mechanism by which organisms synchronize daily rhythms in their physiology and behavior with that of the 24-hour period of the earth's rotation on its axis. In addition to daily rhythms, many organisms living in temperate latitudes have also evolved a circannual rhythm that helps them cope with seasonally changing environments. One such example is the monarch butterfly and its yearly migration triggered by declining photoperiods in the fall. Using genetic knockouts of clock genes bmal1, clock, and cryptochrome 2, circadian clocks have been shown to play a critical role in the monarch sensing and response to photoperiodic changes. However, the neurons and projections that make up the brain circadian circuitry regulating the monarch daily and seasonal rhythms remain virtually unknown. Here, we aim to map the clock neuronal circuitry in the monarch brain by knocking-in a membrane tagged tdTomato fluorescent reporter under the control of the endogenous promoter of monarch cry2. Knock-in methods in the monarch butterfly have not yet been developed and we are currently testing two CRISPR/Cas9-assisted strategies using: (1) a single guide (sg) RNA and a single stranded (ss) DNA donor, and (2) two sgRNAs to remove a DNA region in cry2 of equivalent size to that of the reporter, and either a double stranded DNA or ssDNA donor. Once transgenic butterfly lines are established, future studies will be performed to map the clock neural network in the monarch brain and test if it undergoes seasonal remodeling.

33. Identification of Potential Regulatory Upstream ORFs Involved in Clock-controlled mRNA Translation in *Neurospora crassa*

Osiris López-García (University of Puerto Rico at Mayagüez)
Summer Undergraduate Research Program in Genetics and Genomics
Research Advisor(s): Deborah Bell-Pedersen, Kathrina Castillo

The circadian clock controls daily rhythms in a wide variety of physiological and behavioral processes in diverse organisms, allowing anticipation of daily environmental cycles and maintenance of internal temporal order. Rhythms in mRNA accumulation are observed for up to 50% of the eukaryotic genome. Interestingly, about half of the oscillating proteins in the mouse liver are produced from mRNAs that are not clock-controlled, suggesting a prominent role for clock regulation of post-transcriptional processes, such as rhythmic mRNA translation or protein turnover. While the basic mechanisms of circadian transcriptional control are known, the extent and mechanisms of clock-controlled mRNA translation are understudied. When upstream ORFs (uORFs) in the 5' UTRs of mRNAs are translated, they can repress or activate translation of the downstream main ORF (mORF). Our goal is to determine if uORFs present in clock-controlled mRNAs in Neurospora crassa regulate rhythmic translation of the mORF. Inspection of ribosome profiling reads using IGV identified 26 clock-controlled mRNAs with rhythmic ribosome occupancy within the 5' UTR, including in mRNA encoding the bZIP transcription factor IDI-4. Expression of an IDI-4::LUCIFERASE (LUC) translational fusion harboring the predicted uORF was rhythmic in WT cells. IDI-4::LUC levels peak during the early subjective night, while ribosome-protected reads of the predicted uORF peak in the subjective day. These data suggested that the expression of the uORF rhythmically represses expression of the mORF. Deletion of the uORF is underway to test this hypothesis.

34. Polyphosphate Affects Gene Expression and Pseudopod Formation in *Dictyostelium discoideum*

Jacquelyn McCullough (Texas A&M University)
Independent Project
Research Advisor(s): Richard Gomer

Polyphosphates are chains of phosphate residues found in all kingdoms of life. While its exact functions are not clearly understood, polyphosphate shows potential as a target for life-saving therapeutics. In the model eukaryotic organism Dictyostelium discoideum, secreted polyphosphate inhibits proliferation through extracellular binding and facilitates cell survival in periods of nutrient deficiency. I studied the effects of polyphosphate on mitochondria, gene expression, and pseudopod formation for the following reasons. First, other workers observed a reduction in expression of a mitochondrial gene following exposure to polyphosphate, so I used Mitotracker red and green dyes to further examine polyphosphate's effect on the mitochondria. Second, a variety of known Dictyostelium mutants showed reduced sensitivity to polyphosphate compared to wild type cells, so I used QPCR to determine how polyphosphate affects the expression of associated genes. Third, other workers observed that polyphosphate reduces cell adhesion, so I analyzed pseudopod formation. In the first set of experiments, I found that Mitotracker dye shows no significant effect on mitochondrial size or mass. In the second set of experiments, I found that polyphosphate decreases expression of some genes while increasing expression of others. Finally, I found that polyphosphate decreases pseudopod production and prolongs pseudopod lifespan in Dictyostelium. Together, my work shows that the unusual molecule polyphosphate can regulate both gene expression and cell motility in a model eukaryote.

35. Exploring the Internal Structure of Stimuli-responsive Drug-releasing Biomedical Coatings

Samantha Hernandez (Texas A&M University)
Independent Project
Research Advisor(s): Svetlana Sukhishvili

Layer-by-layer (LbL) assemblies of responsive polymers are promising platforms for highly localized, stimuli-controlled delivery of bioactive molecules. Upper critical solution temperature (UCST) polymers are a unique class of polymer capable of temperature-reversible bonding, that can be utilized to synthesis block copolymer thus enabling the formation of temperature-responsive micelles. In order to prevent the disintegration of micelles at temperatures greater than UCST, micelles can be stabilized by a hydrogen-bonding binding partner in a LbL coating. Incorporation of these UCST polymers in LbL coatings maintains their morphological integrity, hence, preserving their drug-carrying capacity. Here, we explore the influence of micelle assembly solution pH and binding partner molecular weight on LbL assemblies of UCST micelles (consisting of a poly(acrylamide-co-acrylonitrile) core and a polyvinylpyrrolidone (PVP) corona) with poly(methacrylic acid) (PMAA). Through spectroscopic ellipsometry, isothermal titration calorimetry (ITC), and neutron reflectometry (NR) characterization, we found that a highly acidic deposition pH (pH 3) enabled thicker film growth while compromising the micelle morphology. Micelle morphology was more highly preserved at pH 4 when PMAA was slightly ionized and less disposed to penetrate the micellar core. As expected, PMAA invasion of the micellar core decreased the swelling of the micelles, therefore, introducing the importance of binding partner manipulation on LbL micellar assemblies. Further exploration of PMAA molecular weight, in which shorter PMAA is expected to bind less strongly and therefore is expected to enhance film swelling, is discussed.

36. A Protocol of Using Open Access Resources to Perform Medical Imaging 3D Printing

Lucille Lee (Wichita State University)
Independent Project
Research Advisor(s): Egemen Tuzun, Vidya Sridhar, Lee-Jae Guo (Ph.D. Candidate)

Three-dimensional (3D) printing is a new technology in medicine, providing unique value to understanding anatomic structures into details. Performing medical 3D printing requires commercial software and the knowledge of post-imaging processing is restricted. In this study, we aimed to establish a protocol to perform medical 3D printing using open access resources. Whole body computed tomography (CT) images were acquired and reconstructed as digital imaging and communications in medicine (DICOM) files. The data was imported onto the Horos DICOM viewer. Under volume rendering, the left femur was selected as the target and isolated using the cutting function, leaving the patellar bone attached. Surface rendering was used to export the femur model as a standard tessellation language (STL) file. The file was imported onto Meshmixer for 3D refinement. The model fragments and patellar bone were removed. The gaps on the model were filled using the auto repair function and the femur cortex was solidified. The model was exported for polylactic acid (PLA) and resin 3D printing. Both models were printed successfully and both techniques provided sufficient anatomic details of the femur. The overall time from image processing to PLA printing could be completed under 4 hours, contrary to the resin printing taking more than 8 hours. As a result, the PLA printing provided an efficient method with sufficient quality for potential applications. In summary, we established a comprehensive 3D printing protocol using open access resources to post-process CT images and demonstrated an efficient method for medical 3D printing.

37. Vacancy-Driven Gelation for Fabricating Highly Elastomeric, Tough and Conductive Hydrogels

Kamran Darvesh (Texas A&M University)
Independent Project
Research Advisor(s): Akhilesh Gaharwar

Two-dimensional (2D) transition metal dichalcogenide (TMD) nanosheets have received considerable attention due to their high degree of structural anisotropy and chemical functionality. In particular, 2D molybdenum disulfide (MoS2) has been explored in optical sensors, nanoelectronics and photothermal agents due to its tunable band gap. Mo is a transition metal, with D electrons in its outermost orbitals. It forms 2 covalent bonds with the chalcogen atom, sulfur, to produce a 2-D semiconducting nanomaterial sheet (width of the sheet is 1 nanometer). The atomic defects present on the lattice plane of MoS2 provide an active site for various applications including catalyst and chemical conjugations. For example, the Mo:S ratio during the MoS2 synthesis is maintained at 1:6 to create 'active sites', which can be used to crosslink thiolated gelatin (Gel-SH) to obtain shear-thinning hydrogel bioinks for 3D printing. The result of this vacancy-driven gelation of MoS2 with a thiol-activated terminal results in a Nanocomposite Ionic Covalent-Entanglement (NICE), with high mechanical stiffness and high cell viability (>85%). Various ratios of MoS2 and Gel-SH mixtures have undergone mechanochemical testing to better understand the hydrogel. This testing includes, but was not limited to: compression testing, rheological testing, and electrochemical testing. Kappa carrageenan is introduced to the mixture for printability and added stability via ionic crosslinking. Forthcoming results will show an electrochemically conductive bioink capable of 3D bioprinting for various biomedical applications.

