ABSTRACT BOOK

Undergraduate Research Summer Poster Session

Wednesday, August 2, 2017

Interdisciplinary Life Sciences Building Lobby

Physical Sciences and Engineering

10:00 AM – 12:00 PM

Life Sciences, Biomedical Sciences, Health Sciences and Geosciences

3:00 PM – 5:00 PM

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Undergraduate Research

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Undergraduate Research Summer Poster Session

Wednesday, August 2, 2017
Interdisciplinary Life Sciences Building Lobby

Physical Sciences and Engineering
10:00 AM – 12:00 PM

Featured Summer Programs: *AERO-U REU, Astronomical Research and Instrumentation REU, Chemistry REU, CSE@TAMU REU, Cyclotron REU, Engineering Undergraduate Summer Research Grant (USRG) Program, Mechatronics, Robotics, and Automated System Design REU, TTI ATLAS Summer Internships, TURC: Texas A&M Undergraduate Research in Chemistry*

Life Sciences, Biomedical Sciences, Health Sciences and Geosciences
3:00 PM – 5:00 PM

Featured Summer Programs: *Aggie Research Scholars, Atmospheric Science in the Gulf Coast Region at Texas A&M University REU, Beckman Scholars, Biochemistry REU, Bioenvironmental Sciences Undergraduate Research Scholars (BURS), CyberHealthGIS, Ecosystem Science and Management NSF-REU in Costa Rica, Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU, Oceanography REU, Sociology and Landscape Architecture, and Urban Planning REU, TAMHSC COM Summer Undergraduate Research Program, The Louis Stokes Alliances for Minority Participation (LSAMP)*

Physical Sciences and Engineering

10:00 AM – 12:00 PM

1. **Collisional Energy Transfer of Highly Vibrationally Excited C_6H_6 at Low Temperatures**

Jason Kuszynski (Texas A&M University)

TURC: Texas A&M Undergraduate Research in Chemistry

Research Advisor: Dr. Simon North

To make supersonic travel efficient enough to be financially practical, it is necessary to characterize the interaction of molecular internal energy with macroscopic flow properties like turbulence. With its ability to be excited to very high vibrational energies without risk of dissociation, benzene is a critical molecule to characterize and utilize to transfer energy from itself to a bath gas. In previous experiments, the average energy transferred in collisions with benzene is approximately linearly dependent on the internal energy of excited benzene molecules and approximately linearly dependent on the N_2 bath temperature between 300 K and 600 K. In this experiment, highly vibrationally excited benzene generated by 193 nm laser excitation was examined through a rotational-translational temperature rise measured within a nitrogen gas (N_2) bath. Two-line Laser Induced Fluorescence (LIF) of seeded nitric oxide (NO) was utilized due to the ability of NO to quickly equilibrate to bath temperature. Fits for transient N_2 temperature rises were compared to classical trajectory calculations of Collisional Energy Transfer (CET) from benzene vibration to N_2 rotation-translation (V-RT). At bath temperatures below 300 K CET was found to be more efficient than at 300-600 K. Since the temperature dependence of CET changes at low temperature, we propose that vibration to vibration (V-V) CET mechanisms activate below 300 K. Future experiments will examine well characterized hypersonic flow field systems at low temperatures to observe the impact of seeding benzene on shockwave properties.

2. **Determination of Cross-Relaxation Constants for 2-trifluoromethylaniline for Application in Chemical Exchange Saturation Transfer**

Austin Kinley (Texas A&M University)

TURC: Texas A&M Undergraduate Research in Chemistry

Research Advisor: Dr. Christian Hilty

Chemical Exchange Saturation Transfer (CEST) has shown promising applications in MRI through lessening the dependence on potentially toxic paramagnetic contrast agents. The molecule 2-trifluoromethylaniline is being studied using NMR to determine the influence of the nuclear Overhauser effect (NOE) between water protons and 19F of this molecule when exchangeable protons exist near the target spin, 19F. Exchangeable protons provide an additional mechanism for polarization transfer, so the signal of the 19F atoms is expected to be enhanced with the exchange effect. To investigate this phenomenon, transient and steady-state NOE experiments were performed to determine the 1H-19F cross-relaxation rates, sigmaFH. For the aromatic proton adjacent to the -CF3 group, a value of sigmaFH = 0.004375 s-1 was determined at pH 7.0. Additionally, saturation of the water solvent protons produced a value of sigmaFH = 0.03976 s-1. Other experiments have shown the 1H-19F cross-relaxation constants for the other three aromatic protons to be negligible. Because the amino proton peak was too broadened by fast exchange, exchange could not be studied at pH 7.0 using NMR. However, at pH 3.0, the exchange is slower, and a $-NH^2$ peak was detected. Using a pH 3.0 sample, the cross-relaxation constants and exchange rate are currently being determined. These results will be compared with similar experiments in which the exchangeable proton ($-NH_2$) is removed to directly determine the influence of NOE on proton transfer in CEST, providing a basis for further experiments to study chemical exchange of related compounds that could potentially serve as CEST agents.

3. **Molecular Nickel Catalysts Immobilized on Silica by Phosphine Linkers**

Ryan Mendizabal (Texas A&M University)

TURC: Texas A&M Undergraduate Research in Chemistry

Research Advisor: Dr. Janet Bluemel

Homogeneous and heterogeneous catalysts are studied throughout academia and industry and they are applied to a large array of chemical reactions. However, neither of these catalyst types offer both, high selectivity and recoverability, simultaneously. To combat this issue, our group studies immobilized catalysts, where homogeneous catalysts are bound to a solid support by a linker molecule. Such tethered catalysts are highly selective and active, and they can easily be recovered and reused. Immobilized catalysts of interest are most often linked to the surface of silica gel via covalently bound bi- or tridentate phosphine ligands. Immobilized inexpensive nickel catalysts are of particular interest because of their applications in fine chemicals production, for example, for cyclotrimerization reactions of alkynes. Here, we describe the synthesis and characterization of several molecular and immobilized nickel complexes using two different phosphine ligands, $(Ph_2PCH_2CH_2)_3SiOEt$ and $(EtO)_3Si(CH_2)_3N(CH_2PPh_2)_2$. The immobilized new catalysts can be obtained via two synthetic routes, (a) synthesis of the molecular complex followed by immobilization, or (b) via immobilizing the linker first and generating the catalyst on the surface of the oxide support by ligand exchange. All immobilized phosphine linkers and catalysts are characterized by 31P MAS and HRMAS (high resolution magic angle spinning) NMR. The activities and selectivities of the immobilized catalysts are compared to those of the homogeneous analogs, and their recyclabilities are tested. We anticipate that these monometallic nickel catalysts will provide a basis for efficient, comparatively inexpensive Ni/Cu heterobimetallic catalysts for Sonogashira cross-coupling reactions.

4. **Formation of a Molecular Weight Standardization Curve for Cyclohexene Oxide-CO_2 Copolymers using Chain Transfer Agents**

Jared Youts (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Don Darensbourg

Adjusting the chain length of polymers affects many of its physical properties and therefore its uses. By adding chain transfer agents (CT), the average chain length of many types of polymeric reactions is easily controlled. Using and creating a standardization curve for polymers modified by CT will help in making samples with a desired molecular weight. Cyclohexene oxide (and its derivatives) are common monomers used in the study of epoxide-CO_2 copolymerization reactions and was chosen for this reason. Synthesis of poly(cyclohexene carbonate) was done by standard ring opening copolymerization procedures in the presence of (salen)Cr(III)chloride, Bis(triphenylphosphine) iminium fluoroacetate (PPN CO_2CF_3) , and deuterium oxide as catalyst, cocatalyst and CT respectively. The samples were then analyzed by IR, 1H NMR, DSC, and GPC to determine the presence of cyclic products, glass transition temperature and molecular weight.

5. **The Design and Testing of a Novel Spectrometer for Plasma Diagnostics**

Richard Hollenbach III (University of Pittsburgh)

AERO-U REU

Research Advisor: Dr. Christopher Limbach, Dr. Rodney Bowersox

Continuous and pulsed plasma discharges are becoming widely used in the fields of aerodynamics, combustion, and chemistry. Thus, a spectrometer with a high resolution and a wide bandwidth is designed and built to study and characterize the flow of plasma. A model was first programmed using known equations to predict the results of the spectrometer and to optimize parameters. Then the system was constructed upon an optical table using the various parameters calculated from the model. Once built, the spectrometer was tested using a monochromatic laser and the results were compared to the model. The effects of varying two specific parameters were studied and will be useful information for calibrating the spectrometer when more complex light sources are introduced as well as plasma. The effect of a diffraction grating which will prevent cross axis interference was also studied.

6. **Development of a Free-Solution SERS-Based Assay for Point-of-Care Oral Cancer Biomarker Detection Using DNA-Conjugated Gold Nanoparticles**

Luke Oaks (Texas A&M University)

Engineering Undergraduate Summer Research Grant (USRG) Program

Research Advisor: Dr. Gerard L Coté

Oral cancer is an international problem with a low five-year survival rate due to lack of symptoms. The primary detection method is an invasive tissue biopsy and lab test, which is not ideal for a dentist's office. A handheld technology using surface enhanced Raman spectroscopy (SERS) is reported here to detect an oral cancer salivary biomarker, S100P, at the point-of-care (POC).The details of a "SERS-On" sandwich-assay design and characterization will be reported for the detection of S100P. After conjugation of the DNA probes and Raman reporter to nanoparticles, a 10nM limit of detection was shown.

7. **Fairy Houses: A Creative Engineering Experience**

Harrison Froeschke (Texas A&M University)

Engineering Undergraduate Summer Research Grant (USRG) Program

Research Advisor: Dr. Bruce Gooch

A common misconception is that neither Engineers nor their projects are creative. We report on a laboratory program for creating educational displays like those in Museums. The program enables students to design and build an edutainment product, gather data to test their product, and interpret their data. The objective of the project is to create an educational experience for users that shows the potential for creativity within the field of Computer Science. The undergraduate participants created an interactive display that teaches two Computer Science concepts. They created an interactive experience for via a Bluetooth connection to an Arduino powered Fairy House. Users unravel a story that involves solving riddles via interpreting Morse code. The display has two learning goals. First, players gain an understanding of how to turn code into text. The second is players discover how binary trees speed search tasks. We also had two design goals, any number of people can play, and players can join or leave without interrupting others. Through in-house testing and trial runs, the students determined that this method of interactive learning is useful for teaching new concepts.

8. **Cattle Weight From an Image**

John Guerrero (Texas A&M University)

Engineering Undergraduate Summer Research Grant (USRG) Program

Research Advisor: Dr. Bruce Gooch

Our team is building an image processing application that will allow a rancher to compute the weight of a cow using a mobile phone. Knowing the weight of a cow will allow farmers to sell their livestock at the time when the growth of an individual animal has plateaued for a given type of feed. Currently, there is no software that allows farmers to calculate weight from an image using their smartphone on the market. Smartphones are a good hardware to choose since 77% of Americans have access to a smart phone. Ranchers lose up to 10% of their cattle feed raising cows that are past their optimal sale date. Seeing as how the feed is the highest expense in farming and only continues to rise, this situation can be detrimental to farmers and taxpayers who help subsidize the feed. The program works off triangles and basic geometry. The software uses the position and distance of the camera to the cow to calculate the dimensions of the cow. From there the measurements will calculate and the result will be the weight of the cow.

9. **Precise Measurement of αk for the 39.76-keV E3 Transition in 103Rh: Further Test of Internal Conversion Theory**

Blake Bryant (University of Central Arkansas)

Cyclotron REU

Research Advisor: Dr. John Hardy

We have extended our series of precision measurements of internal conversion coefficients (ICC) to include the 39.76-keV, E3 transition in 103Rh. Our goal has been to test the Dirac-Fock ICC calculations, specifically with respect to the role of the atomic vacancy created in the conversion process. We prepared a sample from pure (natural) ruthenium chloride by converting the sample to ruthenium oxide, electrochemically depositing it on an aluminum backing, and subsequently activating it with thermal neutrons at the Texas A&M TRIGA reactor for 20 hours. Decay spectra were then recorded for roughly 120 hours with a HPGe detector that has been precisely efficiency calibrated (±.15% relative precision). In the acquired spectra, all impurities were identified and corrected for accordingly. A program was written using the ROOT framework developed by CERN to extract the area of the 39.76-keV gamma-ray peak from 103Rh, which partially overlapped the Kα x-ray peaks from a 153Gd impurity. From the ratio of the 39.76-keV peak to the Ruthenium K x-rays, we determined a preliminary value for the ICC: αk(39.76)=134.6(19). This result agrees well with the theoretical calculation including the atomic vacancy, αk(hole)=135.2, and disagrees with the calculation excluding the vacancy, αk(no hole)=127.4. This is consistent with our previous measurements, indicating that the atomic vacancy must be taken into account. Precise ICC values are needed in nuclear databases that are frequently used for basic science and application purposes.

10. **Event by Event Simulations of Early Gluon Fields in High Energy Nuclear Collisions**

Matthew Nickel (University of Dallas)

Cyclotron REU

Research Advisor: Dr. R.J. Fries

Collisions of heavy ions are carried out at ultra relativistic speeds at the Relativistic Heavy Ion Collider and the Large Hadron Collider to create Quark Gluon Plasma. The earliest stages of such collisions are dominated by the dynamics of classical gluon fields. The McLerran-Venugopalan (MV) model of color glass condensate provides a model for this process. Previous research has provided an analytic solution for event averaged observables in the MV model. Using the High Performance Research Computing Center (HPRC) at Texas A&M, we have developed a C++ code to explicitly calculate the initial gluon fields and energy momentum tensor event by event using the analytic recursive solution. The code has been tested against previously known analytic results up to fourth order. We have also have been able to test the convergence of the recursive solution at high orders in time and studied the time evolution of color glass condensate.

11. **In Medium-Propagation of the Rho Meson**

Thomas Onyango (University of North Texas)

Cyclotron REU

Research Advisor: Dr. Ralf Rapp

The goal of this research is to study how hadronic matter transitions into quark-gluon plasma. This transition is believed to have occurred in the early universe about 10 microseconds after the big bang. In particular, this transition created more than 95% of the visible mass in the universe, and confined quarks and gluons into hadrons. Hot nuclear matter can be recreated in the laboratory by colliding heavy atomic nuclei at very high energies. This transition into the quark-gluon plasma can be probed by analyzing the invariant mass distributions of ρ-mesons. The ρ-meson was chosen because it decays into dilepton pairs, e.g. e+e- or μ+μ-. Dilepton pairs are a preferred observable because they do not interact through the strong nuclear force inside the strongly interacting fireball, therefore ρ-mesons decay into dileptons in the medium and can be measured during heavy ion collisions. In this project, we developed a parameterization of this process which will help to describe quark-gluon plasma which filled the early universe.

12. **Ion Excitation of Stable Isotopes with TAMU Trap**

Carlos Marquez (San Diego State University)

Cyclotron REU

Research Advisor: Dr. Dan Melconian

The Texas A&M University Penning trap is currently being used for precise mass spectroscopy of ions, but will be focused on testing the Standard Model by studying the β-ν correlation parameter, a(βν), in the future. Our goal was to measure the mass of sodium-23. In order to measure the mass of a single ion, we rely on frequency excitations to gain accurate resolutions. A first ion source that uses 39K was used to calibrate our magnetic field based on its resonance frequency; this known field was then compared to a second ion source for a mass measurement. A second ion source of sodium has been installed to the Penning trap beamline. Stable 23Na ions were bunched and cooled down to a definite energy to then be captured in the Penning trap. These ions were then confined until they were excited to a resonance frequency. Finally, we released the ions and measured how long they took to reach a final detector. From analyzing the Time-of-Flight versus frequency spectrum, we can conclude the mass of the ions being detected.

13. **Heavy Ion Guide Gas Handling System: Calculations and Execution**

Hayden Fowler (University of Alabama in Huntsville)

Cyclotron REU

Research Advisor: Dr. Greg Chubaryan

A heavy ion guide (HIG) is a part of the T-REX upgrade project at the Cyclotron Institute. In the HIG, radioactive nuclei will be produced in heavy ion induced reactions and will be separated from the primary beam and other unwanted reaction products. Separated ions will slow down in an aluminum degrader, losing most of their energy, before stopping inside the gas catcher. In order to collect a variety of ions, it is desired to know the effects of the aluminum degrader thickness and helium gas pressure on the gas catcher's ability to stop ions. The effect of pressure can be calculated using energy loss simulations with SRIM software. SRIM simulations were done using the following ions: Ca-50 at 10 MeV/u, 12 MeV/u, and 14 MeV/u; Ni-68 at 10 MeV/u; and Si-24 at 14 MeV/u; at gas pressures ranging from 100 to 500 mbar. Data was gathered on the average ion energy that could be stopped, the aluminum thickness required for ions to reach this energy, and the energy/space distributions of ions within the gas catcher. The results show that higher pressures can handle more energy and require less aluminum than lower pressures. Furthermore, pressure was shown to have a significant effect on the ion distributions within the gas catcher, with higher pressures resulting in a greater mean and smaller standard deviation. Present simulations will be used as the starting point for in-beam measurements. Design and programming of the digitally controlled interface for the gas handling system was also done.

14. **Characterization of ParTI Phoswiches with the Use of Charged Pion Beams**

Emily Churchman (Texas Lutheran University)

Cyclotron REU

Research Advisor: Dr. Sherry Yennello

The Partial Truncated Icosahedron (ParTI) detector array consists of 15 phoswiches. Each phoswich is made of two scintillating components – a thallium-doped cesium iodide (CsI(Tl)) crystal and an EJ-212 scintillating plastic – coupled to a photomultiplier tube. Both materials have different scintillation times and are sensitive to both charged and neutral particles. The type of particle and amount of energy deposited determine the shape of the scintillation pulse as a function of time. By integrating the fast and slow signals of the scintillation pulses, a "Fast vs. Slow Integration" plot can be created that produces particle identification lines based on the energy deposited in the scintillating materials. Four of these phoswiches were taken to the Paul Scherrer Institute (PSI) in Switzerland where π^+, π^-, and proton beams were scattered onto the phoswiches to demonstrate their particle identification (PID) capabilities. Using digitizers to record the detector response waveforms, pions can also be identified by the characteristic decay pulse of the muon daughters.

15. **Particle Induced X-Ray Emission Experiment Using the K150 3.4 MeV Proton Beam at TAMU Cyclotron Institute**

Yasmin Pajouhafsar (Texas A&M University)

Cyclotron REU

Research Advisor: Dr. Sherry Yennello

Particle Induced X-Ray Emission (PIXE) is a non-destructive analytical technique that is used for various tasks, such as elemental composition. The x-rays are emitted when electrons transition from higher to lower energy levels, causing vacancies in the atom's electron configuration. The overall goal of this research is to successfully set up a PIXE experiment using the K150 proton beam in the Cyclotron Institute at Texas A&M University. The x-rays produced are unique to each element and analyzed with reference to their known energies. The setup consists of 3 different detectors, providing a wide range of energies: XR-100T CdTe γ/X-Ray, XR-100T/CR Si and XR-100SDD. Accelerating 3.4 MeV protons from the K150 and using PIXE, we determine concentrations of NaCl and KBr samples provided by the Chemical Engineering Department. The concentrations for each element found in the samples are obtained and analyzed through the software, GUPIXWIN.

16. **Calibration of a Fusion Experiment to Investigate the Nuclear Caloric Curve**

Ashleigh Keeler (Texas A&M University)

Cyclotron REU

Research Advisor: Dr. Sherry Yennello

In order to investigate the nuclear equation of state (EoS), the relation between two thermodynamic quantities can be examined. The correlation between the temperature and excitation energy of a nucleus, also known as the caloric curve, has been previously observed in peripheral heavy-ion collisions to exhibit a dependence on the neutron-proton asymmetry. To further investigate this result, fusion reactions (78Kr + 12C and 86Kr + 12C) were measured; the beam energy was varied in the range 15-35 MeV/u in order to vary the excitation energy. The light charged particles (LCPs) evaporated from the compound nucleus were measured in the Si-CsI(TI)/PD detector array FAUST (Forward Array Using Silicon Technology). The LCPs carry information about the temperature. The calibration of FAUST will be described in this presentation. The silicon detectors have resistive surfaces in perpendicular directions to allow position measurement of the LCP's to better than 200um. The resistive nature requires a position-dependent correction to the energy calibration to take full advantage of the energy resolution. The momentum is calculated from the energy of these particles, and their position on the detectors. A parameterized formula based on the Bethe-Bloch equation was used to straighten the particle identification (PID) lines measured with the dE-E technique. The energy calibration of the CsI detectors is based on the silicon detector energy calibration and the PID. A precision slotted mask enables the relative positions of the detectors to be determined.

17. **Synthesis of an Unsupported Pincer-type Cobalt Silylene and Activation of Small Molecules**

Jim Zhang (Carleton College)

Chemistry REU

Research Advisor: Dr. Oleg Ozerov

Combining transition metals with metalloids can lead to cooperative reactivity to make difficult reactions more accessible. We are exploring this idea by pairing cobalt (electron rich, Lewis base) with silicon (electron poor, Lewis acid) in a pincer-type complex. This summer, we have made the PSiP-cobalt(I) parent complex and some derivatives of it, including a first (maybe?) non-base-supported cobalt silylene. Crystal structures and NMR data have been obtained for both the parent complex and the cobalt silylene, confirming the sp3 hybridized nature of the parent complex and a planar, sp2 hybridized nature of the silylene. By the time of poster session, I will be having three new cobalt complexes fully characterized, and a couple of reactivities of the silylene shown, such as reaction with water, carbondioxide, hydrogen gas, etc.

18. **Towards Pore-Expanded Ruthenium-Based Metal Organic Frameworks for C-H Bond Functionalization**

Austin Miller (East Tennessee State University)

Chemistry REU

Research Advisor: Dr. David C. Powers

Metal-organic frameworks (MOFs) comprised of late transition metal secondary building units are attractive catalysts for carbon–hydrogen (C–H) bond functionalization. The necessary redox chemistry for C–H bond functionalization can be obtained by incorporating bimetallic paddlewheel secondary building units into the MOF structure. Here, progress towards Ru2-based MOFs, based on 1,3,5-benzenetribenzoic acid ligands is investigated, and activity towards C(sp3)–H amination is reported. Ongoing work aims to access late-metal-based MOFs with palladium or ruthenium via ion metathesis and to interrogate these structures in C–H bond functionalization.

19. **Immobilization of Antimony-based Fluoride Sensors in Gels**

Etienne Collonge (Ecole des Mines d'Alès)

Chemistry REU

Research Advisor: Dr. Francois Gabbai

The known 9-anthryltriphenylstibonium cation [1]+ has been synthesized in order to sense the potentially toxic fluoride anion in water. This cation was selected because of its known ability to bind fluoride in a reaction accompanied by a fluorescence turn-on response. The goal of this study was to immobilize [1]+ in a gel and test the response of the resulting gel to fluoride anions. After testing commercially available edible jello and polyacrylamide gel which did not afford anion responsive gels, we turned our attention to the polysaccharide agar gel. The gel was formulated by mixing a 9/1 (v/v) H_2O/DMSO solution buffered at pH=4.8 with [1]+ (7 X 10^(-6) mol/L) and 1% agar powder. The resulting gel showed a net turn-on fluorescence response when treated with drops of fluoride-containing aqueous solution. Using optical inspection, a response could be detected for fluoride concentrations as low as 10^(-4) mol/L. The remaining aim is to demonstrate that this gel can be used as a selective fluoride sensor for bottle or tap water.

20. **Alignment of Anisotropic Nanoparticles by Electric Fields**

Clement Oudard (Ecole des Mines d'Alès)

Chemistry REU

Research Advisor: Dr. Matthew Sheldon

CdSe/CdS core/shell nanorods have polarized emission due to their anisotropic structure. The use of these particles can lead to possible improvements in luminescent solar concentrators by reducing the re-absorption and scattering losses. Aligning nanorods is the main path to achieve this result. The alignment of CdSe/CdS nanorods in solution under an electrical field has been investigated. More precisely, the polarized absorption of these anisotropic nanoparticles has been observed. Due to their structure, absorption and emission processes are oriented according to the geometry of the particle. Transmission electron microscopy (TEM) and Atomic force microscopy (AFM) have been used to measure the size and homogeneity of the nanorods. Furthermore, the change of absorption over time monitored the alignment of the nanorods while an electrical field was applied. We measured the change of anisotropic absorption as a function of time and polarization angle. These measurements show the interaction between the permanent dipole and (or) anisotropic-induced dipole of the nanorods and the electric field. These results can lead to the achievement of fully aligned CdSe/CdS nanorods.

21. **Synthesis of Fluorine-18 Tracers for Positron Emission Tomography**

Quentin Bouvier (École Nationale Supérieure de Chimie de Mulhouse)

Chemistry REU

Research Advisor: Dr. Francois Gabbai

Positron emission tomography (PET) is a nuclear imaging technique based on the emission of gamma rays from the radiotracers. In oncology, the use of tracers based on fluorine-18 are attracting a great deal of attention because of the short half-life of fluorine-18 (110 minutes). The successful design of a tracer necessitates the discovery of molecules in which fluorine-18 atoms can be easily introduced. To be useful in bioimaging, these molecules must also be stable under physiological conditions. The main objective of this project was to determine if adducts formed between PF5 and imidazoles would be well-suited for such an application. In this presentation, I will present a series of results concerning the synthesis of such adducts along with their stability to aqueous environments. In particular, I will explain that pentafluoro(3-methyl-1H-imidazole-kN3)phosphorous (1) can be synthesized by vacuum pyrolysis of 3,3,-ethan-1,2-diylbis(1-methyl-1H-imidazol-3-ium (2), 3-ethenyl-1-methyl-1H-imidazol-3-ium (3) or 3-(2-bromoethyl)-1-methyl-1H-imidazol-3-ium (4). I will also explain that this compound is stable in water/DMSO at pH 7.5 for extended periods of time.

22. **Free Energy Study of the Diels-Alder Reaction of Isoprene and Acrolein**

Kara Gallo (Gonzaga University)

Chemistry REU

Research Advisor: Dr. Daniel Singleton

Conventional Transition State Theory (TST) states that the transition state for a reaction is defined as the first order saddle point of a potential energy surface (PES). However, according to canonical variational TST, the transition state is more accurately represented by the same topographical feature on a free energy surface (FES). Differences between the PES and FES originate from other thermodynamic considerations, including, but not limited to, entropy and thermal excitation. Throughout the literature, the Diels-Alder reaction mechanism has been classified as concerted; however, modern methodologies have recently called this mechanism into question in favor of a more stepwise process. Therefore, quantum mechanical molecular dynamic calculations in explicit solvent were conducted for the dimethylaluminum chloride catalyzed Diels-Alder reaction of isoprene and acrolein. The resulting FES indicates an asynchronous, or even stepwise, mechanism, contrary to historical PES results.

23. **The Role of Gold Oxidation State in the Synthesis of Au-CsPbX3 Heterostructured Nanoparticles**

David Dacres (Hamilton College)

Chemistry REU

Research Advisor: Dr. Matthew Sheldon

All-inorganic cesium lead trihalide perovskite nanocrystals are promising materials due to their highly efficient photoluminescence that can be tuned across the entire visible spectrum by controlling their halide ratio. Previously, it has been observed that gold (III) salts react with the oleylamine ligand shell of CsPbBr3 perovskite nanocrystals to deposit metallic gold nanoparticles on the surface of the perovskite nanocrystals. These hybrid metal-inorganic perovskites are attractive because of their optoelectronic and physical applications in solar cells, catalysis, and luminescence upconversion. Alternatively, gold (III) cations may exchange with lead (II) cations within the crystal lattice to form $Cs_2Au_2Br_6$. Moreover, when any amount of cation exchange occurs there is an immediate quenching of the nanoparticle fluorescence. Improved synthetic control over this reaction could lead to metal deposition without cation exchange. Here, we report on the use of gold (I) salts for gold deposition on cesium lead trihalide perovskites ($CsPbX_3$, X = Cl, Br, I). We have observed that when equal molar amounts of gold (I) and gold (III) are used for metal deposition on $CsPbCl_3$ perovskite nanocrystals, the gold (I) salts lead to deposition while the gold (III) salts lead to cation exchange. These results illustrate that the use of gold (I) salts can lead to more controllable metal deposition without cation exchange.

24. **Synthesis Towards Sequence-Controlled Polypeptides**

Catherine Morejon-Garcia (Louisiana State Univeristy)

Chemistry REU

Research Advisor: Dr. Karen L. Wooley

Sequence-controlled polymerizations, such as DNA replication and transcription, are essential in biological systems. However, replicating these mechanism in laboratories remains a challenge. From biological systems, much has been learned and applied in biological contexts, such as autocatalytic self-replication of peptides. Beyond the scope of biology, sequence-controlled polymers have yielded advanced materials for digital data storage, among other applications. Given the importance of biological and biomimetic polymers in both biological and non-biological arenas, this work makes progress towards the synthesis of sequence-controlled polypeptides with repeating units comprised of multiple amino acids. Glycine- and proline-containing tetrapeptides identified by theory-based calculations were prepared using solid phase peptide synthesis and ring-closed to generate the corresponding N-carboxyanhydride monomers. Specifically, three tetrapeptides, Gly-Gly-Gly-Gly, Gly-Gly-Pro-Gly, and Gly-Pro-Pro-Gly, were obtained in 20-55% yield and the structures were confirmed by electrospray ionization mass spectrometry (ESI MS), and nuclear magnetic resonance spectroscopy (NMR). Further, high-performance liquid chromatography (HPLC) experiments demonstrated the high purity of the tetrapeptides. Following reaction of the tetrapeptides with triphosgene to form the less polar N-carboxyanhydride monomers, the solubilization of the resulting material in organic solvents is suggestive of successful ring-closing reactions, though further experiments on a larger scale are needed to identify the product. These experiments provide a foundation for future scale-up and optimization of multi-amino acid-containing N-carboxyanhydride synthesis and for the synthesis of sequence-controlled polymers to enable technologies in a variety of fields, including medicine and engineering.

25. **Selection of L-DNA Aptamers Against D-pre-miR-155**

Ian Hall (Lyon College)

Chemistry REU

Research Advisor: Dr. Jonathan T. Sczepanski

Aptamers comprise a unique class of single stranded oligonucleotides that bind a target with high affinity and specificity. Targets range from single atoms to whole cells. The first aptamer comprised entirely of L-nucleic acids, the enantiomer of natural D- nucleic acids was evolved in 1996. L-nucleic acids have identical physical properties, but natural enzymes and proteins are unable to recognize and degrade them. Furthermore, L-oligonucleotides cannot form contiguous Watson-Crick base pairs with their natural D-counterparts. Interactions between oligonucleotides of opposing chirality occur through tertiary structure. L-aptamers have previously been evolved against structured D-RNA targets to circumvent drawbacks associated with D-oligonucleotide therapeutics, namely, in vivo stability and off target effects. In the present study an L-DNA aptamer was evolved against target precursor microRNA-155 (pre-miR-155) using a mirror image selection strategy. Mirror image selections rely on the concept of reciprocal substrate specificity where-in first a D-DNA aptamer is selected against the unnatural L-enantiomer of the target, and after the selection, the L-DNA aptamer is synthesized and can bind the D-enantiomer of the target. Pre-miR-155 is a precursor to microRNA-155 which is a prototypical oncogenic microRNA. The over expression of pre-miR-155 is associated with development and metastasis of several cancers and other illnesses. This selection is designed to steer aptamers to bind the distal stem loop of pre-miR-155 through tertiary interactions and inhibit Dicer mediated cleavage of pre-miR-155. Inhibition of this cleavage prevents maturation of pre-miR-155 to its functional form and should be selectively cytotoxic to cancerous cells over expressing pre-miR-155.

26. **Overexpression of Acyl Carrier Protein Domain of Polyketide synthase AziB from Azinomycin B**

Sorin Miller (New College of Florida)

Chemistry REU

Research Advisor: Dr. Watanabe

Azinomycin B is an antitumor agent produced by Streptomyces sahachiroi, with the ability to form interstrand crosslinks with DNA. The multidomain polyketide synthase AziB has been identified as the primary enzyme responsible for the formation of the naphthoate moiety, yet reactions with only AziB have resulted in the formation of a truncated product, 2-methylbenzoic acid. The thioesterase AziG has been shown to act as the chain elongation and cyclization domain which is responsible for the formation of the expected product, 5-methylnaphthoic acid. Further studies are required to under-stand the mechanism of action of AziG and its role in the syn-thesis of the naphthoate moiety. The objective of this study was to separate and express AziB as two fragments, the acyl carrier protein (ACP) domain and the ketosynthase-acyl trans-ferase-dehydratase-ketoreductase (KS-AT-DH-KR) domain. This will facilitate increased post-translational modification of the ACP domain by phosphopantetheinyl transferase. The ACP domain was successfully cloned into the pET24b overexpres-sion vector and transformed with *E. coli* BL21 cells for further study.

27. **Utilizing Machine Learning to Improve Analysis of Tiara for Texas**

Jacqueline Van Slycke (Siena College)

Cyclotron REU

Research Advisor: Dr. Grege Christian

The Tiara for Texas detector at Texas A&M University consists of a target chamber housing an array of silicon detectors and surrounded by four high purity germanium clovers that generate voltage pulses proportional to detected gamma ray energies. While some radiation is fully absorbed in one photopeak, others undergo Compton scattering between detectors. This process is thoroughly simulated in GEANT4. Machine learning with scikit-learn allows for the reconstruction of scattered photons to the original energy of the incident gamma ray. In a given simulation, a defined number of rays are emitted from the source. Each ray is marked as an event and its path is tracked. Scikit-learn uses the event paths to train an algorithm, which recognizes which events should be summed to reconstruct the full gamma ray energy and additional events to test the algorithm. These predictions are not exact, but were analyzed to further understand any discrepancies and increase the effectiveness of the simulation. The results from this research project compare various machine learning techniques to determine which methods should be expanded on in the future.

28. **Subtracting the Underlying-Event Energy in Reconstructed Jets in √sNN = 200 GeV Proton+Proton Collisions at STAR**

Colby Ostberg (San Francisco State University)

Cyclotron REU

Research Advisor: Dr. Saskia Mioduszewski

Jets resulting from hard scatterings (i.e. scatterings with large momentum transfer) provide insight into parton energy loss in the hot, dense medium produced by ultra-relativistic heavy-ion collisions. Complementary measurements in the medium-free proton-proton environment establish a vacuum fragmentation reference. In a collision, energy that goes into the production of particles not originating from the hard scattering is background (referred to as the underlying event) that must be subtracted from the measured jet-energy. We present a study of different methods to subtract the underlying-event energy in √sNN = 200 GeV proton-proton collisions recorded at the STAR experiment at RHIC.

29. **Toward Microscopic Equations of State for Core-Collapse Supernovae from Chiral Effective Field Theory**

Bassam Aboona (Middle Tennessee State University)

Cyclotron REU

Research Advisor: Dr. Jeremy Holt

Chiral effective field theory provides a modern framework for understanding the structure and dynamics of nuclear many-body systems. Recent works have had much success in applying the theory to describe the ground- and excited-state properties of light and medium-mass atomic nuclei when combined with ab initio numerical techniques. Our aim is to extend the application of chiral effective field theory to describe the nuclear equation of state required for supercomputer simulations of core-collapse supernovae. Given the large range of densities, temperatures, and proton fractions probed during stellar core collapse, microscopic calculations of the equation of state require large computational resources on the order of one million CPU hours. We investigate the use of graphics processing units (GPUs) to significantly reduce the computational cost of these calculations, which will enable a more accurate and precise description of this important input to numerical astrophysical simulations.

30. **Production of Radioactive Beams on the Proton Dripline Using MARS at Texas A&M**

Rebekah Roundey (Hillsdale College)

Cyclotron REU

Research Advisor: Dr. Brian Roeder

Exotic nuclei near the proton dripline are of interest for research in nuclear astrophysics, especially in the study of the r-p process. A 58Ni on Ni reaction at higher energies has been shown to successfully populate isotopes on the dripline, but this reaction has not previously been used at the Cyclotron Institute. In this experiment, a 58Ni beam at 36 MeV/u was impinged on Nickel and Beryllium targets to determine which isotopes could be produced. The resulting fragments were measured with two Silicon detectors in order to determine energy loss and production rates for each isotope. The effects of the different targets and the presence of a Carbon stripper foil on production rates will be presented and compared with simulations from the LISE++ program.