38. Improving Encapsulation Efficiency of Porphyrin Dyes Using BSA for Phosphorescent Biosensors

Caleb Yen (Texas A&M University)
Independent Project
Research Advisor(s): Mike McShane

A major and increasing problem of the world are chronic diseases. One of these major chronic diseases is diabetes. Treating diabetes require constant visits to the hospital and constant monitoring of blood sugar levels. Monitoring blood sugar levels often requires a finger prick test that is uncomfortable for the patient. This lab works on creating optical biosensors that are able to continuously monitor glucose levels in the interstitial fluid. These biosensors contain microparticles that are suspended within a matrix. Within the microparticles are a certain dye and enzymes used to monitor glucose levels. When these biosensors undergo light excitation, the dye within the particles emits photons known as phosphorescence. This signal is then processed and allows one to see glucose levels. One big problem to fabricating these microparticles is the cost of the dye. It is believed that bovine serum albumin (BSA) could be used to more efficiently encapsulate the dye within the microparticles. BSA is a large nonreactive molecule with many nonspecific binding sites. This large molecule could be utilized to prevent vibrational freedom of the dye and prevent it from leeching out. However, the direct effect that BSA has on phosphorescent data is unknown. Figuring out an amount of BSA that could be used to decrease the costs of dye but keep the effectiveness of the biosensors was the main goal of this project. Data collection has not been completed and conclusions cannot be made.

39. Optimizing STAT3 for Spinal Recovery

Shreya Majeti (College Station High School)
Independent Project
Research Advisor(s): Jean-Phillipe Pellois

I synthesized and purified TMR-k5 to deliver a PBAD-EGFP plasmid containing CA STAT3. Theoretically the protein production could heal spinal injuries when injected into astrocytes. Recent developments indicating the role of astrocytes in motor neuron disease (MND), emphasizes their potential as therapeutic targets and agents in cell replacement therapy. I spent the past month amplifying and cloning with PCR. STAT3 regulates cytokine production, thereby mediating inflammatory responses. It is phosphorylated through the JAK-STAT pathway or receptor tyrosine kinases and once dimerized moves into the nucleus, where it activates genes related to cell growth. The structure of STAT3 contains 6 domains: NTD (amino terminal), CDD (coiled-coil), DBD (DNA binding), LD (linker), SH2, TAD (transactivation). Each serves a specific purpose such as stabilization and nuclear import, binding to promoters, interaction with other proteins, recognitionof tyrosine phosphorylation on receptor subunits etc. By changing the 661th base pair from A to C and the 663rd base pair, a constitutively active form of STAT3 was created; it occurs naturally in intestinal T cells from Crohn disease patients due to abnormal STAT/SOCS signalling. To visualize STAT3, I had to tag it with a fluorcent without disturbing its dimerization. The STAT3 sequence was inserted to the N terminus of GFP to avoid blocking N-terminus interation. Previously, to evaluate its function, tyrosine phosphorylation was simulated by IFNa and transcriptional induction/expression of a luciferase reporter gene regulated by a STAT binding site was checked. Once protein production is optimized, I will proceed to harvest and begin injection trials.

40. The Targeted Therapy of Prostate and Breast Cancer with Nanovesicles made from iPSC-MSCs

Sam Wu (College Station High School)
Independent Project
Research Advisor(s): Fei Liu, Qingguo Zhao

To improve the treatment of advanced breast and prostate cancer, we reconstructed nanovesicles (NVs) from uniform induced pluripotent stem cell-derived mesenchymal stem cells (iPSC-MSCs) with active cancer-targeting capacity, a low immunogenicity, and an unlimited supply. Human iPSC-MSCs were transduced with the gene of a tumor killing protein, TNF-related apoptosis-inducing ligand (TRAIL). Nanovesicles were made by breaking down these TRAIL-transduced iPSC-MSCs. The cancer-targeting capacities of these NVs were evaluated in vitro by flow cytometry and in mouse models of breast and prostate cancer by imaging of the fluorescence-labeled NVs. Our results show that NVs carrying TRAIL selectively bind to human prostate cancer and breast cancer cells when compared to non-tumor cells. In mouse models of breast and prostate cancer, NVs accumulated in primary and metastatic cancer after systemic infusion with a significantly higher selectivity than liposomes. Moreover, NVs have no detectable immunogenicity or toxicity and are stable after prolonged storage. These data indicate that iPSC-MSC NVs are promising in the treatment of advanced breast and prostate cancer as a standardized targeting platform with an unlimited supply and easy optimization.

41. Spectroscopic Characteristics and Trends of Werner Salts: An Automated Approach

Daniel Hou (Texas A&M University)
Independent Project
Research Advisor(s): Michael Hall, John Gladysz

Salts of the trications $[Co(en)3]3+$ (en = ethylenediamine) and $[Co(dpen)3]3+$ (dpen = 1,2-diphenylethylenediamine) have recently been explored for their use as catalysts of enantioselective transformations. Particularly with the latter, there have been spectacular successes. In addition to the stereocenters on the ligand scaffold ("S"), these catalysts also were found to have a metal configuration ("L-" or "D-") which in turn influence a product's eventual stereochemistry. It is therefore important to be able to synthesize both the L- and D-version of the catalyst in high yields. In the course of carrying out this chemistry, it quickly became obvious that there were profound anion effects. The synthesis of the trications with a specific metal configuration is controlled by changing the counteranions, but there has been surprisingly little insight into how this fundamental anion control works. In this work, our goal was to establish a basis for spectroscopic characteristics of these Werner salts when the counteranions are changed. We combined DFT theory with our experimental data to arrive at a model which could serve as a guide to experimentalists by providing spectroscopic and diagnostic handles. This work can ultimately improve the synthesis of $[Co(dpen)3]3+$ 3X-.

49. 3-D Analysis of Low-Level Shear and LCL Height Influences on Outflow and Surface Rotation in Simulated Supercell Thunderstorms

Roger Riggin (Salisbury University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Christopher Nowotarski, Matthew Brown

Two previous studies used idealized numerical simulations of supercell thunderstorms to study the influences of both the low-level wind profile (height < 1 km AGL) and lifting condensation level (LCL) on the characteristics of storm outflow and the associated near-surface vorticity. Cold pool strength is related to LCL through boundary layer relative humidity (RH). Higher (lower) RH results in a lower (higher) LCL, which reduces (increases) evaporational cooling in the downdraft, creating a warmer (cooler) and more (less) buoyant cold pool. Variation in the low-level wind profile has been shown to have a large influence on supercell morphology, including both updraft and cold pool characteristics. Changes in cold pool propagation due to both shear and LCL can influence the position of near-surface rotation relative to the mesocyclone. Simulations with different combinations of LCL and low-level shear were visualized in virtual reality (VR). These VR animations allow us to interactively view the model outputs and observe how each combination of LCL and low-level shear modulate where surface circulation will be in relation to the mesocyclone. The results indicate that when the combination of low-level wind profiles and LCL favor the overlap of near-surface rotation and the mesocyclone, vertical vorticity is enhanced indicating the potential importance of this alignment and tornadogenesis.

50. Thermally Forced Gravity Wave Solutions over the Amazon Using Realistic Background States

Angela O'Flanagan (St. Cloud State University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Craig Epifanio, Courtney Schumacher

Heavy precipitation occurs over the Amazon basin but is disconnected from coastal convection. Observed wind profiles across the Amazon also resemble a theoretical gravity wave structure forced by an idealized background state and diurnal heating. The hypothesis of this work is that gravity waves forced by heating at the coast could impact the inland convection. In this study, wave responses are simulated in a simple 2-D model forced by ERA5 background flow. ERA5 shows a nocturnal low-level jet whose inland extension is maximized during March, April, and May. This jet acts as part of the realistic background flow for the model. Additionally, an oscillating heat source is needed to force the model. ERA5 boundary layer heating flux acts as realistic diurnal heating at the coast, giving the required forcing component. The 2-D linear and nonlinear model is forced by the realistic background state and diurnal heating at the coast. The resulting steady state wave response will be analyzed and compared to the output of simple theoretical solutions. The thermally forced wave solutions are expected to show evidence of the low-level jet and stability changes related to the timing of convection in the central Amazon.