31. **Non-Destructive Analysis of Natural Uranium Pellet**

Samantha Wigley (College of Wooster)

Cyclotron REU

Research Advisor: Dr. Cody Folden

As part of ongoing nuclear forensics research, samples of natUO2 have been irradiated in a thermal neutron spectrum at the University of Missouri Research Reactor (MURR) with the goal of simulating a pressurized heavy water reactor. Non-destructive gamma ray analysis has been performed on the samples to assay various nuclides in order to determine the burnup and time since irradiation. The quantity of 137Cs was used to determine the burnup directly, and a maximum likelihood method has been used to estimate both the burnup and the time since irradiation. This poster will discuss the most recent results of these analyses.

32. **Improved Pulse Shape Discrimination Using Two Photomultipliers and P-terphenyl**

Adriana Moya (Arizona State Univeristy)

Cyclotron REU

Research Advisor: Dr. Grisha Rogachev

The goal of this study is to develop a neutron detector with improved pulse shape discrimination (PSD) properties for low energy neutrons. It will be used to measure the neutron background in the Mitchell Institute Neutrino Experiment at Reactor (MINER) at Texas A&M University, as well as a prototype neutron monitor for National Security applications. An organic mono-crystal scintillator, p-terphenyl, was chosen as a detector material because it has excellent pulse shape discrimination properties and is very bright (24,000 photons per 1 MeV of energy deposition). We have explored various PSD methods and determined that continuous wavelet transform has the best resolving power between signals from neutrons and gamma rays. Significant further improvements have been demonstrated by using two photomultiplier tubes (PMTs) instead of one.

33. **Mesostructured "Janus" Surfaces Suspended at Oil/Water Interfaces**

Claire-Marie Auger (Ecole des Mines d'Alès)

J-1 Scholar

Research Advisor: Dr. Sarbajit Banerjee

In order to meet worldwide energy needs, there is an increased focus on unconventional hydrocarbon deposits and the development of efficient methods for extracting such reserves. Steam-assisted gravity drainage has emerged as an important oil recovery method in the Canadian oil sands. This method involves the injection of steam deep within the geological deposits in order to emulsify the oil that is otherwise trapped in the sand. When the hot emulsion is removed from the ground, the water must be removed so that the oil can be refined and the water can be reused for the injection process. In order to meet the challenges of separating emulsions obtained from steam-assisted gravity drainage, we have developed an inorganic membrane for high temperature oil/water separation derived from ZnO nanotetrapods coated onto a stainless steel mesh. The ZnO tetrapod morphology demonstrates orthogonal wettability towards water and oil based on differentials in interfacial energies and a mesoscale surface topology. The morphology provides a high surface area and permits interfacial interactions in the Cassie-Baxter regime for water. We will describe the fundamental origins of the observed differential wetta-bility phenomena and explore the functionalization of such membranes in this work. Functionalization of the surface with a perfluorinated phosphonic acid endows oleophobicity as well as hydrophobicity. By functionalizing the two surfaces differently, the membranes can be suspended at water/oil interfaces wherein they constitute an impermeable barrier between oil and water.

34. **Porosity and Optimization of PPN-150 CO2 capture**

Valentin Carretier (Ecole des Mines d'Alès)

J-1 Scholar

Research Advisor: Dr. Hongcai J. ZHOU

Mesoporous Melamine-formaldehyde resins (mPMFs) are a type of Porous Polymer Network (PPN) that are synthetized from melamine and paraformaldehyde. This polymer has a good interaction with the CO_2 due to it's nitrogen rich backbone. This material has a large range of pores, this allows for effective chemisorption of a considerable amount of CO_2 by the PPN. The PPN is composed of mesopores and microspores in different proportions based upon the synthetic conditions, allowing for different properties based on the synthesis. This polymer can be loaded with alkylamines such as Diethyltriamine (DETA). This loading may increase the CO_2 uptake of the PPN. We tried to find the effect of the DETA loading on the CO_2 uptake. We loaded some PPN-150 with DETA, using a standardized procedure. We then analyzed the loaded samples via thermogravimetric analysis (TGA) using a testing regime of 5 cycles. We compared the data of the CO_2 uptake with the data obtained by BET analysis. We have a whole range of parameters such as the BET surface area, the pore volume, the pore distribution, and the CO_2 uptake. We also worked on the quantification of the hysteresis that we observed on the sorption isotherms to allow for a better quantification of the desorption ability of the polymer-amine composite, which can in turn relate to the cycling performance of the samples. With all these parameters we have complete set of data that allows us to find what is leading the CO_2 uptake and in so, enable us to find ways to increase the CO_2 uptake.

35. **Incorporation of D-cThrK as a Non-Canonical Amino Acid into Escherichia coli**

Chesley Rowlett (Olivet Nazarene University)

Chemistry REU

Research Advisor: Dr. Wenshe Liu

Synthesis of specific post translational modifications in proteins can be difficult but achievable via genetic code expansion techniques. An attempt has been made to synthesize and incorporate D-cThrK into green fluorescent protein (GFP) at an amber mutation site in Escherichia coli via the coordination of pyrrolysyl-tRNA synthetase and its cognate tRNApyl. The incorporation of this non-canonical amino acid and potential chemical transformations following it allow the synthesis of proteins with post translational lysine modifications, making a variety of basic and biotechnological applications available.

36. **A Characterization of Solenoid Valve Fuel Injectors**

Alexander Prophet (St. Olaf College)

Chemistry REU

Research Advisor: Dr. Simon North

In the characterization of a pulsed hypersonic flow field, the timing of gas injection into the instrument is significant when quantifying the initial formation and duration of the flow. For this reason, quantifying the dynamics and mechanism of the pulsed gas delivery component becomes necessary. Whereas the injection component used in this context has generally been a specialized pulse valve, the use of standard automobile fuel injectors has been previously reported, providing a more economical and robust alternative to specialized valves. This work reports on the measurement of solenoid valve fuel injector opening times with attention given to the change in opening time as a function of backing pressure and driver voltage. Ambient pressure and transducer-valve distance are also considered as factors in the measurement obtained, with the most precise measurements being taken at vacuum ambient pressure with a transducer-valve distance of 1 cm. Opening times obtained for the fuel injectors are compared with those found for a Parker Series 9 Pulse Valve, a commercially available solenoid pulse valve for highly reproducible pulses. The method developed for computing the opening time relies on collecting time-resolved pressure traces using an in-house LabView program and subsequently analyzing the pulses via MATLAB.

37. **Water-Stable Low Band Gap -Conjugated Molecules Featuring N-B Coordination**

Jordan Lavoie (St. Petersburg College)

Chemistry REU

Research Advisor: Dr. Lei Fang

Pi-Conjugated molecules with low band gaps have been widely used as functional materials in the field of photovoltaics and bioimaging. In this work, pi-Conjugated molecules with deep-red absorption activities were synthesized through a series of reactions, initially making two different indolocarbazole derived molecules; fluorinated and non-fluorinated. The indolocarbazole derivatives proceed to go through a Stille Coupling reaction followed by a borylation process using BF3. The borylation process provides the N-B coordination needed to limit the torsional motion and lower the LUMO levels of the molecules significantly, affording a narrowed optical band gap (lambda max = 650 nm) and a low-energy emission. The strong N-B coordination interactions render the excellent stability of these conjugated molecules towards water.

38. **Development of an L-RNA Biosensor for the Detection of Structured RNA Targets**

Julia Santell (Texas A&M University)

Chemistry REU

Research Advisor: Dr. Jonathan T. Sczepanski

Finding inhibitors to bind and detect highly structured RNAs is of great interest in the field of molecular biology. MicroRNAs (miRNAs) are a type of short non-coding RNA which are often associated with disease phenotypes in humans, such as the onset and progression of many types of cancer. The current methods to detect these miRNAs rely on Watson Crick base pairing, and while it is well understood, it suffers from 2 major drawbacks in its application: susceptibility to off-target effects by partial complementarity to similar sequences within the genome and difficulty preserving natural structural motifs of the target miRNA after binding. To overcome this challenge, an RNA aptamer in the L chirality was employed to bind the naturally occurring precursor miRNA (pre-miRNA) in the D chirality. This “cross chiral” interaction is highly specific as L- and D-oligonucleotides cannot Watson Crick base pair, insinuating that highly specific structural motifs motivate the binding events between the probe and target while preserving the natural structure of the target. The method will include modifying the stem of an existing fluorescently labeled aptamer selected for precursor miRNA-155 to create instability and fluorescence in the unbound form. Stability will then be regenerated upon binding of the pre-miRNA, quenching fluorescence. Upon addition of a compound which binds the target more efficiently, the aptamer is displaced and a fluorescent signal is generated. The project’s goal focuses on generating a competition-based assay using fluorescent properties of target-stabilized L-RNA aptamers to aid in diagnostic screening of miRNA-binding compounds.

39. **H2O2 Adducts of Phosphine Oxides as Safe, Solid, Stoichiometric and Soluble Oxidizing Agents**

Kyle Angle (Truman State University)

Chemistry REU

Research Advisor: Dr. Janet Bluemel

Hydrogen peroxide is a highly useful oxidant in synthesis and disinfectants, but slowly and irreversibly decomposes into oxygen and water. Thus, its oxidizing power must be determined before each use, and in case the organic substrates are not water-soluble, biphasic reaction mixtures are required. Recently, we discovered that H2O2 adducts of phosphine oxides, for example [(Cy)3PO·H2O2]2, can easily be obtained from the corresponding phosphines and hydrogen peroxide. The scope of applicable phosphines has since been expanded to include aryl phosphines. The use of aqueous hydrogen peroxide for the preparation of H2O2 adducts can be completely circumvented by using Na2O2 as the peroxide source. New forms of soluble anhydrous peroxides have been obtained by deprotonation of the water-free H2O2 adducts of phosphine oxides with n-BuLi. All adducts are highly soluble in organic solvents, particularly methanol and chlorinated solvents, and they are easy to crystallize and purify. 31P NMR spectroscopy allows one to monitor the shelf lives of the adducts. Practically no decomposition is found when storing the solids at 4 °C, and they are stable towards mechanical stress. The adducts have been successfully used for epoxidation reactions and Baeyer-Villiger oxidations, demonstrating their utility. In daily life, the hydrogen peroxide adducts could serve as disinfectants for medical devices, and ointments for infected wounds. In summary, this presentation will describe a new class of materials that has great potential for ample use in academia, industry, and in daily life.

40. **Structural Analysis of TCPP Nanostructures**

Thomas Reyes (University of Alabama in Huntsville)

Chemistry REU

Research Advisor: Dr. James Batteas

Porphyrin molecules are highly conjugated macrocyclic organic molecules. Due to their unique electronic structure these molecules can function as photocatalysts, aiding in the break-down of air pollutants. Further, porphyrins such as tetrakis(4-carboxyphenyl) (TCPP) have been shown to self-assemble into nanostructures with enhanced photocatalytic properties compared to their monomer form. One example is TCPP nanowires, formed through titration with hydrochloric acid. The nanowires form through electrostatic interactions of the protonated TCPP core and chlorine anions, thus the nanostructures can be controlled under different pH conditions. Nanowires are formed at pH values below 2, but nanoplatelets are observed at a pH of 3. The mechanism driving the transition between assembled TCPP nanostructures, however, is not known. Therefore, the goal of this work is to explore the structural details of TCPP assemblies under systematically changed pH conditions. Atomic Force Microscopy (AFM) was utilized to monitor the morphological changes of TCPP nanostructures. The nanowires measured from 0.6-1.5 μm long with diameters of 100-300 nm. Both global and local changes in nanowire structure were measured by either immersing the entire sample in specific pH solutions for set times or using Dip-pen nanolithography. For Dip-pen nanolithography, the AFM tip was used to induce local structural changes utilizing humidity to alter the pH where the AFM tip is in contact with the sample. Preliminary results suggest that in pH 3 solution the wires disassemble primarily in the longitudinal direction at a growth rate of 2 nm/min. When placed in pH 1 the wires assemble at 9 nm/min.

41. **Synthesis of Nitrosolated Metal Dithiolates and bis-Phosphine Ligands as Bridges in Quadruply Bonded Dimolybdenum Complexes**

Rebekkah Hodges (University of Arkansas,)

Chemistry REU

Research Advisor: Dr. Marcetta Y. Darensbourg

The controlled aggregation of the thiolate sulfurs in MN2S2 metalloligands allows it to serve as a bidentate bridging ligand for many dimetallo units [M2]n+ (where M = Mo(II), Rh(II), Pd(II), Cu(II), Ag(I), Ni(II), and Zn(II)) with metal distances ranging from 2.1-4.4 angstroms in paddlewheel-type structures. Emergence of this class of metallodithiolate ligand was originally brought upon by their similarities to N- and P- based bidentate ligands viz bipyridine (bipy) or 1,2-bis(diphenylphophino)ethane (dppe). The difference between the two classes of bidentate ligands lies in the orientation of the lone pairs on the donor atoms and their ability to donate electron density to an exogenous metal center. In the MYD Group, numerous MN2S2 complexes, all with varying success to bind to dimetallo units, have been synthesized for applications in coordination chemistry and catalysis as well as fundamental structure studies. While the NiN2S2 metalloligands (N2S2 = N,N-bis(2-mercaptoethyl)-1,5-diazacycloheptane) have been extensively used in such studies, the analogous M = [Co(NO)](II) and [Fe(NO)](II) derivatives are relatively sparse. The [Mo2(NCMe)10](IV) precursor for generating the [Mo2](IV) central unit was used to stabilize the projected paddlewheels, [Mo2(MN2S2)4](IV). For comparison, the dppe analogue was also attempted. Although no X-ray crystal structures were obtained for the hexametallic derivatives and analogous ligands, significant IR, 31P NMR, and mass spectral data indicated success in the formation of the desired products.

42. **Thermoresponsive Poly(N-isopropylacrylamide) Solubility in Heterogenous Non-Polar Catalytic Systems**

Todd Eliason (University of North Georgia)

Chemistry REU

Research Advisor: Dr. Bergbreiter

Poly(N-isopropylacrylamide) demonstrates inverted temperature solubility, which has lower critical solution temperature (LCST) documented (~32 ˚C). It is used in oxidation, C-C coupling and other recyclable catalytic systems. Soluble PNIPAM-supported catalysts to biphasic system have been reported by our group, however, in this project, we are interested the LCST behavior of PNIPAM in organic media such as toluene, hexane and diethyl ether which are poor solvents to PNIPAM. PNIPAM can be solubilized in organic solvents by adding organic acids to bind with PNIPAM. Octanoic acid is more efficient than acetic acid in solvating the polymer because of more nonpolar interactions. In every solvent tested, this method solubilized the otherwise insoluble polymer, in toluene, benzene, hexane, ethyl ether, methyl tbutyl ether and dibutyl ether. The aromatic solvents took less acid to solubilize the polymer. Every solvent and acid combination was heated 10 ˚C past the boiling point and no clouding-point was observed. There were other ways to recover the polymer, if triethyl amine was added to the solution the polymer would become insoluble, and gave another pathway of recovery. This led to attaching a Dansyl dye to offer better detectability and act as a catalyst surrogate. This dye was to verify the catalytic pathway discovered earlier in the research. Future studies can test more solvent systems to see if an LCST can be observed. There can also be studies into other polymers to see if a different selectively soluble polymer will exhibit LCST behavior.

43. **Mapping Spectroscopic Signatures of LixV2O5 across Lithiation-Induced Phase Transformations**

Hector Figueroa (University of Puerto Rico at Cayey)

Chemistry REU

Research Advisor: Dr. Sarbajit Banerjee

Li-ion batteries are the primary means of powering technological devices spanning the range from mobile computing platforms to electric vehicles. Unfortunately, inadequacies in battery technologies; more specifically, limitations in the capacity of cathode materials, imply that the efficiencies of current storage systems are incapable of meeting the expectations and increased demand of smart devices. V2O5 is a classical layered material for Li-ion incorporation due to its ample available interlayer sites for Li-ions and the readily accessible V5+/V4+ redox couple. Unfortunately, Li-ion diffusion is impeded by the formation of small polarons and the need to nucleate and grow substantially distorted lithiated frameworks upon cation intercalation. Herein, we have chemically lithiated V2O5 nanowires with LiI in acetonitrile solution and can precisely control the incorporation of Li-ions, stabilizing phases with controlled stoichiometries, as determined by X-ray diffraction. These phases allow for evaluation of the specific composition-dependent electronic structure by scanning transmission X-ray microscopy. The availability of spectroscopic signatures of the different phases allows for extraction of phase information for test samples lithiated under varying conditions of overpotential and electrode preparation. These results thus pave the way for monitoring phase progression and phase separation in cathode materials.

44. **Synthesis and Characterization of Late Transition Metal Supported by a New PNSb Pincer Ligand**

Aldo Jordan (University of Texas at El Paso)

Chemistry REU

Research Advisor: Dr. Oleg Ozerov

The synthesis and characterization of a phosphino, amido, stibene (PNSb) tridentate ligand and their Rh and Ir complexes are described. The ligand is based on a diarylamine motif that features modular design with the choice of side arm donors. The combination made for this paper is with a dialkyl phosphine and a diaryl stibene, for steric and electronic purposes. This compound exhibits lowered symmetry due to the different donors across the mirror plane of its compounds. Cyclic voltammetry is typically used to show the ability of the ligand to be oxidized. Through IR spectroscopy, the Rh-CO complex is analyzed with respect to past published complexes to gauge the electron donating ability of the ligand. Synthetic and electronic comparisons to the closely related PNP type ligand will be made in regards to metalation and potential catalytic activity with terminal alkynes through dehydrogenative borylation of terminal alkynes (DHBTA).

45. **Slit Mask Design for the Giant Magellan Telescope Multi-object Astronomical and Cosmological Spectrograph**

Darius Williams (Case Western Reserve University)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jennifer Marshall

The Giant Magellan Telescope Multi-object Astronomical and Cosmological Spectrograph (GMACS) is currently in development for the Giant Magellan Telescope. GMACS will employ slit masks with a usable diameter of approximately 0.450m for the purpose of multi-slit spectroscopy. Of significant importance are the design constraints and parameters of the multi-object slit masks themselves as well as the means for mapping astronomical targets to physical mask locations. Analytical methods are utilized to quantify deformation effects on a potential slit mask due to thermal expansion and vignetting of target light cones. Finite element analysis (FEA) is utilized to simulate mask flexure in changing gravity vectors. The alpha version of the mask creation program for GMACS, GMACS Mask Simulator (GMS), a derivative of the OSMOS Mask Simulator (OMS), is introduced.

46. **The Stellar Kinematics of the Galaxy NGC 4203**

Mikayla Cleaver (Gettysburg College)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jonelle Walsh

At the center of every massive galaxy lies a supermassive black hole. Such black holes have masses that correlate with the large-scale properties of their host galaxies, suggesting that black holes and galaxies co-evolve. To better understand this process, more black hole mass measurements are needed over a wide range of galaxy types. Our research was focused on the S0 galaxy NGC 4203, which is located at a distance of 15 Mpc. Spatially-resolved spectroscopy of this galaxy was obtained with the Keck I 10-meter telescope in Hawaii using the instrument LRIS in long-slit mode. The data were reduced in PyRAF, and steps included bias subtraction, flat fielding, cosmic-ray cleaning, geometric rectification, wavelength calibration, sky subtraction, and flux calibration. Then using the Penalized Pixel-Fitting (pPXF) method, we measured the line-of-sight velocity distribution of stars at different distances from the galaxy center. The distribution was characterized by the velocity, velocity dispersion, and higher-order moments that describe the distribution's deviations from a Gaussian. By analyzing these stellar kinematics, we can infer the mass of the supermassive black hole at the center of NGC 4203.

47. **Specular and Lambertian Reflectance Detector For a Wide Range of Angles**

Lawrence Gardner (Rutgers University)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jennifer Marshall

The goal of this project was to build a device capable of measuring both the specular reflectance of black materials, as well as the Lambertian reflectance of white materials over their full range of incident and observed angles, respectively. This device, the MADLaSR (Multi-Angle Detection of Lambertian and Specular Reflectivity), is designed for specular reflectance testing between 10 and 170 degrees and for Lambertian reflectance testing between 10 and 80 degrees. The data collected from this project may influence the design of optical systems, aerospace structures, or other devices in which maximum lighting control is a necessary consideration. In this paper, I will discuss the design, functionality and limitations of the MADLaSR.

48. **Traveling DECal**

Daniel Freeman (South Dakota School of Mines and Technology)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jennifer Marshall

DECal is a spectrophotometric calibration system used to determine the relative throughput of a telescope. This measurement is important because large surveys, like the Dark Energy Survey, rely on precise measurements. The throughput calculations produced by DECal are used to correct photometry produced for these surveys. However, for multiple telescopes to participate in a given imaging survey, they must all be placed on a standard accuracy scale. Because DECal was permanently installed on the Victor M. Blanco Telescope 4M telescope in Chile, a new system had to be develop that could be adapted to a wide variety of telescopes. The challenges encountered and potential solutions are the focus of this work.

49. **Total Reflectance of Black and White Materials**

Doyeon Kim (Texas A&M University)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jennifer Marshall

The Astronomical Instrumentation Lab at Texas A&M is compiling a library of total reflectance measurements of various materials commonly (and uncommonly) used to reduce or increase the amount of reflected light in optical systems. The total reflectivity of each material was measured over a wavelength range 250 nm < lambda < 2500 nm using a Hitachi High-Tech U-4100 UV-Visible-NIR Spectrophotometer located in the Materials Characterization Facility (MCF). This ongoing project includes the work of many people which has in the past created several problems including inconsistent labeling, lost samples, and mistakes in the data reduction process. Our current work introduces improvements made to the sample organization and data processing pipeline along with a new user-friendly plotting method.

50. **Photometry of Satellite Galaxies of Milky Way**

Niyousha Davachi (University of Texas at Arlington)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jennifer Marshall, Dr. Louis Strigari

The color magnitude diagram of a number of Milky Way Satellite Galaxies have been derived using Gemini Deep Data. These objects have been discovered using Dark Energy Survey telescope. Photometry studies of these objects can lead into a more accurate determination of their sizes, age, luminosities, and distances. This ultimately results in a better understanding of these dark matter-dominated dwarf galaxies and of the formation mechanisms of the Milky Way galaxy.

51. **Classifying Variable Sources in SDSS Stripe 82**

Christina Lindberg (University of Washington)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. James Long

As more astronomical data becomes available to the scientific community, less time can be equally dedicated to each object of scientific interest. Rather than looking at every object in the sky individually, it becomes necessary to develop techniques and algorithms for sifting through large amounts of data, highlighting objects of interest for further analysis based on their classifications. SDSS (Sloan Digital Sky Survey) Stripe 82 is a well-documented and researched region of the sky that does not have all of its ~67,500 variable objects labeled yet. Before labeling these objects, it is useful to identify objects that have already been classified in overlapping surveys. By collecting data from different catalogs, we are able to slowly fill in more classifications within the Stripe 82 catalog. One prominent source of information has been the Catalina catalog that has allowed us to classify an additional 300 objects. The light curves of classified objects can then be used to determine features that most effectively separate the different types of variable objects. By comparing the features of the labeled and unlabeled objects, we can categorize an even greater number of objects in the Stripe 82 catalog, constructing a reference for subsequent large research surveys, such as LSST (the Large Synoptic Survey Telescope), that could utilize SDSS data as a training set for its own classifications.

52. **Comparing Light Curves of Type Ia Supernovae in Six Filters**

Sarah Parker (University of Wisconsin-Stevens Point)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Peter Brown

Type Ia supernovae (SNe Ia) are often called standard candles, since the explosions of these white dwarf stars have similar magnitudes in optical light. Because of this, they are used to measure cosmological distances. This project was a photometric study in which we analyzed the light curves of many SNe Ia in the ultraviolet range of wavelengths. Using Swift Ultra Violet Optical Telescope (UVOT) data, we were able to compare the light curves and create a template of these supernovae's magnitudes in six ultraviolet and optical filters. To do this, we took several averages of their magnitudes over different times from the peak magnitude, and then fit the template back to the individual light curves to show how varied the light curves are. By doing this, we are able to gain insight on the validity of our use of SNe Ia as standard candles for measuring cosmic distances and how much variation there is at different wavelengths.

53. **Chemical Reactions under Extreme Conditions**

Gabriel Shuffield (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Emile A. Schweikert

Individual nanoparticle impacts ,e.g. Au(400)+4, Au(2800)+4, at hypervelocity (> 15 km/s) on solid samples deliver significant energies in under 100 ps to a volume 5 - 10 nm in radius and 10-15 nm in depth. In these impacts a range of species from molecular ions to fragments and atomized species are produced. It has been shown that the atomized species can undergo chemical reactions to produce fragment ions and adducts which were not present in the original sample. Here we examine the possibility for molecular reactions on neat samples. The importance of surfaces and interfaces on chemical reaction rates is well known in catalysis and synthetic chemistry, where systems with high surface area to volume ratios have reaction rates which are dramatically higher than in bulk or solution phase. We present here data which show that reactions between small molecules emitted during a single projectile impact are also possible, e.g. two cysteine molecules are able to react to form a disulfide bond, a critical component of protein structure. Additionally we observe that glycine reacts to form glyoxylate, an important intermediate in the conversion of acetate to carbohydrates via the glyoxylate cycle. These reactions occur amongst ejecta from the topmost 5 - 10 nm and within the first 100 ps after the impact. This demonstrates that ultrafast molecular synthesis can be achieved during a single impact.

54. **Computational Studies of Catalytic Silylation of Benzene and the Selective Cleavage of Si-C Bonds to form Triorganosilanes**

Stephen Botts (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Hall

Previous work done by the Chin research group at the University of Northern Iowa revealed a diruthenium catalyst capable of silylation of C-X bonds to form new organosilanes. The reaction of benzene with HSiEt3 unexpectedly had a preference for Si-C over Si-H bond cleavage, so computational research is being conducted in order to explain: the mechanism of Si-C bond cleavage and how changes in the catalyst might improve the rate of conversion or change the product distribution. Knowledge gained would allow for further development of catalytic systems capable of selective cleaving of desired Si-C bonds to form new organosilanes. Research conducted this summer has probed the thermodynamics of the overall silylation reaction, as well as the mechanistic steps of the catalytic silylation of benzene. By combining crystal structures and experimental data found in literature, computational models were constructed in Gaussian 09; geometries, bond distances and angles, were optimized and potential energy surfaces for the reaction were developed. The potential energy surfaces were searched for transition states and the nature of the transition states and the minima (reactants, intermediates, and products) were confirmed by using analytical frequencies. The new computational results for the mechanism will be compared to the original proposed mechanism of the Chin group.

55. **Computational Study of the Methyl Transfer Between Ni, Pd, and Pt Intermediates during Oxidative Carbon-Carbon Bond Formation**

Laura Bily (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Hall

Palladium complexes have been studied extensively for their ability to form carbon-carbon bonds through reductive elimination. Many of these reactions progress through Pd(0/II) cycles. However, some experiments have investigated oxidatively-induced reductive elimination, in which Pd(III) and Pd(IV) intermediates are formed, and elimination occurs from one of these high-valent metal centers. In particular, the dimethyl Pd(II) complex (N4)Pd(II)Me2, possessing an ancillary, flexible tetradentate ligand (N4 = N,N-dimethyl-2,11-diaza[3,3](2,6)pyridinophane), was shown to be readily oxidized by dioxygen at room temperature in the presence of protic solvents. Then, an intermolecular methyl transfer occurs to form a trimethyl Pd(IV) intermediate, from which ethane is eliminated. Here, DFT theory is used to investigate the reaction energies and transition state barriers of this methyl transfer. These energies were also determined for analogous complexes where Pd was replaced with Pt or Ni. Based on the energy of reaction, methyl transfer occurs with relative ease between Ni centers and between Pd centers; however, methyl transfer is not as facile between Pt centers.

56. **Designation and Building of Time of Flight Mass Spectrometer**

Dacheng Kuai (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Simon W. North

Time of flight mass spectrometry is a convenient approach to study the molecular masses and reaction intermediates. Resonance Enhanced Multiphoton Ionization (REMPI) was chosen as the ionization technique. The main purpose of this study is to develop a functional TOF-MS to study the photodissociation of atmospherically relevant molecules.

57. **Measuring Radial Velocities of Two Stars in Horologium I**

Craig Pellegrino (Vassar College)

Astronomical Research and Instrumentation REU

Research Advisor: Dr. Jennifer Marshall, Dr. Louis Strigari

In recent years, the Dark Energy Survey has confirmed the existence of dozens of satellite galaxies of the Milky Way. These low luminosity, dark matter dominated galaxies provide a laboratory in which we may test theories of galaxy formation and evolution in the Lambda-Cold Dark Matter model of cosmology. Here, we present the results of radial velocity calculations for two stars in Horologium I, one such satellite galaxy. High-resolution spectra were obtained with the Ultraviolet and Visual Echelle Spectrograph (UVES) on the European Southern Observatory's Very Large Telescope. Data were processed using the FLAMES-UVES Pipeline and radial velocities, along with their associated errors, were calculated with the data reduction software IRAF. The measured velocities are in agreement with velocities reported in previous studies of Horologium I, increasing the number of member stars of this galaxy. By building a collection of stars in Milky Way satellite galaxies we may begin to study their histories, leading to a deeper understanding of the formation of these galaxies as well as the structure of the universe.

58. **Visualization of Latency Data**

Shiva Saravanan (Texas A&M University)

CSE@TAMU REU

Research Advisor: Dr. Dilma Da Silva

Many problems in computing involve the efficient processing of data. One of the key questions in this area is that of whether processing data at the edge of the local network or in the cloud is more cost-effective. This problem can be tackled by measuring the latency of sending data to cloud servers and edge servers. One important method of tackling this problem is visualizing the sequence of data from these types of latency experiments. This poster showcases a method of data visualization from the results of a latency experiment in which UDP datagrams are repeatedly sent and received from a server, and the results are then measured. These results are put into a text file, which is then generated into an mp4 that is embedded into an HTML file for viewing on the web. This framework is intended to speed up the visualization of data from experiments relating to edge and cloud computing. However, although the framework was developed to assist in experiments in which the efficiency of edge and cloud computing are compared, it can be used for any problem in which sequential data (such as repeated measurements from sensors) must be processed.

59. **Lithium Nitrate Trihydrate Undercooling**

Aaron Garcia (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Patrick Shamberger

Lithium nitrate trihydrate (LiNO3·3H2O or LNH) is a promising thermal energy storage (TES) material for the increased power output of developing electrical systems and components. As a phase change material (PCM), LNH can store and release large amounts of heat at a constant temperature as it transitions to and from solid to liquid phases. LNH exhibits large specific heat of fusion, volumetric and specific energy storage density, thermal conductivity, and thermal diffusivity compared to other commonly used PCMs such as octadecane and water. Additionally, LNH has a relatively low melting point of 30 °C. However, one problem with LNH is that it suffers from undercooling of around 40 °C, resulting in unpredictable solidification while cooling. Likasite (CHNH or Cu3(OH)5(NO3)·2(H2O)) and zinc hydroxy nitrate (ZHN or Zn3(OH)4(NO3)2) are two identified catalysts that promote nucleation in and reduce the undercooling of an LNH system due to their similar lattice registry and surface chemistry to LNH. Both catalysts have been tested in small volume (~10 mL) systems of LNH. This project focuses on designing an experiment that will allow the catalysts to be tested in larger LNH systems (~5 mL). The effect of catalyst distribution throughout the system and repeated heating and cooling cycles will also be addressed. Hermetically sealed test tubes will be filled with pure LNH or LNH with small amounts of nucleation catalyst concentrated at the bottom or spread throughout the system. The temperature of the LNH will be monitored as the tubes are heated and cooled in a programmable water bath.

60. **Combustion in Oil and Gas Applications**

Elizabeth Seber (Pennsylvania State University)

Undergraduate Research in Energy and Propulsion REU

Research Advisor: Dr. Berna Hascakir

With a growing demand for oil, the petroleum industry has no choice but to look into novel ways to recover more oil from unconventional reservoirs. Heavy oil and oil sand reservoirs, which are abundant in North America, prove to be the perfect challenge. The conventional method of heavy oil production involves solvent-steam flooding, a method used to flow the heavy oil out of the reservoir. This method leaves a considerable amount of residual oil, and this must be taken into account when choosing an extraction method. The typical method of determining residual oil involves a solvent washing of the spent rock, or leftover reservoir. However, using combustion through thermal analysis method gives a more complete look at the spent rock, and was one point of focus for this study. The second point of focus was using an entirely different recovery method. In-Situ Combustion (ISC) is a heavy oil recovery technique that uses the high temperatures of combustion to burn and push the oil towards the production well. This method has a high recovery factor, and is known to produce an upgraded and low viscosity oil, but is known to fail due to the complex chemical reactions that occur. Using combustion kinetics study, this research takes a look into the reactions happens in different zones of ISC and how reservoir rocks and fluids will react at high temperature. Studying this enhances our understanding of combustion reactions, and will help us predict how ISC will perform in different types of reservoirs.

61. **Self-driving Vehicles and Pedestrians Communication**

Quang Le (Texas A&M University)

TTI ATLAS Summer Internships

Research Advisor: Dr. Srikanth Saripalli

Self-driving vehicles has been in development since at least the 1920s, but developers have only made signification achievements in recent years. Nowadays, drivers can communicate with pedestrians using gestures, and pedestrians can understand them most of the time. When self-driving vehicles are fully developed, the drivers will be replaced by computers. Once the drivers are removed, the pedestrians will have problem guessing what vehicles trying to do. This project is a first phase of creating a system that can effectively communicate with pedestrians. To visually communicate with pedestrians, two RGB panels, front and back, were used to display messages which can be symbols, or texts. To audibly communicate with pedestrians who are visually impaired, two directive speakers were used. One speaker was used to initialize the guidance, and the other speaker was used to provide follow up instructions. Directive speakers were used to make sure only targeted audiences can hear them. Two RGB panels was built and tested, and pedestrians who are approximately 10 feet away from the vehicle can read the instruction even under direct sun light. The audible communication was programmed, but was not tested due to delay in shipping. That this early stage of development, only the velocity data provided by the GPS was used. For that reason, the RGB panels can only display the information to tell the pedestrians if the vehicle is moving or not. In the future, when the vehicles can detect the pedestrians, more appropriate messages will be displayed.

62. **Roundabout Operations and Safety Performance**

Luis Sevillano (University of Puerto Rico in Mayaguez)

TTI ATLAS Summer Internships

Research Advisor: Dr. Raul Avelar

This research will examine the relationship between a roundabout's operational performance and safety. Besides improved traffic conditions at roundabouts, vehicular and pedestrian safety are expected to improve as well, in comparison to conventional intersections. This is due to providing vehicles with fewer conflicts points and lower speeds. However, this data only takes into consideration general situations. This research will collect data on operational at select roundabouts and will use it to assess their performance, via Highway Capacity Manual (HCM) methods. The research will collect data at roundabouts located in Bryan, College Station and in the Austin area. At the same time, this research will study the number of conflicting interactions between users. These conflicts are anticipated to have an impact in the operating and safety performance of these facilities. Some of the key metrics that with be taken into consideration for this research are: number of conflicting interactions, capacity, queues, vehicle and pedestrian behavior, and geometric conditions.