51. Diurnal Variability in Tornadogenesis and Forecasting in Tropical Cyclones

Brian Filipiak (University of Rochester)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Chris Nowotarski

Landfalling tropical cyclones generate many hazards like storm surge, wind damage, heavy rainfall totals, potential for flash flooding, and tornadoes. Forecasting these multiple events is problematic as forecasters are unable to focus on just one type of hazard. Given this and less clarity in the environmental parameters and radar attributes of the cells that produce them, there is often a high false alarm rate for tornado warnings within tropical cyclones. To improve the ability to forecast tornadoes in these unique conditions, understanding the relative location and timing of tornadic events is key. Additionally, identifying differences in the near-storm environmental conditions associated with tornadic and nontornadic cells and their spatial and temporal variability is expected to yield more accurate forecasts. Using storm report and radar data, cells were identified as tornadic or non-tornadic, and tornadoes were identified as warned or non-warned for all landfalling US tropical cyclones in the 2018 season. Soundings of the near-storm environments for each cell were gathered from Rapid Refresh (RAP) numerical model analyses, from which relevant convective parameters were calculated and compared. This analysis shows there is a clear diurnal cycle in tropical cyclone tornadoes, as there is a peak in tornado frequency in the late afternoon. Results will be presented investigating how changes in the near-storm environment contribute to the diurnal cycle in tornadoes. Finally, variability in forecasting skill scores (both spatially and temporally) relative to the diurnal cycle and tropical cyclone position are examined.

52. An Analysis of Lightning Characteristics During Hurricane Harvey

Claire Onak (Lake Superior State University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Renyi Zhang, Timothy Logan

Hurricane Harvey made landfall near Corpus Christi, Texas, producing heavy precipitation near Houston, which hosts one of the largest petrochemical complexes in the world. The concentration of particulate matter in this region frequently exceeds the annual average of the National Ambient Air Quality Standards due to emissions from the Houston industrial area. Numerical model simulations and ground-based measurements show that anthropogenic aerosols invigorate convection and enhance lightning near Houston. Understanding the influence of anthropogenic aerosols on tropical cyclones is necessary to accurately predict future storms to minimize destruction in the industrialized Gulf region. Measurable quantities used to evaluate the effects of aerosols on convective systems include precipitation, radar reflectivity, and lightning. Lightning production is directly relevant to convection strength and the abundance of co-existing liquid and ice hydrometeors. This study is aimed to characterize lightning during Harvey and evaluate how industrial aerosols likely contribute to increased lightning activity and storm intensity. Ground and satellite-based measurements were analyzed to determine the horizontal and vertical extent of lightning. Measurements by the Houston Lightning Mapping Array and National Lightning Detection Network were used to determine the maximum horizontal dimensions of individual lightning flashes using the LMA display software, XLMA. The HLMA and NLDN data, in addition to satellite measurements from the Geostationary Lightning Mapper were used to generate a ten-year climatology in the Houston area to compare with the lightning events during Harvey. This presentation will focus on the analysis of lightning flash dimensions and climatology during this event.

53. Assessing Shallow Meridional Circulations over the East Atlantic and West African Monsoonal Regions Using Reanalyses

Erin Buttitta (Texas A&M University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Courtney Schumacher

Reanalyses show large discrepancies between each other, especially in regions with shallow meridional circulations such as the East Pacific, East Atlantic, and West African monsoon. Additionally, the mechanisms of the shallow meridional circulation in the East Pacific ITCZ are not the same as the East Atlantic and West African regions. This study aims to assess the vertical structure of both the East Atlantic ITCZ and West African monsoonal meridional circulations. This study uses reanalyses MERRA-2, ERA-Interim, ERA-5, and JRA-55 to plot maps at different pressure-levels and vertical cross-sections of the zonal winds, meridional winds, and vertical velocity values for each season. These are used to analyze the shallow meridional circulations (SMCs) in the East Atlantic oceanic and West African regions. Preliminary results from reanalyses MERRA-2 and ERA-Interim suggest a distinct SMC seasonality. The East Atlantic SMC located in the northern part of the ITCZ is stronger during the spring season (MAM), and the low-level return flow at 700 hPa may be associated with the southerly component of the anticyclonic circulation over West Africa (the Saharan high). There is also a moderate meridional sea surface temperature (SST) gradient north of the ITCZ in the East Atlantic during the MAM, which could modulate surface pressure gradient and shallow convection over this region.

54. Trajectory Analysis of Air Parcels Injected Into the Lower Stratosphere with Regards to Ongoing Convective Activity

Grant Farmer (College of Charleston)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Kenneth Bowman

The Dynamics and Chemistry of the Summer Stratosphere (DCOTSS) project will fly the NASA ER-2 aircraft to make in situ observations of air injected into the lower stratosphere by overshooting convective storms. The DCOTSS project serves to examine the composition of the stratosphere as it pertains to our changing climate. Generally, this injected air tends to follow upper-level atmospheric flow patterns, which can place it in the nearby vicinity of ongoing and developing convection. The presence of nearby convection is dangerous for DCOTSS flights because the aircraft used for data collection are unable to handle the resulting turbulence. Understanding how the trajectories of lower stratospheric air parcels overlap with ongoing and future convection is important for project flight patterns, procedures, and safety. Plotting particle trajectories alongside radar overlays can allow for project members to see where unsafe flight conditions might be present. Data and figures used in this presentation are taken from June 2019, and similar methodology can be applied to any other time period where sufficient data is present. Plotting trajectories in this manner is beneficial because it will save time and money when planning reconnaissance flights for the DCOTSS project.

55. The Quasi-Biennial Oscillation's Effect on Lightning in the Tropics

Lily Houston (University of Georgia)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Courtney Schumacher

The Quasi-Biennial Oscillation (QBO) is a 24 to 36-month oscillation of the zonal wind in the stratosphere, typically between 50 and 70 hPa. In the east phase, the tropopause is higher and colder at the equator and 200-50 hPa wind shear decreases, with opposite conditions in the west phase. This study will look at how these environmental variations during the QBO affect lightning in the tropics. Monthly, 2.5 degree lightning data is obtained from the Lightning Imaging Sensor (LIS) onboard the Tropical Rainfall Measuring Mission (TRMM) satellite from 1998 to 2013. Environmental parameters are obtained or derived from monthly European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis Interim (ERA-Interim) and regridded to match the spatial resolution of the LIS data. In addition to the 16-year annual averages, this study looks at seasonal variations of 200-50 hPa wind shear and tropopause temperatures by QBO phase to evaluate their potential influence on lightning during different seasons. The highest correlation between flash rates and shear is located in southern Brazil (R= -0.696) in boreal summer, indicating that as shear increases, lightning decreases, as expected. The highest correlation between tropopause temperature and flash rates is in India (R= -0.810) in boreal summer, indicating that there is an inverse relationship between lightning and tropopause temperature, also as expected. These preliminary results support the hypothesis that lightning is enhanced in the east phase and suppressed in the west phase along the equator, and provide further insight on lightning production and convection in the tropics.

56. An Analysis of the Dynamical Mechanisms that Lead to Intensity Changes of Hurricanes in the Atlantic Hurricane Basin and their Association with ENSO

Matt DeMaria (University of Oklahoma)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Ramalingam Saravanan

El Niño Southern Oscillation (ENSO) has been shown to have a large impact on both the strength and the quantity of tropical storms in the Atlantic Hurricane Basin. During the El Niño phase of ENSO, enhanced convection in the Equatorial Eastern Pacific leads to more upper tropospheric outflow that moves against the tropical easterlies in the Caribbean and Northern Atlantic Ocean to create more vertical wind shear and decrease the statistical probability of hurricane development. Vertical wind shear is considered to be one of the most important indicators of how the intensity of a tropical system will change over time. By using reanalysis data to model the vertical profile of Hurricane Igor and Danny, which occurred in years at opposite ends of the ENSO cycle, I can look to analyze whether vertical wind shear played a large role in intensity changes of these tropical systems. An analysis of other variables like mid-tropospheric moisture, sea surface temperature, and relative vorticity will also be carried out to examine whether these may have also caused intensity changes in the tropical systems.