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

Christian Estela (Texas A&M University)

TTI ATLAS Summer Internships

Research Advisor: Dr. Thomas FErris

The goal of this project is to develop and test countermeasures that can be implemented to help human drivers recover from problems that can arise in interactions with partially automated vehicle systems. For examples, vehicles can include adaptive cruise control and lane keeping assistance functionality to support the driver in longitudinal and lateral guidance. If and when the systems fail or a human reacts inappropriately due to misinterpreting the automated control inputs, display and control support can help the driver take over control safely and effectively. This study will be conducted using scenarios developed in a driving simulator at Texas A&M University located in the Human Factors & Cognitive Systems lab. The simulator will be used to test individuals abilities to take control of this partially automated vehicle when a fault is triggered remotely and appears to the driver to have occurred in the vehicle system. The individual is unaware as to when this partially automated vehicle will fail and will have to take over control when this occurs; the timing and effectiveness of this takeover will be the main outcome of interest in this study. The purpose of this project is to investigate and develop countermeasures for the types of situations where automated vehicle functions fail and the subject has to take control of the situations. Various types of multisensory cues and control advice will be studied and designed to redirect attention to this main task (manual driving).

64. **Indoor Data Set Collection for Vision-based Simultaneous Localization Mapping for Indoor Mobile Robot**

Chuan-kuo Wong (New Jersey Institute of Technology)

Mechatronics, Robotics, and Automated System Design REU

Research Advisor: Dr. Sheng-Jen ("Tony") Hsieh

SLAM (Simultaneous Localization and Mapping) is the ability for a robot to localize itself and build a map of the environment at the same time. This algorithm is a fundamental element for self-driving cars and augmented reality. Cameras are necessary for this computer vision process. In order to have accurate SLAM data, the cameras should always be calibrated. This paper describes the parameters and the different methods of camera calibration. In the current state-of-art SLAM algorithm, ORB-SLAM is one of the best algorithms that is able to build accurate maps. We believe the data presented in the paper would be helpful for future research in the area of visual SLAM.

65. **Mechanical Testbed for Patterned Tubes**

Christopher Kim (Northwestern University)

Mechatronics, Robotics, and Automated System Design REU

Research Advisor: Dr. Seok Chang Ryu

A robotic needle steering system allows accurate control of the needle's orientation and path to avoid obstacles and reach targets within the human body. For the desired movement and tip-positioning accuracy, the needles should have a high torsional stiffness and low flexural stiffness, and this is achieved by embedding various repetitive patterns on the superelastic shape memory alloy, nickel titanium (NiTi) tubes. One limitation associated with using NiTi is its highly nonlinear stress-strain behavior, which makes it nearly impossible to model its deformation and mechanical behavior, especially when patterned. Hence, the need for a mechanical testbed that can empirically evaluate the mechanical properties of the patterned tubes is pressing. The mechanical testbed, so conceptualized, is manufactured by 3D-printing (with PLA polylactic acid), and actuated by two independent stepper motors atop a ball-screw actuator. Together with a 6-axis Force/Torque sensor, this enables a user-friendly graphical user interface (GUI) to obtain measures for axial, torsional, and flexural rigidity of patterned tubes.

66. **Thrust-Based Climbing Robot for Structural Inspection**

Zhong Thai (Oklahoma State University)

Mechatronics, Robotics, and Automated System Design REU

Research Advisor: Dr. Sheng-Jen ("Tony") Hsieh

Inspection of civil structures has been a cumbersome and costly endeavor necessary to prevent catastrophic failures. Technology to facilitate this has been under development for the past few decades in the form of wall climbing robots, but a large portion of these focus on using suctions cups or some kind of adhesion which are poor solutions for the rough and dirty surfaces of building exteriors. To address these problems these problems, a robot using thrust was developed. This robot would use a ducted fan to push onto a surface, generating enough friction to allow the robot's tank treads to function. An Arduino Nano acts as the controller of the robot, processing sensor input from two accelerometers and sending commands to the motors, servos, and fans. A servo controls the angle of the fan through a simple 4-bar crank-rocker linkage system. The controller is a modular controller phone app that communicates with the robot through Bluetooth. In addition to the robot, models were developed to help set up a closed loop system that can adjust the speed and angle of the fan for to maximize efficiency while the robot moves over varying slopes. This was developed for the 2017 Mechatronics, Robotics, and Automated System Design Research Experiences for Undergraduates program at Texas A&M University.

67. **Alexa-based Intelligent Tutoring System Using Voice Conversation to Teach Ladder Logic Programming**

Chulabhaya Wijesundara (University of Massachusetts Amherst)

Mechatronics, Robotics, and Automated System Design REU

Research Advisor: Dr. Sheng-Jen ("Tony") Hsieh

This study focuses on the development and evaluation of a voice conversation-based intelligent tutoring system that is able to teach students about counter instructions in ladder logic programming. This system utilizes Amazon's Alexa intelligent agent to create a front-end voice-user interface that allows students to access and utilize the back-end tutoring system. Students can query Alexa for questions or tutoring. Should the student request questions, the tutoring system interfaces with Alexa to output questions in voice. As the student responds to these questions in voice, their performance is monitored and the system dynamically adapts the level of questions Alexa provides.

68. **Design, Build, and Evaluation of Cableway Robot for Smart Irrigation System**

Dilmurod Saliev (Binghamton University State University of New York)

Mechatronics, Robotics, and Automated System Design REU

Research Advisor: Dr. Sheng-Jen (“Tony”) Hsieh

The automation of work in the agriculture area is essential to increase production or quality of food. In this work the process of measure soil moisture is automated by the use of a robot, this work is usually done by people that have to bury the sensor in the soil in several different areas to map the moisture distribution around the field and plan irrigation schedules and water volume in each section. As a way to light this burdening task from people this project proposed a robot design that moves around the field by using a cableway system attached to the structure of a central pivot irrigation system. The robot is divided in three main parts automatic drill system, power source and deployment system, and cableway system. Automatic drill system would be in charge of auger a hole in the soil at a specified depth and bury the sensor in the bottom of the hole. Power source and deployment system consist of a winch that deploys the automatic drill system and retracts it. Cableway system consists of a gripper that works as a train over a cable suspended by supports in the structure. The objectives of this study are to design and build an autonomous soil measuring robot to evaluate its performance. The goal of the present study is rather to establish a sound knowledge base to use for the more detailed studies needed to design an operational system that will be successful in the irrigation system.

69. **Substrate-Guided Synthesis of 1-D Hafnium Dioxide (HfO2) and Mg Nanowires**

Oscar Gonzalez (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Sarbajit Banerjee

Controlling nucleation phenomena is imperative for defining the crystal structure of solid-state compounds and can be accomplished using an appropriately modified substrate as a template. Here, we demonstrate two examples of substrate-directed materials growth. The first thrust is focused on the stabilization of orthorhombic HfO2 using epitaxial growth from a VO2 template. HfO2 has a higher dielectric constant, band gap, and hardness as compared to SiO2, which has led to interest in the integration of this material as a gate dielectric for energy efficient devices. Metastable phases of HfO2, such as orthorhombic or cubic HfO2, are expected to exhibit substantially improved properties as compared to their monoclinic counterparts, which represent the thermodynamic minimum. Unfortunately, these phases are usually only attainable at higher temperatures and pressures. An epitaxial growth method has been explored as a synthetic approach for stabilizing orthorhombic HfO2. The second thrust is focused on the synthesis of 1-D Mg nanowires by electrocrystallization. The synthesis of nanostructured magnesium has not been extensively explored due to the limited number of reducing agents that can reduce Mg precursors to metallic magnesium. Here, we demonstrate the role of thiols in the production of high coverage substrate-bound Mg nanowire arrays via directed electrocrystallization of magnesium from Grignard’s reagents. More intricate structures are of interest for applications in corrosion inhibiting coatings, where magnesium is providing cathodic protection, and in magnesium-ion batteries where such arrays can serve as a metallic anode.

70. **Synthesis and Characterization of Stair-step Trimetallic M(II)N2S2Pd(II)S2N2M(II) Complexes as Biomimetics of ACS Enzyme Active Site**

Heechang Shin (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Marcetta Y. Darensbourg

The active site of Acetyl coA synthase offers a cyc-gly-cys tight binding motif that harbors a Ni(II) center. The cis-dithiolates of the NiN2S2 metalloligand allows bidentate binding to support a second catalytically active nickel center that allows organometallic like C-C coupling reactions. Recently the MYD group reported NiN2S2 stabilized Pd(II)(diphos) bimetallic complexes as biomimetics of the ACS active site that efficiently allows Suzuki-Miyura C-C cross coupling reactions. Although most previously reported Pd(II) precatalysts are stabilized by substituted phosphine ligands in their catalytic cycle, it is necessary to pursue an analogy between diphosphine and dithiolate stabilized Pd(II) units in order to advance the scope for the viability of such heterometallic catalysts. Here we report the synthesis and characterization of four M(II)N2S2Pd(II)S2N2M(II) complexes [where, M = Ni(II), V(O)(II), Fe(NO)(II), Co(NO)(II)] featuring bis-metallo-cis-dithiolate bound Pd(II) in a square-pyramidal cum stair-step conformation. These trimetallic complexes were tested for Suzuki-Miyura and Sonogashira cross coupling reactions with varied substrate scope; Ni(II)N2S2Pd(II)S2N2Ni(II) complexes showed best results with 5% catalyst loading at 95 degree Celsius. The M(II)N2S2Pd(II)S2N2M(II) complexes were characterized by IR, NMR, CV, EPR and X-ray crystallography.

71. **Surface Analysis using Massive Cluster SIMS**

Jesse Sandoval (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Emile A. Schweikert

Secondary Ion Mass Spectrometry is a powerful analytical technique which uses primary ion to impact a surface and generate ions (secondary ions) to characterize the surface of the sample. Using massive cluster projectiles has been shown to increase the emission of molecular species by 100-1000x compared to atomic projectiles enabling molecular characterization. Here a sequence of projectiles separated in time and space are used to bombard a surface, in the so called event by event bombardment detection mode. Here, from single projectile impact the co-emitted secondary ions are mass analyzed with a Time-of-Flight (ToF) mass spectrometer. These co-emitted ions originate from a nano-volume ~10 nm in diameter on the surface. Using 520 keV Au4004+ (33 km/s) an average of 15 ions per impact are emitted which allows for the analysis of co-emitted ions. Interrogating these individual mass spectra for characteristic ions from different components one can determine if the two ions are emitted together or in separate impacts. If ions are emitted together the number of these impacts can be determined and the homogeneity of the two components determined. Thus the method allows to evaluate molecular homogeneity at the nano-scale level. The methodology was tested on a set of polymer blends and two control samples, and the homogeneity of the blends was evaluated. The methodology and results will be presented

72. **Fixture Design for Confined Compression Testing of Hydrogels**

Robert Kempner (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Moreno

Articular cartilage, a biphasic soft tissue, is vital to the proper function, lubrication, and protection of joints in the body; however, if this tissue deteriorates, repair is exceptionally difficult: transplants are costly and can be rejected by the new host, and synthetic tissues of this nature are not yet available. Understanding the mechanical properties of cartilage and other biphasic materials, such as hydrogels, is an integral step towards synthesizing effective and viable materials for the repair damaged articular cartilage. Uniaxial confined compression testing is one of the standard methods used to further understanding of mechanical properties of biphasic materials. Fixtures for confined compression testing have been designed that mimic in vivo conditions by confining the specimen radially and only allowing fluid flow from one side. The ejected fluid flows through a porous platen which can be exchanged for materials of differing composition and porosity. These fixtures will be used to effectively perform confined compression testing to further our understanding of these mechanically complicated biphasic materials.

73. **Fixture Design for Unconfined Compression Testing of Hydrogels**

Abigail Meza (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Moreno

Articular cartilage is a biphasic soft tissue that is essential for the proper biomechanical functions of joints. Its unique properties allow joints to withstand large compressive loads without being crushed or damaged. If the tissue deteriorates, pain and loss of proper joint function occurs, affecting a person's ability to perform everyday tasks. The treatment of cartilage injury is costly and not always effective. Novel hydrogels are being developed as synthetic methods for replacing articular cartilage. To determine if hydrogels are suitable for this purpose, their mechanical behavior will be compared to that of articular cartilage. For this purpose, a compression fixture was designed with impermeable, rigid platens' to create a uniform distribution of load. Additionally, future work will include other forms of mechanical testing such as confined compression and tensile testing. The data from these tests will be used to characterize mechanical behaviors of hydrogels within the context of articular cartilage replacement.

74. **Improved Design for Rainwater Collection and Storage System**

Veronica Knisley (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Alan Palazzolo

In countries such as Guatemala, rainwater storage cisterns are constructed to provide villagers with clean water year-round. However, the current systems can be expensive and dangerous to construct, and their current design limits their water collection and delivery potential. The objective of this project was to develop a more affordable yet sturdy rainwater collection and storage system for these communities. The new design was modeled in SolidWorks and was tested through a one-way fluid-structure interaction (FSI) simulation. This simulation was carried out with ANSYS FLUENT and ANSYS Static Structural. This presentation details the results of this simulation, such as the maximum wind pressure, Von-Mises stress, and deformation of the structure. This, in turn, is used to verify whether or not this new design is viable for use in small villages.

75. **Factors Surrounding Child Seat Usage In Ride-share Services**

Arwah Al-Kahtani (Texas A&M University)

TTI ATLAS Summer Internships

Research Advisor: Dr. Katie Womack

While American adults continue to improperly restrain children in adult seat belts, studies have shown motor vehicle injuries are the leading cause of injury deaths for children less than 8-years-old. In 2015, fifteen percent of American adults used ride-share services as an alternative transportation (PEW Research Center), including adults with children. To this day, ride-share companies lack the implementation of child restraint laws leading drivers to conclude improper assumptions regarding their responsibilities towards their clients and creating a controversy between ride-share drivers and passengers. Although thirty-four states in the U.S have exempted for-hire vehicles and/or taxis from child restraint laws, forty-nine states have not used the term "ride-share" in their legislation when specifying vehicles exempted or not exempted from child restraint laws. This research paper compiles and analyzes data extracted from ride-share driver forums, parent forums, and pilot focus group studies. All data sources provide a comprehensive perception of child restraint laws vocalized by ride-share drivers and passengers. The purpose of this paper is to provide a rough estimate of the average number of ride-share drivers and passengers following child restraint laws when using ride-share services.

76. **Interstate 35 Travel Time Assessment**

Daniel Khuat (Texas A&M University)

TTI ATLAS Summer Internships

Research Advisor: Dr. Robert Brydia

The Texas Department of Transportation (TxDOT) has been working painstakingly on the Interstate 35 corridor in Central Texas for many years. During the construction process, drivers along the corridor have encountered inconveniences to their travel times by queues created by lane closures and accidents. Researchers from the Texas A&M Transportation Institute (TTI) have developed a system that predicts traffic conditions on Interstate 35 when a lane closure is to occur. Predicted delay data from these assessment reports will be compared to actual travel time data using Bluetooth sensors during the lane closures in order to assess the accuracy of those predictions. Deviations between predicted and actual travel times will be examined to identify, if possible, any systemic contributors to those deviations.

77. **Pilot Study for Human Factors Testing of Devices to Warn Pedestrians of Turning Buses**

Ryan Augustine (University of Vermont)

TTI ATLAS Summer Internships

Research Advisor: Dr. Kay Fitzpatrick

Pedestrian commuting is becoming much popular in the U.S. as walking is promoted as healthy, environmentally-friendly, and inexpensive. However, these users have much higher exposure then other modes of transportation, and therefore a greater risk to injury. Transit vehicles provide a challenge for engineers in protecting pedestrians due to the driver's line of sight being obscured. One report claims 60% of collisions between transit vehicles and pedestrians happen during a left or right turn at an intersection. The frequent occurrence of this type of event is a result of both the pedestrians and the bus having the right of way, but the distracted (or undistracted) pedestrian does not notice the turning bus. The goal of the project I am affiliated with during my internship at TTI will address the factors surrounding Turning Bus Pedestrian Safety by implementing the following tasks: A literature review of recent studies regarding pedestrian safety and field study where research participants will be asked to walk a course in an urban environment and be asked to keep an eye out for new warning system technologies. The pedestrians will then be asked questions about the effectiveness of each device. As a research assistant, I will be assisting with the tasks mentioned above as the timeline permits. I will be writing about the following topics in my paper: The effectiveness of the devices that will be tested in an urban environment and warning devices that has been tested in previous studies.

78. **Change of Vehicle Operating Speed in presence of Bicyclists on Urban Arterial Roadways**

Lizzie Clark (Virginia Tech)

TTI ATLAS Summer Internships

Research Advisor: Dr. Kay Fitzpatrick

The urban arterial roadways in the U.S. continue to adapt to the increasing need of bicycle facilities. In many cases, the bike paths are not detached from the traffic lane by physical separation. The presence of bicyclists utilizing these bike paths affects traffic flow and the drivers' ability to maintain an optimal traveling speed. This study aims to explore the implication of operating speed in presence of bicyclists. To accomplish the research goal, this study requires several databases: 1) Bike count data for 15 minute intervals, 2) Annual Average Daily Traffic (AADT), 3) Vehicle average speed data for 15 minute intervals, 4) Roadway inventory data. This study considered San Diego, CA as a case study for examining the research hypothesis. The San Diego Association of Governments (SANDAG) provided access to bicyclist count data (15 minute intervals) for forty-seven count stations. This research effort also extracted travel time data on these roadways from the National Performance Management Research Data Set (NPMRDS) using spatial coordinates at the segment start and end points. The roadway geometrics considered in this study are: existence of buffer, width of buffer, width of bike path, type of bike path, and presence of motorized vehicle parking alongside bike path. The obtained results will examine whether presence of bicyclists on roads would affect changes in motorist operating speeds by developing a mixed effect logistic regression model.

79. **Driver Training for Automated Vehicle Technology**

Rachel Sable (Virginia Tech)

TTI ATLAS Summer Internships

Research Advisor: Dr. Michael Manser

Automated vehicles provide a unique opportunity to improve transportation safety. With crash prevention features such as Automatic Emergency Braking, Lane Keeping Assistance, and Adaptive Cruise Control, there should be an inevitable decrease in motor vehicle crashes. However, to utilize the safety features in newer vehicles with automated technologies, drivers must understand how to use these systems correctly. There are currently no industry standards for training drivers to use automated vehicle technology. A series of consumer focus groups were analyzed to begin development of training methods for future testing with drivers. Focus groups discussed how consumers prefer to be trained to use new vehicle technologies and explained why certain training methods are more appealing than others. Participants were also prompted to share concerns about the requirement of training.

80. **Measuring Retroreflectivity Values of in Service RRPMs**

Andrew Peretin (Virginia Tech)

TTI ATLAS Summer Internships

Research Advisor: Dr. Adam Pike

Raised retroreflective pavement markings (RRPMs) help to provide traffic lane delineation for nighttime drivers. The markers reflect light from car headlights back to drivers of vehicles to help give visual guidance of road lines. The amount of light reflected back to the drivers is referred to as retroreflectivity. An issue with RRPMs is that retroreflectivity values decrease over time and there is no government standard for levels of retroreflectivity of in service RRPMs. This is because there is no system in place for measuring the retroreflectivity value of these RRPMs. Once there is a standard in place, these markers can be replaced only when necessary and deemed inefficient. The goal for the experiment is to show a correlation between a portable (handheld) and a mobile device (attached to car) to help later develop standards. The mobile unit is currently only used to measure pavement markings but has the ability to measure markers faster by driving next to them. Unlike the mobile device, the handheld device has to be placed next to each marker to effectively measure its retroreflectivity. Thus, it is much more efficient to use the mobile device when taking readings of many RRPMs. Currently, the mobile device hasn't been used to measure RRPMs, however, the experiment will show whether or not the Mobile device has the ability to measure the RRPMs retroreflectivity. The handheld is a known way to measure RRPMs and if a correlation exists, the mobile unit can be used to help develop standards.

Life Sciences, Biomedical Sciences, Health Sciences, and Geosciences

3:00 PM – 5:00 PM

1. **Fun in the Shade: Using ArcGIS Least-Cost Path Analysis to Navigate Pedestrians Across Texas A&M's Campus While Minimizing UV and Heat Exposure**

Isaac Lello-Smith (Cornell University)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Do you get hot walking across campus? Texas A&M students, faculty and staff, (hereafter referred to as Aggies) are exposed to high temperatures and intense UV rays on A&M's campus. Navigational technology can help Aggies avoid heat and UV rays while walking across campus. Investigators developed a program in the geographic software ArcPRO to navigate Aggies across A&M's campus in a way that minimizes their exposure to solar radiation, heat and UV rays. Treating incoming solar radiation as a cost, the program applies a least-cost path analysis to determine the least sunny paths across campus. To test the program's efficacy, study participants walked from an assigned starting building to a destination building, first using a route of their own choice, and then using the least-cost path generated in ArcPRO. Participants wore Arduino sensors to measure their exposure to UV and temperature on their two navigations as well as a GoPRO and GPS unit to track their path across campus. The participant's perceptions of thermal comfort and navigational ease were recorded through a survey. Investigators predict that participants will be exposed to less heat and UV radiation when following the least-cost path, but will take more time to reach their destination.

2. **Participatory Sensing of Cycling Path Safety with Wearable Devices**

Kalynn Kosyka (Smith College)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

According to the 2012, National Survey of Bicyclist and Pedestrian Attitudes and Behavior In the US the number of injuries including fatalities increased by 6% since 2006. The main causes of injuries are road conditions such as uneven roads or cracked sidewalks. We propose that by attaching smart devices to the users' back pocket and the back of the bike we will b able to develop features collected from the accelerometer allowing the analyzation and training of the machine which will allow the classification of road quality. By having a system which takes GPS, accelerometer data and maps road quality counties will be able to make infrastructure improvement which will improve bicyclist daily commute and perhaps decrease injuries.

3. **Morbidity & Mortality of Texas Tornado Outbreaks**

Heather Swienton (Texas A&M University)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Tornadoes, amongst other natural disasters, are the cause of some of the most noteworthy morbidity and mortality rates in the United States. Among states, Texas has experienced the highest number of tornado related fatalities in the last century alone. An in-depth understanding of tornado outbreaks (informally defined as a grouping of six or more tornadoes) is necessary in order to mitigate future casualties. However, outbreak severity, though long studied, has not been formally standardized. High correlations between morbidity and mortality rates and the presence of major (F3 or greater) tornadoes within a given outbreak could give insight to outbreak severity. While utilizing the widely accepted Fujita Scale as a flawed but consistent severity measure, the goal of this study is to examine the impact major tornadoes have in outbreaks and outbreak-related morbidity and mortality rates. Outbreaks containing six or more tornadoes during the time period of 1980 and 2009 have been investigated, comparing tornado outbreaks with and without major (F3 and greater) tornado events to non-outbreak events of major and minor (F0-F2) severity. Investigators predict that there is a statistically significant relationship between the occurrence of major tornadoes in outbreaks and high rates of morbidity and mortality.

4. **Using Machine Learning to Classify Smoking Motions from a Smartwatch's Accelerometer**

Daniel Hou (Texas A&M University)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Cigarette smoking is the leading preventable cause of premature death worldwide and is responsible for more than 480,000 deaths per year in the United States. While 15.1% of the US population smokes, approximately 70% of this population is currently trying to quit. One effective smoking cessation intervention technique is reminding smokers to take up another action as a replacement to their smoking. We propose that smoking has unique, repetitive hand-to-mouth motions that can be tracked using smartwatches. By feeding arm motion data from 45 naturalistic smoking sessions into a machine learning algorithm, we propose a two-tier model to classify and distinguish smoking behavior from similar movements like drinking or eating. This poster describes our methods and results.

5. **An Analysis of Mercury Loading in Sediments Offshore of the Modern Brazos River Delta, TX USA**

Evan Flynn (Eckerd College)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Tim Dellapena

Globally, Mercury (Hg) is one of the most detrimental aquatic contaminants present in marine sediments. Hg pollution poses a large risk to ecosystem and human health. This contaminant naturally enters marine environments through processes such as volcanic eruptions and mercury-rich bedrock erosion. However, with increased anthropogenic activities, non-point and point source pollution has caused an increase in Hg concentrations within marine sediments. The Brazos River and its upper watershed along the Northern Texas coast is one of many fluvial systems affected by the increased mercury pollution. Being one of the largest carriers of sediment to the Gulf of Mexico, the Brazos sediments have a significant impact on the offshore sediment composition along the Texas coastline. Brazos sediments, characteristically fine grained and a rich red to brown in color, are deposited along the western flank of the river's mouth due to southwestern net longshore drift in the region. This sediment transport leads to an eventual deposition of Brazos River sediments, creating what has been called the Texas Mud Blanket (TMB). This study seeks to investigate the concentrations of Hg within the TMB to determine contaminant loading through and offshore of the Brazos River. Water content, organic content, and Hg concentrations will be analyzed from samples of cores collected along the TMB. The results of Hg concentrations will then be compared to Lead (Pb) 210 dating to determine the time of deposition and possible links between Hg loading in the Brazos River and increased industrialization in the region.

6. **Transportable Energy for Harbor Protection and Harbor Resilience**

Josephine Schamle (Florida Institute of Technology)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Joan Mileski

Port resilience is the ability to adapt to and recover from complications. Such complications may arise from natural disasters such as hurricanes. One of the main issues in port resilience is the power that is needed to keep port operations at previous standards. With the use of tidal energy obtaining a hurricane's strength for later power supply, this would permit faster and more effective port resilience. Tidal energy allows for tidal currents to be converted into a harnessed energy source. This energy source is best used in areas of high tidal ranges. With an environmental disaster such as a hurricane, the tidal ranges would provide a temporary placement of a tidal energy turbine system which would store potential energy for later operations. Also tidal energy could also be utilized as a structural placement because it can act as a barricade from a storm surge. This study is a small structural comparison with a scaled representation of the wave and structural design. Port resilience would be optimal for temporary tidal turbine placement using caisson as an outer house structure.

7. **Reconstructing Hurricane Activity Over the Last 300 Years Using Bluehole Sediments from Grand Bahama Island, The Bahamas**

Grace Kim (Stony Brook University)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Pete van Hengstum

Hurricanes are one of the most devastating natural disasters; however, a short observational record (~150 yrs) of Atlantic hurricanes limits understanding of long-term patterns and drivers of hurricane activity. Blueholes form when sinkholes on a carbonate platform become flooded by sea-level rise, thereafter becoming natural traps for continual sedimentation over time. During hurricanes, coarser-grained sediment is transported into blueholes that otherwise accumulate finer silt and clay particles. Therefore, bluehole sediment may provide unprecedented insight into Atlantic hurricane frequency variations over the last several millennia. In 2016, four sediment cores were collected from Lane's Delight Blue Hole (LDBH) on Grand Bahama Island. An age-model generated from seven radiocarbon-dated leaves from the ~12 m long core, LDBH-D4, reveals a sedimentation rate of ~0.6 cm/year over the last 1700 years. The top 187 cm (~300 yrs) of LDBH-D4 was analyzed using loss on ignition procedures and sieving at 32μm (coarse-silt) and 63μm (sand) fractions to distinguish downcore variability in sediment texture as a proxy for hurricanes. Coarse-sediment variations in the sampled portion of LDBH-D4 reveal up to nine event-beds that correlate temporally with hurricanes that passed within 50 km of LDBH during the last 150 years, including Hurricanes Jeanne (2004) and Erin (1995). Part of LDBH-D4 from 50-100 cm appears to have been reworked; however, the remaining sampled core supports the suitability of LDBH-D4 to reconstruct paleo-hurricane activity. Further analysis of LDBH-D4 may provide insight on the response of hurricanes to regional and global climate variablity over the last 1700 years.

8. **Marsh vs. Mangrove Vegetation: Differences in *Callinectes sapidus* Predation Success**

Jade Blennau (Stony Brook University)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Anna Armitage

Mangrove vegetation is encroaching into previously marsh-dominated environments of the Texas coast. Changing the characteristics of the dominant plant assemblage can influence the predator-prey dynamics that shape community structure. This study looked into how shifts in structural environment affect the prey capture rate of *Callinectes sapidus* (blue crab) on penaeid shrimp. Artificial materials were used to create three treatment environments to mimic the structural rigidity of (1) salt marsh plants *Salicornia spp.*, Batis maritima and most closely Spartina patents, (2) more rigid stems and pneumatophores of the black mangrove Avicennia germinans, and (3) a control treatment with no artificial plant species.There was 64% lower total mortality within more rigid mangrove environment in comparison to more flexible marsh environment and control. Further, the time to first capture was more than doubled in mangrove treatments. This outcome suggests that mangrove encroachment into salt marshes may reduce blue crab foraging efficiency. Understanding the effects of habitat structure on varying predation success is key for making meaningful predictions about the ecological consequences of shifts in the community structure on the Texas coast.

9. **Development of High Resolution Melting Assay (HRMA) for Species ID of Phloem-Feeding Planthoppers, *Prokelisia marginata* and *Prokelisia dolus***

Nevada Jordan (Texas A&M University at Galveston)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Jaime Bremer-Alvarado

Prokelisia is a genus of dimorphic phloem-feeding planthoppers that, along with other species of leafhoppers and mirid bugs, may account for >90% of herbivore biomass in salt marshes. Previous studies have shown an association between abundance of planthoppers and ecosystem services of Spartina marshes. Identification of *P. dolus* and *P. marginata* to species level is problematic, as only the males are visually distinct, and then only by microscopic characteristics. The objective of this study is to create a fast, efficient, reliable way to distinguish between *P. dolus* and *P. marginata*. To that end, DNA sequencing data will be used to develop high resolution melting assays (HRMA) that can reliably assign individuals to the correct species. A segment of the cytochrome C oxidase I (COI) gene from pre-identified individuals was PCR amplified and Sanger sequenced. Sequences from both species were aligned, and fixed differences were identified and used to design an HRMA that distinguishes between the two species. The assay was then tested on a large pool of specimens (n=96) on multiple qPCR platforms to ensure that there are no ambiguous results. The resulting assay will be useful in distinguishing between *P. dolus* and *P. marginata*, therefore reducing the chance of including inter-specific genetic variation into a planned population study of *P. marginata* in Spartina salt marshes along the Gulf of Mexico coast.

10. **Origins and Transformation of Dissolved Organic Matter (DOM) Investigated Through Coupled Microbial-Photochemical Incubations of Vascular Plants Leachates**

Katherine Perez-Rivera (University of Puerto Rico)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Karl Kaiser

Dissolved Organic Nitrogen (DON) constitutes the majority of total dissolved nitrogen (TDN) in rivers and supports a substantial fraction of near-shore primary production. For this research, we investigated compositions, sources and transformations of DON with coupled microbial-photochemical incubations of a diverse set of vascular plant leachates. Measured molecular biomarkers included hydroxyl-proline (Hyp) as a tracer of plant-derived nitrogen and D-amino acids as indicators of bacterially-derived DON. Results showed a rapid removal of plant-derived DON mainly composed of amino acids, and build-up of microbial DON with lower bioreactivity. In addition, incubation experiments will be used to calibrate DON-specific biomarkers to study the fate of DON along the Sacrament/San Joaquin River Delta and the San Francisco Bay Estuary.

11. **Deformable Submarine Slump Experiment**

Erina Szeto (University of California Berkeley)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Juan Horrillo

Submarine slumps, or landslides, are the primary mechanism by which tsunamis are produced in the Gulf of Mexico. With data collected on historical submarine slumps and current locations of sediment buildup, numerical simulations are used to model the resulting tsunami waves in the Gulf. Maps of vulnerable cities are generated showing inundation, momentum flux, and other important flooding information. These simulations need to be validated using a physical experiment. The physical model has the accurate form of the continental shelf and implements a novel mechanism that stays together while being submerged in water but collapses independently, contrary to previous experiments that have used a gate which disturbs the water surface. The model runs successfully and is currently undergoing repeatability tests. The resulting wave data set will be compared with waves created by numerical simulations, and the experiment may be performed on a larger scale.

12. **Feeding Ecology of Deep-Sea Fishes**

Emily Gipson (University of Central Florida)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. R.J. David Wells

Deep-sea fishes are a vital part of pelagic food webs, but little is known about their feeding ecology and inter-specific trophic relationships. Knowledge of trophic relationships is essential to our understanding of predator-prey interactions and nutrient cycling in deep-sea ecosystems. In this study, two different analytical approaches were used to study the feeding ecology of eight species of mesopelagic and bathypelagic fishes collected from the northern Gulf of Mexico. Stable isotope analysis of Carbon-13 and Nitrogen-15 was performed on white muscle tissue to provide information regarding the trophic position and carbon sources of each species and stomach content analyses were conducted on the specimens to give more taxon specific insight into their diets. All 213 specimens used in this study were collected in 2011 shortly after the Deepwater Horizon oil spill using midwater trawling gear fished to a depth of 1500 m. The sample size of each species ranged from 19 to 38 individuals and was based heavily on their availability. Roughly half of the specimens had empty stomachs, revealing a pattern of infrequent feeding. Much of the stomach contents were highly digested and unable to be identified visually. From the specimens with visually identifiable stomach contents, teleosts were the most commonly identified prey item.

13. **Biodiesel-Emissions and Fuel Economy**

Angel Aralu (University of Georgia)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Edward Clancy

Biodiesels are used as fuel substitutes for diesel, and are made from renewable resources such as vegetable oils, algae, or plants. In this study we compared the fuel economy, exhaust gas emissions and stability of biodiesel to marine diesel fuel when mixed with water. Biodiesel has no sulfur nor aromatics contents and is made using the transesterification process (Hideki). Biodiesel is can be used in place of traditional diesel fuel or mixed in different proportions with diesel fuel and used in the diesel engine with little to no modifications to the diesel engine. We demonstrated that bio-diesel mixed with conventional diesel fuel (10:90) could reduce carbon monoxide and Nox emissions at reduced loads. Diesel engines are heavily used by naval ships releasing carbon dioxide, carbon monoxide and NOx to the environment replacing diesel completely with biodiesel or using biodiesel as an addictive would lead to the reduction of carbon-dioxide, carbon monoxide and NOx emission to the atmosphere. It would reduce our dependence of fossil fuels because a portion of our diesel oil consumption would come from a renewable source. We observed that 10:90 blend of biofuel with marine diesel fuel produced a fuel that did not cause an emulsion when mixed with water, an important property in marine applications.

14. **Species Validation of the Marine Fish, *Ecsenius pulcher***

Leila Harris (University of West Florida)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Ron Eytan

Despite only making up 0.25% of the world's oceans, coral reef ecosystems contain over 25% of the world's marine life. Our ability to quantify biodiversity has fundamentally shifted as genetically-based species delimitation methods now enable us to discover and describe new species. The Blenniidae, a Family in the Order Perciformes, is one of the most diverse groups of marine fishes with 58 genera and roughly 400 species. When a potentially new blenny species is found, it is often not clear if it is valid, as traditional metrics of species delimitation such as morphology and color can be inconclusive. An example is the blenny species *Ecsenius pulcher*, that was split into two monophyletic groups: *E. pulcher* and *Ecsenius sp.*, based upon individual color morphs and limited molecular analyses. For this study, tissue samples obtained from the Gulf of Oman, Socotra, and Iran included individuals from each group, as well as, a single undescribed specimen from Iran, that is causing further taxonomic confusion by sharing similarities with both groups. DNA sequence data was collected from two mitochondrial genes and five nuclear genes: two exons and three introns, via PCR, to create a multi-locus DNA sequence dataset. Utilizing this dataset to delimit the *Ecsenius* species and infer their interrelationships by using the computer program BPP, the validation or falsification of the existing taxonomic classification of *E. pulcher* will occur. Resolving the species phylogeny of *Ecsenius* is the initial step towards understanding the extent of hidden biodiversity on coral reefs.