57. The Phasedown of Hydrofluorocarbons from the Cooling Sector

Miranda Bitting (University of Delaware)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Yangyang Xu

A critical, but less known, contributor to the climate change problem is the usage of hydrofluorocarbons (HFCs), coolants widely used in air conditioning and refrigeration. The goal of this study is to explore the HFC issue from all sides—including chemical properties, atmospheric lifespan, global warming potential (GWP), current emissions, feasible alternatives, and mitigation efforts in the policy arena. HFCs were introduced after the Montreal Protocol was passed as a replacement for ozone-depleting CFCs and HCFCs, but they've had unintended environmental consequences. Although their atmospheric lifetimes are relatively short (decaying within 10-100 years), they have very high GWPs and thus greatly enhance the greenhouse effect. With the growing demand for residential cooling and increased access to air conditioning in developing countries, atmospheric HFC concentrations are expected to increase staggeringly if left unchecked. Emissions scenarios paint a bleak picture: baseline projections suggest up to 0.5°C of warming this century from HFCs alone, destroying any other efforts to limit global warming under 1.5ºC as called by Paris Agreement. The Kigali Amendment to the Montreal Protocol was designed to add HFCs to the list of substances to be phased out. Most countries have ratified the amendment, but the US hasn't. Despite resistance from the US federal government, states and private companies have rolled out their own phase-out policies. Now more than ever, it is of grave importance that countries work together to address the HFC issue, just as they came together 30 years ago to successfully deal with ozone hole threat.

58. A Year of Passive Hydrocarbon Monitoring Next to an Eagle Ford Well Site

Olivia Sablan (Carroll College)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Gunnar Schade

The recent boom in unconventional oil and gas development in the Texas Eagle Ford shale area has led to an increase in hydrocarbons in the atmosphere. Emissions from production sites include hazardous air pollutants, such as benzene, which is a known carcinogen. Since such pollutants are a potential threat to health and the environment at a local and regional level, it is important to look at near-site exposure levels, and how weather plays a role in the dispersion of hydrocarbons from their source in order to assess the emission's effects on surrounding areas. For this purpose, we set up passive hydrocarbon sampling devices (Radiello samplers) to monitor exposure on a private property in the far eastern Eagle Ford from the emissions of an adjacent oil and gas production site with an occasional flare. Selected hydrocarbons were analyzed using thermal desorption and gas chromatography with flame ionization detection. Hydrocarbon data was analyzed in conjunction with local weather data from a regional station to identify trends. Changes in temperature, wind speed, and percentage of wind traveling over the site toward the monitor were taken into account. We discovered that changes in benzene levels were correlated with changes in season. Considering the oil and gas site is situated north of the private property being monitored, this trend is likely because there is a shift during winter from a majority of southerly winds to northerly winds.

59. Rainfall Characteristics of Warm Season Mesoscale Convective Systems in Southeast Texas

Rachel Eldridge (Texas A&M University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Don Conlee

This research examines several mesoscale convective systems (MCS) during the months of May and June of 2019. The primary instrument used to characterize rainfall is the OTT Parsivel 2 optical disdrometer, which uses a laser emitter and receiver to detect falling objects that attenuate the lasers signal. The duration and magnitude of this attenuation gives the disdrometer enough information to determine the drop sizes, drop velocities, rain rate, and other characteristics of the precipitation. NASA strategically places these disdrometers to use them for calibration and validation of space-borne precipitation sensors and has recently provided one to Texas A&M Atmospheric Sciences. The initial goal of this research was to develop local tools to effectively manipulate the raw data files from the disdrometer so comparisons and analyses can be made to better understand drop size distributions. This enabled a comparison of rainfall characteristics between four recent local MCS events, both against each other and previously-observed systems by disdrometers in the literature in other locations.

60. Identifying the Abundance and Composition of Bacterial and Archaeal Communities in Transitioning, Active, and Inactive Hydrothermal Vents at 9° 50' N East Pacific Rise (EPR)

Victoria Deery (Texas A&M University)
Observing the Ocean REU
Research Advisor(s): Jason Sylvan

Hydrothermal vents form when geothermal conditions chemically modify cold seawater entrained in oceanic crust, injecting hot toxic fluid that is rich in reduced chemical species into the ocean. Chemosynthetic microorganisms convert captured energy from these chemical species into biomass, forming the foundation of complex food webs at deep-sea vent systems. To understand the factors shaping microbial communities at vents and their influence on ocean chemistry, it is critical to identify taxa and abundance of microbes present. A gap in current vent knowledge is understanding how microbial communities and geochemical conditions change as venting ceases. This is because it is hard to predict and be present for the cessation of venting in the deep sea. This project will determine what happens to vent-associated microbial composition and abundance when chimneys initially cease venting by analyzing samples of hot active and cool inactive vents processed immediately and after 1-3 weeks of exposure to the cold seafloor away from venting; modeling an abrupt vent shutoff or blockage. Community DNA was extracted from these samples before amplification and sequencing of the 16S rRNA gene by polymerase chain reaction (PCR) to determine the prokaryotic community composition. Microbial abundance was determined using epifluoresent microscopy cell counts. Initial attempts at PCR indicated potential inhibition by PCR inhibitors present in the vent chimney samples, troubleshooting is underway. I present here results from cell counts for active and inactive chimneys. These results will lay the foundation for our understanding of what happens to microbial communities immediately after venting ceases.

61. Natural and Toxic Dissolved Metals in Galveston Bay and the Surrounding Gulf of Mexico

Brett Farran (Florida State University)
Observing the Ocean REU
Research Advisor(s): Jessica Fitzsimmons

Galveston Bay is an anthropogenic estuary where human-impacted freshwaters mix with saltwater from the Gulf of Mexico. The greater Houston area houses a third of the petrochemical industry in the U.S., serving as a significant potential source of toxic metals to the Bay (such as lead), while two rivers also carry natural sources of metals (e.g. iron and copper) into the Bay. In the Bay estuary, some metals serve as essential micronutrients for biota, while other metals act as neurotoxins that could endanger the valuable fisheries within the Bay. Thus, the distribution of each metal varies uniquely as a result of its own anthropogenic/natural sources, and each interacts with the natural ecosystem (salinity gradient, sediments, and ecosystem) of Galveston Bay in different ways. To tease apart these sources and sinks, we created a dissolved metal time series over nine research cruises in Galveston Bay, across eight sampling stations. We show that different natural river fluxes, disasters like hurricanes and chemical spills, and regional anthropogenic sources have metal-specific impacts on the distribution and concentration of metals in the Bay over time. The Gulf of Mexico also interacts directly with Galveston Bay freshwaters. Thus, we also measured the same suite of metals in samples from three cruises in Gulf of Mexico waters surrounding Galveston Bay. We show that some metals in the Gulf of Mexico appear to be freshwater sourced, but by comparison to Galveston Bay concentrations we can distinguish which stations are influenced by Galveston Bay vs. other riverine sources.

62. Using Drone Image Tracing to Estimate Surface Flows

Carlos Abarca (Pennsylvania State University)
Observing the Ocean REU
Research Advisor(s): Robert Hetland

The overall goal of this project is to develop and test methods for estimating small scale circulation patterns in the coastal ocean using drone video and expendable floats; we will use particle image velocimetry (PIV) techniques to measure the surface velocity field. The specific objective is to test this method using a Mavic 2 Pro drone. The first goal will be to test fly the drone while also capturing clear and concise images. Image quality is extremely important for accurate PIV tracing so we will need to consider several factors: distortion, steadiness of drone flight, and the size of an object are the most important image qualities that will be tested. Distortion can be tested by using a checkerboard pattern and analyzed on Matlab. Steadiness of flights can be tested using stationary objects as "beacons." These beacons will remain in the frame at all times maintaining our image. The size of the object will determine the height at which we are able to film. Ground Sample Distance is a useful parameter that can tell us the pixel size based on flight height, image size, sensor size, and focal length. With calculated image quality, we can begin to use PIV analysis to measure flow in captured video.

63. Understanding the Distribution of PFAS in Galveston Bay and the Gulf of Mexico and Their Effect on Fish Tissues

Jill Coughlin (Pace University)
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Research Advisor(s): Yina Liu

Per- and polyfluoroalkyl substances (PFAS) have gained increased attention from scientists, environmental regulators, and the general public, due to their emergence as a new contaminant in water and wildlife. PFAS are a diverse group of compounds. PFAS are present in nonstick cookware, food packaging, firefighting foam, etc. PFAS are not metabolized by mammals which allows some of the higher molecular weight compounds to bioaccumulate in humans and other mammals. Consumption of fish and drinking water are major avenues for human contact with PFAS. PFAS can accumulate in bodies of water because of pollution or events of run off. The local Houston area has recently been subjected to two major events, Hurricane Harvey and the Deer Park Intercontinental Terminals Company (ITC) fire. To extinguish the ITC fire, firefighting foam potentially containing PFAS was used. These events could change the PFAS distribution in Galveston Bay due to run-off. The objective of this research study is to understand the distributions of PFAS in Galveston Bay and compare their concentrations with that observed in the Gulf of Mexico. The speciation of PFAS in fish and water will be compared to understand preferential partitioning of these compounds to fish tissues. It is expected that with the completion of this study that we will have an understanding of a trend the distribution of PFAS in Galveston Bay and whether these compounds have transported to open ocean from coastal environments. Additionally, we will have a better understanding in possible partitioning of PFAS to fish tissue.

64. Effect of Turbulence Generated by Upwelling on Diatom Chain Length

Kate Johnson (University of Colorado)
Observing the Ocean REU
Research Advisor(s): Lisa Campbell

Diatoms are a major component of coastal phytoplankton communities. These non-motile microalgae are encased in a silica cell wall, and some diatom species form chains of cells. However, the factors that determine chain length are not well-understood. One hypothesis is that increased nutrient availability created by turbulence associated with upwelling supports growth of diatoms, and consequently increases chain length. The objective of this research was to examine the species-specific response to upwelling in three diatoms: Asterionellopsis, Skeletonema, and Pseudo-nitzschia. Pseudo-nitzschia is of particular interest because half of the species in this genus can produce the neurotoxin domoic acid. The effect of upwelling on chain length was examined in a 10-year phytoplankton time series recorded by an Imaging FlowCytobot stationed off the coast of Port Aransas, Texas. Machine-learning algorithms were used to classify images and determine the chain length in each of the three diatoms. We identified upwelling periods using the Texas Automated Buoy System (TABS) wind and water temperature data. Preliminary results showed that Asterionellopsis chain length tended to decrease, Skeletonema chain length tended to increase, and Pseudo-nitzschia chain length tended to vary during upwelling events. A possible reason for these results is the difference in connective material between the three diatoms. Skeletonema have strong siliceous links between cells, while both Asterionellopsis and Pseudo-nitzschia connect using weaker mucus pads. This difference in connector strength could explain the difference in chain length in the face of turbulence generated by upwelling.

65. Comparing the Structure of the Water Column on the Texas-Louisiana Continental Shelf During the Summers of 2016-2019

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Research Advisor(s): Steven DiMarco

Physical and chemical observations were performed on the water column over the inner Texas-Louisiana continental shelf during the summers of 2016-2019 aboard the R/V Pelican. These observations include conductivity, temperature, density, dissolved oxygen, CDOM (Colored Dissolved Organic Matter) fluorescence, and chlorophyll fluorescence. Observation stations were visited along the cruise track from Galveston Bay towards the Flower Garden Banks for 2016. For 2017-2019, a triangular track connecting Galveston Bay, the Flower Garden Banks, and Terrabonne Bay was followed. Station spacing along the cruise track was about 25km. Warmer and fresher surface waters were present in 2016 and 2019, with 2017 and 2019 having warmer water throughout the column. The coldest and saltiest surface waters occurred in 2017. Hypoxic conditions (dissolved oxygen < 1.4 mL/L) were observed in bottom waters for the years 2016, 2018, and 2019. These conditions coincided with a sharp water column pycnocline, which indicated high stratification that inhibits oxygen ventilation to bottom waters. This stratification persists due to low wind speeds and the presence of fresh surface waters. The absence of hypoxia in bottom waters in 2017 coincided with well mixed waters due to higher wind speed events, promoting oxygen ventilation. A towed instrument was able to observe the presence of two interacting water masses in shallow waters (7-14 m) that was overlaying a dense hypoxia structure. The results of this project reinforce the importance of high stratification on the development of hypoxic conditions in the Texas-Louisiana continental shelf.

66. Visualizing the Hidden World: Utilizing CARD-FISH to Detect Microbes Exposed to Oil

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Research Advisor(s): Jason Sylvan, Amanda Achberger

The Deepwater Horizon Oil Spill of 2010 released more than four million barrels of oil into the Gulf of Mexico, wreaking havoc in the water column and surrounding shorelines. Although several methods, including application of detergents, were used to clean up the oil spill, marine microbes played a huge role in ridding the waters of oil. Microbes are capable of using hydrocarbons as a source of energy, thus, there is considerable interest in understanding what microbes degrade oil, what pathways they use, and what possibilities that knowledge may offer for bioremediation of future spills. This study takes a microscopic look at how two hydrocarbon-degrading genera of microbes, Alteromonas and Alcanivorax, aggregate in the presence of oil. We used Catalyzed Reporter Deposition-Fluorescent in Situ Hybridization (CARD-FISH) to analyze microbial aggregation in three treatments: surface seawater (Control), water accommodated fraction of oil (WAF), and diluted chemically enhanced water accommodated fraction of oil (DCEWAF). After testing several concentrations of formamide for hybridization, CARD-FISH probe fluorescence was brightest at 40% and 55% formamide concentrations for Alteromonas and Alcanivorax, respectively. We hypothesized that there will be higher amounts of aggregates compared to single cells in oil treatments vs untreated seawater. Preliminary results indicate that CARD-FISH is a dependable way of visualizing microbial aggregate behavior. Alteromonas samples showed a higher presence of aggregates in oil treatments. A similar trend is expected for Alcanivorax. This study may lead to implications for further research in understanding the different genera that are able to degrade specific hydrocarbons.

67. Differences in Chromophoric Dissolved Organic Matter (CDOM) Inputs from the Trinity and San Jacinto Rivers into Galveston Bay

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Research Advisor(s): Gerardo Gold-Bouchot

Chromophoric dissolved organic matter (CDOM) is the optically active fraction of dissolved organic matter that is present in oceans, rivers and estuaries. It is derived from the decomposition of detritus, organisms, and other organic material. The two major freshwater inputs into Galveston Bay are the Trinity and San Jacinto rivers, with the Trinity providing roughly 70% of the input. The San Jacinto river flows through the Houston metropolitan area and the Trinity river passes through agricultural and forest environments. Given the distinct pathways of the two rivers, we hypothesized that CDOM inputs from the two rivers will be different. CDOM was determined in samples collected in March and June 2019 from 20 stations in the bay, and two additional freshwater sites in the rivers, to allow for determination of CDOM before it enters the bay. Fluorescence and absorbance spectra were measured with an Aqualog spectrofluorometer, and Coble's peaks were measured to estimate the composition of CDOM. Higher protein-like peaks possibly associated with organic matter from wastewater treatment plants were observed in the San Jacinto river. A higher absorption coefficient at 350 nm and a lower spectral slope were observed in the San Jacinto, indicating that the concentration, molecular weight and aromaticity of CDOM differ between the two rivers. The observed differences are due to the distinct pathways of the rivers, both of which are influenced by anthropogenic activities such as agricultural and industrial runoff, and wastewater treatment plant discharge.

68. Nitrous Oxide on the Texas-Louisiana Continental Shelf

Melissa Shugart (University of South Carolina)
Observing the Ocean REU
Research Advisor(s): Shari Yvon-Lewis

Nitrous oxide (N2O) is a potent greenhouse gas present in trace quantities in the Earth's atmosphere. N2O has a warming potential approximately 300x that of carbon dioxide, and it is the primary source of atmospheric nitrogen oxides, which can deplete the stratospheric ozone layer. The oceans are one natural source of N2O to the atmosphere as N2O can be produced during the bacterial processes of nitrification, which occurs under oxygenated conditions, and denitrification, which occurs under poorly oxygenated conditions. More N2O is produced during denitrification. The Texas-Louisiana shelf, located in the northern Gulf of Mexico, has seasonal occurrences of hypoxia associated with high N2O concentrations. The goal of this project is to determine the concentrations of N2O in the water column at various locations and depths along the Texas-Louisiana shelf as an extension of a summer time series. Samples were collected at various locations and depths in the northern Gulf of Mexico during June 2018 and July 2019 and analyzed using gas chromatography with electron capture detection. In 2018, N2O concentrations ranged from 5 to 9 nM, and one of of the 10 stations sampled was hypoxic. There was no significant difference in N2O concentrations between the hypoxic station and the non-hypoxic stations. In 2019, 14 stations were sampled between July 4 and July 7, five of which were hypoxic. N2O concentrations ranged between 1 and 7 nM and were generally lower than those observed in 2018.