15. **Pattern of Evolution of Hydrozoa (Cnidaria) Across the Isthmus of Panamá**

Hannah Schwaiger (University of West Florida)

Ocean and Coastal Research Experiences for Undergraduates (REU-OCEANUS) REU

Research Advisor: Dr. Maria Pia Miglietta

Panamá, Central America, separates the Pacific and Atlantic Oceans. Roughly 3.5 million years ago, the formation of the Isthmus of Panamá created isolated populations of the same marine species on either side of the landmass, which have potentially since evolved into separate species (geminate species). Here we investigate the Hydrozoan (Cnidaria) pattern of evolution on the Atlantic and Pacific sides of Panamá using the mitochondrial RNA 16S gene, the Hydrozoan barcoding molecule. The 16S gene was amplified and sequenced, resulting in the 384 sequences used in this project to generate phylogenetic trees of Hydrozoan specimens collected over two years from both sides of Panamá. After producing a phylogenetic tree comprising all specimen, sequences were blasted against the NCBI GenBank. Sequences that corresponded to five taxa of interest (genera *Eudendrium*, *Bougainvillia*, *Zanclea*, and the family Corynidae) were selected from the master dataset to form sub-datasets and build corresponding phylogenies. Available sequences belonging to the taxa were downloaded from GenBank and added to each sub-dataset. We built ML and Bayesian trees for the taxa of interest to investigate their patterns of evolution. Constructing phylogenetic trees comprising Panamanian samples and congeneric species worldwide aided in the identification of the specimens collected and provided a method to identify putative geminate species across the Isthmus. Typically, our specimens showed that the Atlantic and Pacific sides of Panamá host different species that are not geminate species. We also found instances of Hydrozoan specimens having identical sequences to those across the Isthmus, suggesting human mediated species introduction.

16. **Comparative Transcriptomics of Amphinomid Fireworms and Relatives (Annelida: Amphinomida)**

Giovanni Madrigal (Texas A&M University at Galveston)

The Louis Stokes Alliances for Minority Participation (LSAMP)

Research Advisor: Dr. Jessica Labonté, Dr. Elizabeth Borda

Amphinomid is a distinct and elusive Order of polychaetes that are distributed globally and play important ecological roles in marine environments. This group includes the commonly known fireworms, though this characteristic is not universal across the clade. Although the amphinomid tree is robust, its current phylogenetic position at the base of the annelid tree of life remains unresolved, mainly due to the lack of genomic data for amphinomids, and more generally invertebrates. In this study, we use transcriptomics to elucidate the genes involved in basic biological pathways and processes comparatively across species representatives of the three main amphinomid clades: Euphrosinidae (*Euphrosine*), Amphinominae (*Hermodice*, *Paramphinome*) and Archinominae (*Chloeia*), relative to other basal annelids as well. Due to limited availability of genomic data for invertebrates, the access to bioinformatic tools that may produce confident results remains limited or are cost prohibitive. Here we design a bioinformatic pipeline using freely available software to annotate and compare transcriptome data for the four amphinomid species. Preliminary results indicate the presence of over 2,000 conserved proteins among these species, with a range of 7,000-22,000 genes being unique to an individual species. As the data collection progresses through the pipeline, thousands of potential proteins are being detected and filtered for the most reliable annotations. Once completed, a consensus of these results will be generated in order to build a biological pathways map and a phylogenetic tree that will be compared to current hypotheses.

17. **Is Distance from PrEP Clinic Correlated to Decrease in HIV Incidence**

Sterling LaBoo (Texas A&M University)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Preexposure-Prophylaxis for HIV, (PrEP), is a relatively new treatment that if taken properly significantly reduces risk of infection with HIV. Clinical trials and studies have confirmed the effectiveness of PrEP on a clinical and case level but broader effects have not been studied. Global Information Systems, (GIS), and HIV incidence rates from multiple years can be used to determine if the location of clinics offering PrEP services and distance affect incidence rates in an area. This poster explores the correlation between PrEP services and incidence rates.

18. **Does Exposure to Agricultural Education Reduce Organic Food Purchasing?**

Lauren Mabe (University of Central Missouri)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Organic agriculture is a rapidly growing sector of the food industry. Consumers' motivations behind purchasing organic food depends on a variety of social and economic factors. Consumer attitudes towards organic food products can be influenced by their knowledge of the technologies behind conventional food production, such as pesticides or genetic modification, which can be gained directly from interaction with agriculture or through agricultural education. Using survey data gathered at Texas A&M University, this study aims to determine factors that affect food buying decisions, specifically focusing on the consumer's relationship to agriculture. It is predicted that people with no relationship to agriculture will be more likely to buy organic food, as they have less knowledge of conventional farming practices. It is hoped that the results of this study can be used by producers, distributors, and marketers of agricultural products to aide in their economic decision making.

19. **Data Visualization and Analysis of Metropolitan Human Migration Flow Patterns in the United States**

Georgia Bass (University of Massachusetts at Amherst)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Factors that drive human migration include environmental conditions, economic stability, political unrest, and for social and demographic purposes. Whether external or internal forces cause humans to move, visually mapping human migration across the United States can inform policy makers, economists, and contribute to a more in-depth understanding of why people move. In and out flow migration counts between metropolitan statistical areas has been documented by the American Community Survey and published by the U.S Census Bureau. Intersecting spatial data, large data analytics and cyberGIS to produce three unique visualizations — this study investigates how different visualization techniques can change an individual's basic knowledge of migration flows. By producing a chord diagram, a interactive symbol map, and a correlation map all built using in and out migration data for metropolitan statistical areas we showed how graphical perception and understanding of the data changes based on the visualization technique used. Participants in the study were asked to complete a series of timed tasks each tailored towards using one visualization over another. A series of survey questions following the completion of the task ask about their efficiency in choosing which visualization to use and knowledge about migration gained from completing the tasks.

20. **Characteristics of Areas Undeserved by Dentists: Identifying Patterns in Oral Health Disparities**

Leiana Edwards (University of North Carolina at Chapel Hill)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Often an indicator of other diseases and ailments, dental health is a vital component of overall health. As one of the most common chronic diseases among all age groups, dental disease can easily be avoided with preventative care. Access to such care is often dependent on different determinants including income, race and ethnicity, access to insurance, and location and distance to a dentist. Consequences of poor oral health can be physical, socio-economic, psychological, and emotional, especially when compounded with other determinants, such as diabetes, smoking, poverty levels, and race. Research shows the relationship between these determinants and oral health; however, little research has been done to link the location of dentists to the prevalence of these determinants. Using a regression analysis with data from the Centers for Disease Control and Prevention and a Robert Wood Johnson Foundation, correlations were found between the rate of dentists in each county and the resulting percentage of oral health determinants in that county. It is predicted that in areas with more dentists will there will be a lower occurrence of these determinants due to their relationship found in the literature.

21. **An Undescribed Species of Parachiloglanis (Siluriformes: Sisoridae) from Nepal**

Mindy Dang (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Kevin Conway

The sisorid catfish *Parachiloglanis hodgarti* (Hora, 1923) is found in high altitude rivers and streams across the Himalayan region, including Bhutan, Nepal, and India. The distribution of this species is highly fragmented with disjunct populations in central and eastern Nepal (type locality), northern India (Assam, Sikkim, West Bengal) and throughout Bhutan. A recent investigation of Bhutanese material of *P. hodgarti* concluded that multiple undescribed species are confused under the name *P. hodgarti* and it is likely that a similar situation exists in India and Nepal. We investigated material of *P. hodgarti* from eastern Nepal (type locality) and central Nepal to assess whether the material from these different areas belongs to the same species. We collected standard counts and measurements, and information on external morphology, and osteology. Principal component analysis recovered no quantitative differences in body measurements. Qualitative traits proved to be more significant in distinguishing between material belonging to the different populations that we investigated, including the following features: pattern of skin granulation, coloration, and presence of a notch between the base of the adipose fin and caudal fin. From the observations recorded herein, we concluded that material of *P. hodgarti* from central Nepal represents an undescribed species.

22. **Estimation of anthropogenic and catastrophic effects of Florida Manatee (*Trichechus manatus latirostris*)**

Katherine Carbajal (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Hsiao-Hsuan (“Rose”) Wang

One of the most endangered marine mammals in the coastal areas of the United States is Florida manatee (*Trichechus manatus latirostris*). The Florida manatee population has been increasing and decreasing since 1991 along the east and west coast of Florida, respectively, and has a present population of about 6,250. However, the populations had been dramatically fluctuated due to various anthropogenic factors. Causes of manatee deaths can be broken down into five categories: watercrafts, crushed/drown by flood gate or canal lock, entanglement, perinatal, and other natural factors (such as disease and natural catastrophe). Unfortunately, three among these five categories are associated with human. Hence, we aimed to estimate and compare anthropogenic and natural catastrophic effects on the manatee population dynamics. We conducted a literature review to obtain the basic demographic data and then developed a stage-structure population dynamics model of Florida manatee during this summer. We then will use the data from Florida Fish and Wildlife Conservation Commission synoptic surveys to calculate average mortality rates and 95% confidence interval of those for five scenarios including baseline, anthropogenic threats, cold stress, 2010 oil spills, and perinatal effects. We will simulate each scenario with the worst, average, and better effects from each of their average mortality rates for 30 years in the coming academic year.

23. **Geographic Variation of Consumer Choice on the Healthcare Marketplace in Texas**

Samuel Lee (University of North Carolina at Chapel Hill)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Before the advent of the Patient Protection and Affordable Care Act (PPACA), insurers were free to deny coverage from those who were sick, allowing them to target healthier individuals who were less costly. The PPACA disallowed insurers from discriminating by health status and in 2014, the PPACA enacted the creation of state marketplaces, where consumers could shop for health insurance plans. As a result, more than 20 million people have become insured. However, concerns surrounding the Marketplace have been brought up after several large insurers pulled out of the market, due to large financial losses. This has left more than 1,000 counties with just one insurer. If more insurers are to pull out, many people may find themselves without any options to buy insurance plans on the Marketplace. This research investigates the variation in the number of plans in the counties of Texas to illuminate what county attributes are associated with having a higher number of plans available. Health indicators as well as market characteristics of the counties of Texas were used to see what attributes were associated with higher degree of choice in terms of available plans.

24. **The Impact of Natural Disasters on Domestic Violence: An Analysis of Reports of Simple Assault in Florida (1999-2007)**

Sera Gearhart (University of Redlands)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

Background: Natural disasters are increasing in frequency and severity worldwide. Disaster describes an event that acts an extreme social failure, or an abrupt incident that disrupts normal behaviors in a negative way, usually with loss of life. Individual-level vulnerability to natural disasters has been shown to align deeply with social stratification. Multiple studies have found a relationship between natural disasters, or national crises, and increased rates of interpersonal violence (IPV). People experiencing IPV in the recovery period of natural disasters may face unique barriers to escaping their situation, including loss of safe housing, and a need to remain with family associations in order to be recognized for relief aid. This analysis aims to establish quantitatively the impact of natural disasters on reports of simple assault. Data and Methods: We address this research question using disaster data compiled by the Federal Emergency Management Agency (FEMA), and county-level data on domestic violence reported to police and published by the Florida Department of Law Enforcement. Results: According to the model, the presence of a long-lasting natural disaster (n>199 days), increases the reports of simple assault by about 78 assaults yearly.

25. **Analyzing in UV Risk and Risk Perception in College Students: UV Risk Surveys and Dosimeter Readings**

Maeve Scully (Ohio State University)

CyberHealthGIS

Research Advisor: Dr. Daniel Goldberg

It has been proven that prolonged UV exposure can lead to dangerous diseases, such as melanoma skin cancer. This study aims to show that most college students believe themselves to be at less risk to sun exposure than is true. By quantifying survey responses about everyday sun protection and behavior and comparing them to the percent of maximum daily exposure based on FDA-determined skin type, we will determine whether or not different demographics believe to be less at risk than they actually are. We have designed a comprehensive 19-question survey about sun activity that will be measured on a 5-point scale in order to be converted into a percentage for comparison purposes. UV exposure is measured using a calculated UV index through the wearable dosimeter, Shade, and a daily limit will be determined based on limits recommended by the American Conference of Governmental Industrial Hygienists. Although it is impossible to predict if a participant will get UV-related ailments due to exposure, we can determine if their current exposure levels are within their daily limit based on skin type and the results of the study will hopefully lead to better sun protection strategies in everyday lives.

26. **Quality of Social Vulnerability Assessments in Coastal County Hazard Mitigation Plans**

Carlo Chunga Pizarro (Texas A&M University)

Sociology and Landscape Architecture, and Urban Planning REU

Research Advisor: Dr. Walter Gillis Peacock, Dr. Shannon Van Zandt, Dr. Michelle Meyer and Dr. Fayola Jacobs

All jurisdictions interested in procuring hazard mitigation funding from the Federal Emergency Management Agency are required to develop a local hazard mitigation plan. A critical element of the planning process involves conducting a hazard analysis of their jurisdiction. In the past, hazard analyses primarily focused on an evaluation of the hazard exposure of the jurisdiction and an assessment of vulnerability in terms of the built environment and population distribution. The last several decades have seen an increasing recognition of the importance of social vulnerability assessment as a critical component of vulnerability analysis. Despite this recognition, past research suggests that there has been limited implementation of social vulnerability assessments as part of local hazard mitigation plans. The purpose of this research is to assess the prevalence and degree to which current coastal hazard mitigation have undertaken and used social vulnerability analyses. Specifically, a sample of coastal county hazard mitigation plans from coastal states along the Gulf Coast will be evaluated utilizing a protocol that rates mitigation plans based on a set of clearly specified measurement rules that captures the nature, extent, and detail to which these plans assess, map, and utilize social vulnerability to capture this important element of hazard risk assessment.

27. **Interannual Changes in Hypoxia at the Flower Garden Banks and Texas Coast**

Diana Sandoval (Bryn Mawr College)

Oceanography REU

Research Advisor: Dr. Henry Potter

The purpose of this study is to find if the hypoxic zone along the Texas Coast and at the Flower Garden Banks in June 2017 is different compared to June 2016. Hypoxia occurs at low or depleted levels of oxygen in a body water with less than 1.4 ml L-1. Using a CTD, dissolved oxygen, temperature, density, salinity and organic matter were measured at 18 different stations in the Gulf of Mexico. The data was then analyzed and compared to data that was obtained on the research cruise of the previous year during which similar measurements were made. It was found that, whereas in 2016 hypoxia occurred extensively along the Texas Coast, there was no hypoxia in the area where data was collected this year. This can possibly be explained by the weather conditions. River runoff from the Mississippi, Atachafalaya, and the Sabine River are also taken into account. The results show how much the hypoxic zone has changed and provides information about the mechanisms that contribute to hypoxia in the Gulf of Mexico.

28. **Assessment of Sources of Chromophoric Dissolved Organic Materials to Galveston Bay via Excitation Emission Florescence**

Lauren Castanon (California State University)

Oceanography REU

Research Advisor: Dr. Gerardo Gold-Bouchot

The Galveston Bay watershed contains numerous EPA Superfund sites, resulting in the historically low water quality within Galveston Bay. Analysis of Chromophoric Dissolved Organic Matter (CDOM) has been demonstrated to have applications in the tracing of freshwater inputs to coastal bodies of water. CDOM as a tracer of inputs has not yet been studied in Galveston Bay. The goal of this study is to determine the location of the key sources of freshwater bearing terrestrial contaminants to Galveston Bay. Eleven seawater samples were taken from Galveston Bay during the course of two research cruises. Samples were obtained from a four liter Niskin bottle, and were filtered before being analyzed with a Horiba Aqualog fluorimeter. Excitation-emission matrices, as well as absorbance results were obtained for each sample. Results were analyzed using the “cdom”, and “eem” packages in R. Preliminary results demonstrate that there are differences between the absorption spectral curves, slopes, and slope ratios at differing locations throughout the bay. It is predicted that emission-excitation analysis (particularly Coble’s peaks) will demonstrate a negative relationship between salinity and humic terrestrial CDOM compounds. Knowledge of the sources of CDOM and other materials to the bay will allow for more informed measures to be taken in the efforts to improve the water quality of the bay, and to understand sources and distribution of pollutants and other compounds in the bay.

29. **Quantifying the Growth of Microbial Aggregates in Response to Oil and Dispersant**

Charles Holmes (James Madison University)

Oceanography REU

Research Advisor: Dr. Jason Sylvan

The Deepwater Horizon (DwH) oil spill in 2010 released approximately 750 million liters of crude oil from the seafloor into the northern Gulf of Mexico, representing a relatively unique anthropogenic disturbance. Research cruises to the DwH site observed notable quantities of marine oil snow (MOS), particles larger than 0.5 cm composed of extracellular polymeric substances (EPS), floating on the sea-surface. In studying MOS formation from EPS, previous work has also observed micro-aggregates (10-200 μm) in seawater exposed to oil with or without the dispersant Corexit, a product used in the cleanup of oil spills including DwH. In order to characterize the growth of these micro-aggregates, samples collected from mesocosm experiments completed Fall 2015 - Summer 2016 were analyzed to quantify micro-aggregate area using epifluorescence microscopy and image analysis. In the control and oil-only treatments, size distribution remained stable through time in experiments not supplemented with phytoplankton. Treatments with concentrated and dilute Corexit - CEWAF and DCEWAF, respectively - featured larger micro-aggregates. These data, along with previous work describing increased micro-aggregate concentrations in CEWAF and DCEWAF treatments, indicate that Corexit application enhances environmental response to oil spills by stimulating micro-aggregate formation. Additionally, it was observed anecdotally that micro-aggregates increased in size toward the end of mesocosm experiments, implying a putative relationship to MOS. The micro-aggregate size data collected here, however, do not support the hypothesis that micro-aggregates conglomerate to form MOS. This suggests that marine oil snow and micro-aggregate formation are distinct, yet parallel, processes involved in the environmental response to oil spills.

30. **Exopolymer Formation by Phytoplankton in Relation to Marine Aerosols**

Andrew Whitesell (North Carolina State University)

Oceanography REU

Research Advisor: Dr. Daniel Thornton

Phytoplankton are photosynthetic organisms that live within the ocean, which covers 71% of the planet’s surface and are responsible for 40 % of Earth’s oxygen production. Polymers released by phytoplankton may form two classes of gel-like exopolymer particles in the ocean: transparent exopolymer particles (TEP), composed of polysaccharides, and coomassie stainable particles (CSP), made primarily of proteins. TEP and CSP may be important in the formation of marine aerosol and clouds, through atmospheric-ocean interactions at the surface levels of the ocean. The aim of this project was to quantify the production of TEP and CSP during the growth and death of a diatom culture, and to determine if there was a correlation between TEP and CSP production, and the formation of aerosol that could contribute to cloud formation by acting as cloud condensation nuclei (CCN) or ice nucleating particles (INP). A batch culture of the diatom Thalassiosira Weissflogii was grown in a marine aerosol reference tank (MART) and TEP and CSP were sampled as the diatoms grew in the tank. TEP concentrations displayed growth and decay patterns similarly to cell concentrations, while CSP concentrations remained relatively constant throughout the experiment. These data show that TEP concentration depends on the concentration of phytoplankton within a culture, and indicates that TEP and CSP are distinct populations of exopolymer particle. The next step of this research will be to relate the growth of the diatom, and characteristics of the exopolymer particles, to aerosol properties measured in the MART.