69. Hydroclimate Variability in the Yucatán Peninsula Over the Past 7000 Years

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Seasonal rainfall variability in Mexico's Yucatán peninsula is predominantly regulated by the latitudinal position of the Intertropical Convergence Zone (ITCZ), a low latitude band of atmospheric convection that undergoes seasonal shifts towards the poles of the warmer hemisphere. Given the dearth of ground fed aquifers in the region, local fresh water availability is heavily dependent on precipitation. Global warming models in the northern hemisphere suggest an increase in precipitation variability over the Yucatán in the coming century despite a more northerly displaced ITCZ. However, the understanding of the relationship between ITCZ position and Yucatán rainfall on longer timescales is limited by the brief (~160 years) observational record. Sediments preserved within cenotes, sinkholes, and blue holes provide an excellent archive of environmental change, allowing us to reconstruct thousands of years of past climate variability via transitions between sediment type, grain size, or elemental composition. Sediment cores collected from Pac Chen sinkhole located in the Yucatán Peninsula provide a sub-decadal record of hydroclimate variability over the past 7000 years. Through the use of grain size analysis, radiocarbon dating, and X-ray fluorescence we have developed a record of rainfall and drought that indicates increased precipitation during the Holocene climate optimum when the ITCZ was in a more northerly position, but also shows regional rainfall variability independent of ITCZ location. With this record, we are able to better understand past climate shifts, draw conclusions about present drought/rainfall patterns, and infer future scenarios which can help mitigate risks posed by droughts or floods to vulnerable communities.

70. Invasive Species and Ballast Water Technology

Steven Lopez (Texas A&M University at Galveston)
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Research Advisor(s): Joan Mileski

Ballast water helps cargo ships maintain buoyancy throughout their voyage by taking in water into the hull of the ship and then discharging the water once the ship completes its trip. This can pose a major threat in spreading invasive species. These species are a group of organisms that are introduced to a nonnative habitat. They can cause widespread destruction throughout the habitat, which includes damaging ecological niches, food webs, and extinction of native species. The International Maritime Organization (IMO) released a convention in 2004, setting regulations and standards that countries must follow to combat invasive species. The standards include treated ballast water. Many ballast water treatment methods are available and comply with the standard. I reviewed the pros and cons of various ballast water technology using a rubric which includes cost, effectiveness against killing microorganisms and rate of adoption. Electrolytic chlorine regeneration has been found to be a promising technology, but is not widely used. Further analysis is required to determine why this safe and cost-effective method for treating ballast water has not been readily adopted in commercial ships.

71. Abundance and Distribution of Natural Organochlorine Compounds in Seawater

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Research Advisor(s): Karl Kaiser

The processes driving the formation of refractory dissolved organic carbon (rDOC) within the ocean are largely unknown. Chlorination of organic molecules can inhibit microbial oxidation effectively preserving organic carbon in the ocean. Plant decomposition and atmospheric deposition produce terrestrial organochlorine compounds, but little is known about the production of marine organochlorine compounds. An investigation into the concentrations and distribution of chlorinated organic compounds and the processes that are involved in the production and removal of these compounds in marine environments will further understanding of rDOC cycling within the ocean. Six organochlorine compounds were identified in marine dissolved organic matter and potential relationships between the concentrations of these compounds and several ocean parameters (ie. temperature, salinity, dissolved organic carbon concentration, etc.) will be analyzed. In addition, photochemical experiments were conducted to investigate production and removal processes. Generating and analyzing the global distribution of chlorinated organic compounds with continued investigation into their response to photochemical reactions will resolve fundamental mechanisms of dissolved organic matter cycling in the ocean.

72. Connecting the Dots Between Marketing and Port Development Characteristics: a Multi-Case Content Analysis of U.S. Major Ports

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Maritime transportation corresponds to nearly 90% of the tonnage and 80% of the value traded internationally. Despite this huge economic impact, the maritime sector is often not visible to the general public, which can become a problem when additional resources are needed for port development. This research aims to identify the main elements of port development and analyze whether they are integrated into port marketing strategies. We focused on the top ten U.S. public ports managed by port authorities ranked by total volume throughput. Through a multi-case study, we applied content analysis on the public and audited information for each port to understand the port's developmental goals. Data was collected from publicly available information (i.e. financial reports, economic impact studies, and master strategic plans) released by port authorities. Additional information regarding organizational structure and mission and vision statements were also collected. With the support of the general marketing principles and specific port development literature, we analyzed and compared the ten cases. Results indicate two main trends. Firstly, ports' master plans are dominated by expansion projects, focusing on capacity increase, including deepening of channels. Secondly, ports focus their marketing efforts in the value proposition by the type of service they can offer and less on price, promotion, or place. These results are considered consistent with the literature. However, further research is recommended on two main fronts: to enlarge the sample of ports and time period and to capture the port users' perspective of the effectiveness of these strategies.

73. Changes in Feeding Preferences of Littoraria irrorata in Response to Mangrove Encroachment

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Climate change is altering vegetation distribution in ecosystems around the world. The decreased frequency of extreme cold events has contributed to the expansion of black mangroves (Avicennia germinans) into coastal wetlands along the Gulf Coast of Texas. The effects of this expansion on salt marsh food webs has not been thoroughly explored. In this experiment, we explored whether the marsh periwinkle snail (Littoraria irrorata), a common saltmarsh herbivore, exhibits a feeding preference for leaves from salt marsh cordgrass (Spartina alterniflora) or black mangroves. Littoraria are generally considered as Spartina specialist, so we hypothesized that they will preferentially feed on Spartina leaves. In order to access herbivory patterns on the types of leaves that the snails commonly interact with, two trials were conducted: one comparing snail herbivory between live mangrove to live cordgrass and one comparing detrital mangrove to live cordgrass. The leaves were photographed and weighed before and after approximately two weeks of grazing by snails. The leaf area was then measured in the program Image J to determine the area lost due to snail herbivory. When presented with live Spartina leaves and live Avicennia, the snails showed a preference towards Spartina, consuming over 25% more of the leaf area. When presented with live Spartina and detrital Avicennia, the snails showed no preference, consuming approximately 8% of the leaf area in both species. Understanding how basal consumers, like Littoraria, are affected by mangrove encroachment may help us understand potential bottom-up effects that influence the ecosystem as a whole.

74. Housing the Community or Tourists: Processes of Gentrification in Galveston Post Hurricane Ike

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Research Advisor(s): Jenna Lamphere

Community development is a multidimensional process in coastal communities, one of those dimensions often involves fostering a tourist industry alongside the residential community. Galveston, Texas has been struggling with this issue post-Hurricane Ike in 2008. We focus on the redevelopment of affordable and public housing, which has yet to be holistically addressed. The lack of affordable housing has initiated strife amidst the community and led to an increasingly gentrified island. We propose three driving forces of gentrification in Galveston: gentrification by natural disaster, historic preservation, and growth of the short-term rental market. We have conducted ten hours of fieldwork, twenty interviews, and collected 1,023 newspaper articles and census data. We analyzed our fieldnotes, interview transcripts, articles, and statistics to identify patterns and relationships. Our preliminary findings indicate that all public housing was destroyed after Ike and reconstruction has been slowed due to negative public attitudes. This began the gentrification of the island and two factors enabled it further. First, historic landmarks increasing home values, making the housing market unaffordable. We note, however, a local preservation organization is taking action to help the issue and not be an obstacle. Second, the growth of short-term rentals has cut into the long-term rental market as well as encouraged a more tourist-driven community causing a problematic environment for residents, especially the low-income population. There is not a holistic approach being taken to combat gentrification in Galveston leading to the transformation from a community environment to a less diverse and inclusive tourist destination.

75. Save the Sea Turtles, Save the World: Marine Plastic Pollution and Policy Solutions

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The dilemma of marine plastic pollution is a global issue that affects the Earth's oceans and marine life. This research examines the notion that enduring resolutions are done by a series of small things brought together. It is imperative to investigate policies and efforts as a method to formulate a database of prevailing exertions. Solutions to problems are discovered through comprehensive investigation of policies and efforts as a method to identify successful trends. However, there is no database available like this one that compiles the current pollution prevention efforts worldwide from social media through government strategies, business ingenuities, and academic research. It's contended that something trivial as a social media hashtag can be a catalyst towards large-scale impact. Data results from social media were compiled from January 2018 to July 2019. The results collected were filtered into a database, which utilized categories to segregate findings globally, nationally and commercially. The contemplations of results were considered to combat the methodology limitation related to duplicates, redundancies and inconsistencies in search results. As hashtag consumption continues, the data will need to be compiled and stored for future preservation actions as a way to evaluate the overall health of the ocean and measure active global agendas to combat marine plastic pollution. The hashtag results showed 27 countries and 24 businesses having active legislation or enacted policies and initiatives to combat marine plastic pollution. The data collected affirmed the notion that something as small as a social media hashtag can cause significant impact.

76. Impacts of Photo-oxidized Dispersed Oil on *Phaeodactyum tricornutum*

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The Deepwater Horizon oil spill spilled 130 million gallons of oil into the Gulf of Mexico. This was followed by application of 1.4 million gallons of chemical dispersants in an effort to disperse the oil into the water column and promote the biodegradation of oil. Photooxidation of oil is a natural process that causes oxygenation of an oil slick. Although the toxicity of oil on phytoplankton has been extensively studied, the effects of photo-oxidized oil, especially in combination with dispersants is virtually unknown. Phytoplankton vary in their sensitivities to oil and dispersant exposure. Here, we studied the effects of photo-oxidized oil in the presence of dispersants on the growth and photo-physiology of oil and dispersant resistant pennate diatom Phaeodactylum tricornatum. We exposed P. tricornatum to two different dilutions of dispersed oil and dispersed photo-oxidized oil and monitored their growth rates and photo-physiological parameters such as photosynthetic efficiency (Fv/Fm), electron transport rates between photosystem II and I (rETRmax), and light harvesting ability (α). Growth rates were unaffected when exposed to dispersed oil and dispersed photo-oxidized oil. Analysis of various photo-physiological parameters revealed no significant differences between any treatments, except for lower rETRmax values in photo-oxidized dispersed oil treatment on the very first day of exposure. Further research are underway to determine the mechanisms behind the resistant nature of P. tricornatum.

77. The Forthcoming Economic Recession: Business Survivability Assessment and Strategies

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Research Advisor(s): Mazen Brho

The economic cycle appears to approach the peak. The International Monetary Fund predicts a slow worldwide economic growth; inflation and interest rates are rising rapidly; and the trade battles between the two largest economies, U.S. and China, signal more financial turmoil to occur. As a result, economists are upending the 2018 optimism, predicting a potential economic crisis on the horizon. Whether the downturn is imminent or in a few years, the question is how well are business prepared and what are the possible survivability strategies to prevent bankruptcy? To assess business survivability and demonstrate potential strategies, this research paper conducts a multiple discriminant insolvency analysis and a market sensitivity analysis on publicly traded transportation forms listed on the U.S. exchange markets. The research focus on transportation domain is due to its prominent function that promotes survivability of multi-industry chain. Additionally, this research paper will provide several business strategies for industry practitioners to assess the current financial position; enhance the financial resiliency and hedge the possibility of default risk.

78. Placement of Dry Ports to Enhance Utilization of Port Capacity

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Research Advisor(s): Jenna Lamphere, Joan Mileski

The Port of Houston moves the greatest amount of cargo in and out of the country. The Barbours Cut and Bay port Container Terminals have the capacity to handle approximately 4.3 TEU yet in 2017 the total number of twenty-foot equivalency units (TEUs) handled was 2.4 million. By building dry ports accessible for established distribution centers, building future distribution centers proximal to the Port of Houston and co-opting community and political interests to influence transportation policy and law maximizes profits for port industries and alleviates congestion downtown. According to Pfeffer and Salanik's Resource Dependence open-systems perspective businesses should build distribution centers closer to the Port of Houston where they accumulate their resources. Distribution centers located in Northwest Houston require truck drivers to travel through downtown to reach their destinations causing increased travel times for cargo to be transported. Analysis of dry ports in Phoenix, AZ and Salt Lake City, UT, determine the city of Houston would benefit from building a dry port in the North or West compelling truck drivers to use beltway 8 opposed to main downtown roads. Coopting politicians and transportation leaders to the Port of Houston commission would maximize the utilization of infrastructure and support of dry ports.

79. Examining Growth of the First Two Years of Life between Elasmobranch Species

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Research Advisor(s): David Wells, John Mohan

Relatively little is known about the early life histories of many elasmobranch species. Most shark species are known to deposit a band pair in their vertebrae with predictable periodicity, which can thus be used to determine age and growth rates. The bands within the first two years of a shark's life takes up a large portion of the vertebrae, but the significance of this remains unstudied and could yield valuable insight as to their early biology. If there is a difference between the rate of growth in the first 1-2 years of a shark's life and the species of shark, it is predicted that the bull shark Carcharhinus leucas will experience the most growth. Five shark species from the Gulf of Mexico were used in this study; spinner Carcharhinus brevipinna (n=10), bull C. leucas (n=10), blacktip Carcharhinus limbatus (n=12), shortfin mako Isurus oxyrinchus (n=9), and bonnethead Sphyrna tiburo (n=12), for a total of 53 samples. The band-pairs of these samples were counted separately by four independent readers to ensure accuracy, with an average percent error of 13%. The distance of vertebrae material deposited from the birth band to year 1 and year 2 was then measured and compared among species. It was determined that C. brevipinna, I. oxyrinchus, and C. limbatus displayed the most growth within the first and second bands, with S. tiburo growing the least by the first band and C. leucas displaying the least growth by the second band. Though the hypothesis was not supported, the differences in growth can be attributed to the different rearing conditions and environments of each pup, which attests to the diverse conditions needed to support multiple life history strategies of marine elasmobranchs.

80. The Effect of the Cool-Skin of the Ocean on Surface Heat Fluxes

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Research Advisor(s): Ayal Anis

Skin sea surface temperature (SST), which controls heat exchange through the air-sea interface, is the temperature of the first few microns of the sea surface. Satellites with high-resolution radiometers provide skin SST with large spatial coverage but limited temporal resolution. In contrast, instruments on buoys collect bulk SST at shorter time intervals of seconds to minutes at depths of 10cm-2m. Bulk SST values may be higher than the skin SST by a few tenths of a degree (°C) due to the cool-skin effect and, unless corrected, are likely to introduce errors when computing surface heat fluxes. Our objective is to estimate errors introduced in surface heat fluxes if bulk SST are not corrected for the cool-skin. We hypothesized that the difference in temperature between bulk and skin temperatures would not significantly impact heat flux estimates. Through an investigation using physical parameterization of the cool-skin and measurements of bulk SST, we determined the effect on heat fluxes. Our results suggest that on average the net heat flux calculated from bulk SST values were higher by up to 17% compared to fluxes corrected for the cool-skin. Furthermore, the largest contribution to the difference resulted from the latent heat flux component, for which uncorrected values were higher by up to 47%. Hence, our results do not support our initial hypothesis.

81. Investigating the Phenotypic Effects after Deletion of the Major Promoter Driving Expression of the Transcriptional Regulatory Protein CHD8 in *Danio rerio*

Glory Onajobi (Emory University)
Biochemistry REU
Research Advisor(s): Gary Kunkel

CHD8 is a transcriptional regulatory protein that regulates gene expression by chromatin remodeling. The CHD8 protein is thought to affect the expression of many other genes that are involved in brain development. Mutations in the CHD8 gene impair the function of the CHD8 protein, and symptoms that result from loss of function mutations have been discovered to align with symptoms found in individuals with Autism Spectrum Disorder (ASD). The model system used in the investigation of the CHD8 transcriptional regulatory protein will be the Danio rerio (zebrafish) species. Single guide RNAs (sgRNAs) and Cas9 were injected into the embryos of wildtype zebrafish in an attempt to generate a germline mutation containing a deletion of the CHD8 promoter. Screening of fish bred from the genomic injection determined there was one potential mosaic founder fish containing the CHD8 promoter deletion. DNA sequencing of the potential founder fish verified the expected CHD8 promoter deletion. Phenotypic effects of presumed reduced synthesis of the CHD8 protein were visualized through evidence of disruption in brain development. 89% of embryos outcrossed from the founder fish lacked a prominent mid-hindbrain boundary (MHB) in comparison to 3% identified in a wildtype cross. Studies are underway to examine the level of CHD8 mRNA in F1 embryos bred from the founder fish.

82. Timing of Phage Lambda DNA Replication Influences Cell-Fate Outcomes

James Corban (Texas A&M University)
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Research Advisor(s): Lanying Zeng

The variable expression of genes through regulatory cascades leads to separate phenotypic outcomes in cells, a process referred to as cellular decision-making. The bacteriophage lambda and E. coli infection system stands as one of the most well-defined models of cellular decision-making. There are two primary fates for infected cells: the lytic pathway, in which the cell bursts and ~100 phage progeny are released; the lysogenic pathway, a more temperate fate in which the phage genome integrates into the host chromosome and establishes stable lysogenic cells. Previous studies have indicated that phage lambda DNA copy number and the timing of phage DNA replication within host cells can influence cellular decision-making. Nalidixic acid (NA) is an antibiotic which inhibits DNA gyrase, an enzyme involved in E. coli and phage lambda DNA replication. In this work, infected E. coli cells were treated with NA and analyzed via single-cell and bulk-level studies to quantify variances in phage DNA replication and the resultant impacts on cell-fate outcomes. We show that the phage DNA replication rate (relative to E. coli DNA replication) in NA-treated cells was reduced as compared to control cells. Results also indicated that NA-treated cells undergo a delayed start to phage DNA replication. The fates of NA-treated cells differed significantly from control cells, including a substantially higher proportion of infected cells expressing both lytic and lysogenic fates ("mixed" fate cells). Our results provide evidence that the timing of phage DNA replication plays a critical role in the determination of final cell-fates.

83. Analysis of Induced Pluripotent Stem Cells Containing the tw2 Haplotype for Future Eradication of Invasive *Mus musculus*

Jordyn Dobson (New Mexico State University)
Biochemistry REU
Research Advisor(s): David Threadgill

Invasive mouse species, most commonly Mus Musculus, can deplete food sources and introduce new predators to islands and, by doing so, have endangered several native species. Therefore, it is critical to extinguish invasive mouse species on islands to restore natural habitats. Methods such as rodenticides can be successful but can also have effects outside of targeting Mus Musculus alone. The most precise approach for eradication would be through gene drive technologies that take advantage of super-Mendelian inheritance. A daughterless mouse system can theoretically be created by introducing Sry, the gene on the Y chromosome that directs male sex determination, into an autosomal locus that has super-Mendelian inheritance. The Sry gene will be incorporated into the t-haplotype of chromosome 17. The t-haplotype is a selfish element that naturally enhances its own transmission, making it a suitable target for the insertion of the sex determining gene. The anticipated result of this insertion would be the production of a 95% male population over generations. Induced pluripotent stem cells (iPS cells) have been derived from mouse embryonic fibroblasts (MEFs) containing the tw2 allele of the t-haplotype. These cells are currently be characterized for optimal growth medias and normal chromosome number. Once characterized, these iPS cells will be used to generate aggregation chimeras. To do this, the iPS cells containing the tw2 haplotype will be aggregated with 8-cell stage mouse embryos before allowing to progress to the blastocyst stage to evaluate their ability to form chimeras.

84. The Role of uppS in Cell Length Determination in *Bacillus subtilis*

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While the structure and assembly of the cell wall has been reported on extensively, the mechanisms responsible for the determination of cell shape remain largely undetermined. Here, we test the notion that the availability of a key metabolite involved in cell wall synthesis may be central in determining cell length. Previous studies in the Gram-negative organism Escherichia coli highlighted that levels of the isoprenoid-derived molecule undecaprenyl-phosphate (Und-P) played a critical role in the determination of cell length. Because of its role as a precursor for multiple components of the cell envelope, depletion of Und-P was found to lengthen and sometimes lead to misshapen cells. Conversely, overexpression of uppS, the gene encoding the Und-PP synthetase, restored the depleted cells to wild-type length. To test if Und-P availability also affects the cell length of the Gram-positive organism Bacillus subtilis, we placed the B. subtilis uppS gene under the control of an inducible promoter and overexpressed the gene. We found uppS overexpression led to a significant decrease in cell length, suggesting that Und-P availability is also a determinant of cell length determination in B. subtilis. Given the sensitivity of both E. coli and B. subtilis to Und-P availability, pathways regulating its availability are viable targets for broad-spectrum antibiotics.

85. Effect of F6q Mutation in the N-terminus of Yeast Ampiphysins Rvs161p and Rvs167p on Membrane Fission

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Research Advisor(s): Hays Rye, Xue Gong

BAR superfamily of proteins has a positively charged concave surface that binds to the membrane and induces curvature. Members of the BAR domain consists of the N-BAR, the F-BAR, and the I-BAR. N-BAR domain was mainly focused on in this study. The N-BAR domain consists of the N-terminal amphipathic helix which acts as a wedge that penetrates the outer leaflet of the membrane, further inducing curvature. The N-BAR domain focused on in this study, is the only known N-BAR domain of the budding yeast, Saccharomyces cerevisiae Rvs161p and Rvs167p. Our unpublished data indicate that Rvs proteins can induce membrane fission in vitro. Besides its BAR domain, its N-terminus also further induce curvature. Also, our unpublished data shows that deletion of the N-terminus would halt membrane fission and endocytosis in vitro. These results indicate the importance of the N-terminus of the Rvs proteins in inducing membrane fission. Knowing this, we generated F6Q mutations through site-directed mutagenesis in amino acid residues of the N-terminus of both Rvs161p and Rvs167p and tested its effect on membrane fission. Through this study, we show how changes in amino acid residues in the N-terminus of Rvs161p and Rvs167p affect membrane fission.

86. Directed Evolution of Lysis Genes from Viral Dark Matter

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Research Advisor(s): Ryland Young

The rise in antibiotic resistant bacteria necessitates the search for bacterial proteins that could be targeted for drug development. Viruses of bacteria (phages), particularly ssRNA phages could serve an important role in unraveling new targets in peptidoglycan (PG) pathway. ssRNA phages contain 3 core conserved genes (mat, coat, and rep) and the fourth is the lysis gene which encodes a protein that lyses the bacteria by blocking PG synthesis. A recent exploration of the ssRNA genomes from metatranscriptomes has led to the discovery of 22 new lysis proteins that cause lysis in E. coli. Surprisingly, some of these genomes had two or more possible lysis gene candidates per phage genome. In this study, we investigated if one such phage (Beihai9) indeed had two functional lysis genes. The first lysis gene candidate was shown to be functional in E. coli, whereas the second lysis gene candidate was shown to be non-functional in E. coli. We wondered, is it possible to evolve the second (non-functional) lysis gene to gain lytic function in E. coli? Through directed evolution we obtained mutants that gained lytic function. Thus, showing that ssRNA phages can encode more than one lysis protein. Encouraged by these results, we expanded our directed evolution strategy to other lysis gene candidates from metatranscriptomes. Through this method, we were able to find at least two new lysis proteins and one of them is the smallest lysis protein ever discovered at 21 amino acids in length. Experiments are underway to characterize these new candidates.

87. 3,3'-Diindolylmethane Induces 26S Proteasome-mediated ERα Degradation via p38 MAPK Inhibition in MCF-7 Breast Cancer Cells

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Research Advisor(s): Stephen Safe, Keshav Karki

3,3'-diindolylmethane (DIM) is a major oligomerized version of the phytochemical indole-3-carbinol (I3C) native in cruciferous vegetables such as broccoli and Brussels sprouts. Once formed in the gut, DIM exhibits chemopreventive and antitumorigenic activity in breast cancer patients as shown by clinical studies. Although no clear mechanism of DIM's chemopreventative role in cancer cells has been proposed, DIM has been shown to downregulate estrogen receptor-alpha (ERα), a member of the nuclear receptor family of transcription factors observed to be overexpressed in breast cancer cells and induces cell proliferation upon binding hormonal estrogens. Evidence of 26S proteasome activation in response to p38 mitogen-activated protein kinase (p38 MAPK) inhibition by small molecules provided a starting point to elucidate the mechanistic cellular pathway behind DIM's degradation of ERα. Research in our lab demonstrates that inhibition of phospho-p38 MAPK upon DIM treatment in MCF-7 breast cancer cells is followed by ERα degradation, which was rescued by cotreatment with proteasome inhibitor MG132 suggesting ERα degradation is mediated by 26S proteasome activity. Further experiments aim to screen upstream signaling proteins involved in phospho-p38 MAPK inhibition, of which additional MAPK family members and the PI3K/Akt pathway are of interest.

88. Effects of Quebracho Extract and Branch Chain Volatile Fatty Acid Incubated with Cynodon Hay upon in vitro Gas Production

Chris Johnson (Texas A&M University)
Independent Project
Research Advisor(s): Luis Tedeschi

The ruminant livestock sector is considered one of the most significant contributors to the existing greenhouse gas (GHG) pool. The objective of this study was to determine the effect of volatile organic acid (VOA) on the fermentability of Cynodon Dactylon hay and methane production utilizing the in vitro gas production technique. Total methane production was adjusted for the fermentable organic matter content of each sample. Treatments consisted of a single encapsulated method (S2) at a level of 3% of salts of VOA, and rumen fluid collected from receiving 1% of DM of Quebracho Extract (QT) (n=2) or no QT (n=2). In vitro gas production data were collected for 48 h and analyzed using Gasfit. Kinetic analysis of cumulative 48 h gas production was performed using Gasfit. There was no statistical difference in the total gas production between each treatment ($P<0.0001$). There was no statistical difference in the degradation rate ($P=.0020$), however, the combination of VOA and QT showed to increase the fermentation rate of the non-fiber carbohydrate portion ($P=0.05$), and decrease methane production ($P=0.02$). The data suggest that the combination of VOA and QT can reduce methane production without effect in vitro overall fermentability of Cynodon hay. The effect of VOA upon ruminal fermentability with or without the combination of different additives should be tested further on in vitro and in vivo studies.

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