31. **PCB and PAH Contamination of the Antarctic Benthic Environment**

Alyssa van Doorn (Rowan University)

Oceanography REU

Research Advisor: Dr. Andrew Klein

McMurdo Station, Antarctica has been inhabited by scientists and staff continually since the late 1950s. This habitation has led to anthropogenic contamination of the local environment surrounding research stations. Monitoring and mitigating pollution in Antarctica is necessary to operate in accordance with the Antarctic Treaty and The Protocol on Environmental Protection. This study uses chemical data previously collected by Texas A&M's long-term environmental monitoring program at McMurdo Station from 2000-2012. This study is the most extensive analysis of polychlorinated biphenyl (PCB) and polycyclic aromatic hydrocarbon (PAH) pollution in the marine sediments surrounding the station. The study objectives include identifying and quantifying the PCB mixtures present, detecting temporal changes in the PCB or PAH chemical profiles, and identifying the sources of PAHs. Temporal change in PCB and PAH mixtures were identified via examining chemical profiles and using GIS. Polytopic vector analysis was employed to identify the number of PCB mixtures present and PCB chemical profiles were compared to commercial PCB mixtures (Aroclors). Molecular indices based on PAH ratios were used to identify the source of PAH contamination. PCB and PAH concentrations are decreasing over time, specifically light molecular weight PAHs. While previous studies have indicated that one PCB mixture (Aroclor 1260) dominates at McMurdo, this research suggests that at one location, a second mixture which appears similar to Aroclor 1254 may also be present. PAH molecular indices indicate a complicated history of PAH contamination at McMurdo with a mixture of pyrogenic and petrogenic sources.

32. **Analysis of Hydrodynamic Impact Induced by Tidal Turbine Arrays**

Cassidy Gonzalez-Morabito (Rutgers University)

Oceanography REU

Research Advisor: Dr. Kristen Thyng

Tidal energy is a new and emerging source of renewable energy; implementing tidal farms into coastal regions with strong tidal currents can provide a carbon-free source of energy. Tidal turbines operate by extracting kinetic energy from the surrounding fluid, and converting that energy into electricity. Due to the high capital expense and limited space available for tidal turbines, we want to make this energy extraction as efficient as possible by optimizing the tidal turbine array. However, extracting energy from the environment has impacts; quantifying these impacts and understanding the processes occurring in the environment is important for determining their significance. We use a nonlinear shallow water numerical model, OpenTidalFarm, to simulate a tidally-forced headland with turbines, and optimize for power while simultaneously imposing a penalty onto the tidal farm if too significant of an effect to the flow is produced. This penalty on the turbine farm forces the model to decrease the environmental change induced by the farm. Our measure for impact to the environment is an integrated change to vertical vorticity in a designated conservation domain. We have found that an increase in penalty leads to a decrease in energy production, and demonstrate the possibility of parameter choices that lead to a local maximum in energy production with a minimum in change in the environment. These environmental effects may be harmful, or may cause no damage whatsoever, but understanding the changes induced by the turbines are an important process which should be understood when evaluating a potential deployment location.

33. **Methyl Halides in the Water and Air of Galveston Bay**

Ashley King (University of Connecticut)

Oceanography REU

Research Advisor: Dr. Shari Yvon-Lewis

Methyl halides are incredibly important because they supply halogens to the atmosphere which impact its chemistry and composition. For instance, the halogens contribute to chemical reactions that can lead to the breakdown of ozone. Methyl halides are formed through human activities or biogenic processes. There is very little previous research on methyl halides in bays and estuaries. The results from this study will be used to investigate the distribution and possible sources of methyl halides in bays and estuaries. Galveston Bay is heavily influenced by anthropogenic inputs, substantial freshwater input from Trinity River, and limited water exchange with the Gulf of Mexico. Water samples were collected at ten sites in Galveston Bay. Six of the sites were sampled for air, as well. All samples were analyzed using a purge and trap Gas Chromatograph with a Mass Spectrometer (GC-MS). Methyl Iodide was supersaturated throughout the bay with an average saturation anomaly of 1014% +/-789% and Methyl Bromide was closer to equilibrium (7.998% +/-74%) with some sites supersaturated and some undersaturated. Methyl Iodide and Methyl Bromide were highest in water concentration in the lower bay (9.62 pM and 4.57 pM, respectively) and highest in air concentration in upper bay (2.14 ppt and 4.65 ppt, respectively). There was a strong positive correlation between the compound concentrations in both air and water, suggesting they came from a common source. Biogenic formation via marine algae is the only source they have in common, suggesting their sources were mainly biogenic.

34. **Assessment of a Coupled Model's Skill in Simulating Coastal Winds in the Gulf of Mexico**

Amanda Ceroli (University of North Carolina at Wilmington)

Oceanography REU

Research Advisor: Dr. Ping Chang and Dr. Jaison Kurian

Computer modeling has become more prevalent in the advancement of science, and is therefore continually expanding and improving. This project seeks to validate a coupled ocean-atmospheric model's accuracy for simulating surface wind velocities along the U.S. Gulf of Mexico coastline over a 3-year period. Coupled modeling is a newer concept used to predict natural ocean-atmosphere phenomena. It allows the ocean and atmosphere to interact. Previous models used to forecast winds only focus on influences within the atmospheric realm. These "atmospheric-only" models do not completely account for the constant exchange of properties at the ocean-atmosphere interface and the influences they have on coastal wind strength and direction. Improved coastal wind predictions can lead to enhanced forecast skills of coastal currents and other ocean-borne natural phenomena. This project validates a Coupled Regional Earth Systems Model's (CRESM's) wind velocity hindcast from January 2010-December 2012 at 16 coastal buoy locations along the Gulf coast with the respective buoy measurements during the timeframe. Data from the European Center for Mid-range Weather Forecast's (ECMWF's) Reanalysis product, a widely accepted atmospheric-only global data assimilation system, from this timeframe was also used as a reference for comparison. We expect ECMWF's data to be in strong agreement with buoy observations as wind observations have been integrated into the model. CRESM is expected to produce a wind product that is more consistent with ocean circulations. Our result shows that even without using data assimilation, CRESM can produce consistent wind fields with accuracy comparable to or better than ECMWF winds.

35. **Searching for a Missing Lysis Gene: How Bacteriophage PhiKT Breaks Free**

Ashley Holt (Texas A&M University)

Beckman Scholars

Research Advisor: Dr. Ry Young

Among phages of Gram-negative hosts, most lysis systems require three classes of proteins: holins, endolysins, and spanins. Spanins function during the last step of lysis by disrupting the outer membrane of the host cell. Although spanins are necessary for lysis, a few double-stranded DNA phages do not encode identifiable spanins. Bioinformatic analysis of phage PhiKT of *E. coli* revealed no recognizable spanin genes. Surprisingly, PhiKT lyses its host under conditions that require spanin function. We identified the lysis gene region of the PhiKT genome, and expression of this segment in a plasmid-driven system resulted in rapid lysis of the host. This segment encodes only three predicted genes: the endolysin, a 56 amino acid hypothetical novel gene, and the holin. The unknown gene product lacks features required for spanin function including a transmembrane domain or a lipoylation signal. However, both nonsense and in-frame deletion mutations of the unknown gene blocked lysis, and the gene complements spanin defect in a known lysis system. Therefore this small hypothetical gene seems to be involved in disruption of the outer membrane. Further investigation will be needed to determine the mechanism of this novel lysis system.

36. **Shedding Light on Floral Regulation in Maize**

Rebekah Frazier (Centenary College of Louisiana)

Biochemistry REU

Research Advisor: Dr. Rebecca Murphy

The domestication of maize began around 9,000 years ago by indigenous farmers in Mexico. As cultivation spread north to more temperate environments, plants were selected for decreased photoperiod sensitivity, and today's commercial lines are now very nearly day neutral. Present day maize now feeds millions globally, making it one of the most agriculturally important crops in the world. Because the precise timing of maturation is so intricately linked to grain yield and quality, understanding the regulation of this pathway has become central in the accelerated improvement of maize as we anticipate the demands the ever-increasing world population will have on this globally important crop. Though several genes have been identified that affect photoperiodic flowering in maize, the understanding of floral regulation in this species is far from complete. Here we characterize alleles of several putative floral regulatory genes in tropical and temperate lines, and analyze the photoperiod response of these genes in long and short day conditions to gain understanding about their role in flowering.

37. **Variations in the Human PITPNA Gene Affect the Biochemical Functions of PITPα**

Garland Siebert (Texas A&M University)

Biochemistry REU

Research Advisor: Dr. Vytas Bankaitis

Phosphatidylinositol transfer protein (PITP) is a ubiquitous cytosolic protein that is responsible for the transfer of phosphatidylinositol (PtdIns) and phosphatidylcholine (PtdCho) between membranes. PITPα, a mammalian PITP, is responsible for manipulating the position of PtdIns within the membrane in a manner that allows kinases to phosphorylate the inositol head group, which ensures normal cellular output. When the gene responsible for encoding PITPα is knocked out in mice, it results in aponecrotic spinocerebellar disease, hypoglycemia, and intestinal and hepatic steatosis. Therefore, it is important to determine if there are variants of the PITPα gene (PITPNA) in the human genome that results in a dysfunctional protein. We identified single nucleotide polymorphisms (SNPs) of PITPNA within the human population by utilizing the Exome Aggregation Consortium database. The most severe mutations were of the most concern, thus any SNP that resulted in codon redundancy or coding for similar amino acids were filtered out. Recombinant proteins mutated with the selected SNPs were then purified and assayed for their ability to transfer PtdIns and PtdCho between lipid membranes. We found that the SNP, M240T, resulted in a defective PITPα that could transfer PtdIns at only 40% efficiency of wild-type PITPα. This work gave insight on how SNPs in the human population affected the overall mechanical and biochemical functions of PITPα.

38. **Biochemical Mechanisms of *Chlamydomonas reinhardtii***

Kriti Gaur (Texas A&M University)

Bioenvironmental Sciences Undergraduate Research Scholars (BURS)

Research Advisor: Dr. Joshua S. Yuan

All species of algae contain a carbon concentrating mechanism (CCM) for photosynthetic efficiency. *Chlamydomonas reinhardtii* is a model organism for algae biofuel research. The primary objective of the experiment was to determine the effects of different concentrations of inorganic carbon (Ci) on the CCM, in strains of *C. reinhardtii*, CC-503 & CC-4425 (D66). By analyzing the effects of different concentrations of Ci, in the form of NaHCO3 on *C. reinhardtii*, data can be gained on how *C. reinhardtii* produce triacylglycerides under environmental stress. *C. reinhardtii* can produce isoprenoids by only using a MEP pathway, meaning that it is at a metabolic advantage to produce complex hydrocarbons. The secondary objective of the experiment was to extract squalene from a transgenic squalene-synthase mutant of *C. reinhardtii*, (SQS) in order to potentially analyze the use of squalene as a biofuel compound. Exposure of both strains of *C. reinhardtii* to increasing concentrations of NaHCO3 resulted in a decrease in optical density and an increase in overall lipid content, as the molarity increased. The increased molarity of the NaHCO3 caused a condition of environmental stress, which resulted in the *C. reinhardtii* storing additional triacylglycerides inside the cell body as a food reserve. Different strains of *C. reinhardtii* have different reactions to environmental stress depending on the evolutionary adaptations that a strain has. Squalene extraction was attempted for the 6 samples of dried algae biomass, using a GC-MS machine. The data for the squalene extraction was inconclusive, as squalene is a volatile compound that is difficult to extract. Thus, the squalene extraction was unsuccessful. Future applications of this research may include exposing other strains of *C. reinhardtii* to other forms of environmental stress, to enhance lipid production in the cell.

39. **Estimation of Deepwater Horizon Oil Spill Effects on Population Dynamics of the Loggerhead Sea Turtle (*Caretta caretta*)**

Madeline Jones (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Hsiao-Hsuan (“Rose”) Wang

Deepwater Horizon (DWH) was the largest offshore oil spill in US history. The result was 87 days of constant oil and natural gas flow, which resulted in approximately 3.19 million barrels of oil being released into the ocean. Deepwater Horizon significantly affected the Gulf of Mexico and surrounding beaches, including threatened and endangered marine life such as the Loggerhead sea turtle. Both federal and state agencies charged with overlooking U.S. natural resources conducted numerous assessment activities to quantify the adverse effects of oil and its consequences on wildlife resulting in a DWH Natural Resource Damage Assessment. Short and long-term effects to juvenile and adult Loggerheads result from catastrophic oil spills, such include oil adhesion, over-heating, and oil ingestion which can lead to egg mortality, developmental defects, and impacts to the skin, blood, salt glands, and digestive and immune systems. Hence, we aim to determine how the event of oil spills affects the population dynamics of loggerhead sea turtles. During the summer, we have conducted a thorough literature review to obtain the demographic data and developed a stage-structured population dynamics model for loggerhead sea turtles. We will then use the model to quantify the potential effects of oil spills on the population of loggerhead sea turtles in the coming academic year.

40. **Evaluation of Morbillivirus Exposure to Bottlenose Dolphins (*Tursiops truncatus*) Following the Deepwater Horizon Oil Spill**

Annie Montgomery (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Hsiao-Hsuan ("Rose") Wang

Deepwater Horizon (DWH) was the largest offshore oil spill in the petroleum industry's history. For a total of 87 days, approximately 3.19 million gallons of oil and natural gas seeped into the Gulf of Mexico. DWH significantly altered the ecology and biology of the Gulf of Mexico and its surrounding areas, including many species of threatened and endangered marine life and habitat quality. Following the oil spill in April 2010, an unusual mortality event occurred in the Gulf of Mexico in cetaceans, primarily bottlenose dolphins (*Tursiops truncatus*). Dolphin morbillivirus (DMV) was investigated to be the cause of this event. DMV is a well-recognized paramyxovirus that causes dolphin deaths in the United States from acute viral pneumonia, viral encephalitis, or from fungal or bacterial infections from immunosuppression. Therefore, we aim to determine how the event of oil spills affects the exposure of bottlenose dolphins to morbillivirus. During the summer, we have conducted a thorough literature review to obtain the polymerase chain reaction (PCR) and serological analysis data for different age categories in order to develop a model to determine morbillivirus exposure in bottlenose dolphins. We will then use the model to quantify the effects of DWH on the morbillivirus exposure to bottlenose dolphins population dynamics for the future 20 years in the coming academic year.

42. **Engineering Eukaryotic Lipids into *Escherichia coli***

Tori Zlomie (Texas A&M University)

TURC: Texas A&M Undergraduate Research in Chemistry

Research Advisor: Dr. Gloria Conover

At present, eukaryotic membrane proteins expressed in Escherichia coli are exposed to a non-native environment lipid environment. Our research aims at expressing biosynthetic genes to produce eukaryotic lipids in Escherichia coli such that overexpressed membrane proteins will be a more native-like lipid environment. Eukaryotic membrane proteins represent important candidates for protein structural studies as they are key players in numerous biological processes. Aberrant expression and activities of integral membrane proteins are associated with human disease. As a result, they represent more than 50% of the US Food and Drug Administration approved drug targets. One of the biggest challenges facing structural studies of eukaryotic membrane proteins is the production of high quantities of pure proteins. Bacteria is an cheaper and much quicker than insect or mammalian cell expression systems, and often easier to obtain high yields in bacteria. We hypothesize that establishing a more native lipid membrane environment in Escherichia coli will lead to funcational expression of eukaryotic membrane. Here, we overexpressed biosynthetic genes to produce phosphatidylcholine and phosphatidylinositol and analyzed extracted lipids using the Bligh Dyer method by thin layer chromatography. Fractional abundance of lipid species depended on growth conditions. Phosphatidylcholine was found to be better produced by the phospholipid N-methyltransferase versus the phosphatidylcholine synthase pathway. P phosphatidylinositol was produced by the phosphatidylinositol synthase pathway without causing toxicity. In summary, two eukaryotic lipids were successfully produced in *Escherichia coli*.

43. **Crystallization of an Ammonia Transport Channel in Complex with Lipids**

James Semper (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Arthur Laganowsky

The ammonia transporter (AmtB) found in various prokaryotic organisms is essential for their survival. We recently observed an allosteric effect of specific lipid pairs binding to *E. coli* AmtB via native ion mass spectrometry. These findings suggest, for the first time, the importance of the lipid composition in the celluar membrane on the function of membrane proteins. Here, we seek to understand these allosteric regulations from a structural basis via X-ray crystallography. To this end, we utilize a recombinant expression system to obtain functional protein followed by extensive purification and delipidation using nickel affinity and size exclusion chromotagraphy. Sample purity was confirmed via mass spectrometry. Crystals of extensively purified protein were grown in various conditions, resulting in diverse crystalline morphology. Collection of diffraction patterns is currently ongoing in an attempt to elucidate the structural consequences of lipid allostery on AmtB.

44. **Genetic Basis of Domestication**

Jace Aloway (Texas A&M University)

Aggie Research Scholars

Research Advisor: Dr. David Threadgill

Domestication has occurred in many species of animals for thousands of years. The process is considered one of the most influential factors in human history, dating back to the human transition from hunter-gatherer society to agricultural society. By learning more about the genetic mechanisms of domestication, we can learn more about the genetic basis of behavior and the process of evolution. This will aid in conservation and reintroduction efforts in endangered species. A recent study has identified two fixed genetic polymorphisms in domesticated rabbits that differ from wild rabbit populations and other sequenced mammals. These polymorphisms, located within the genes TTC21B and KDM6B, may be subject to selection during the domestication process. Both genes are involved in signaling during embryonic development in mammals. To test the effects of these alleles, mouse homologues will be genetically targeted within the WSB/EiJ (WSB) mouse line, a wild-derived inbred strain. We aim to recreate the rabbit domestic polymorphisms to test for resulting effects on wildness behavior in the mice. DNA was extracted from WSB mouse embryonic fibroblasts (MEF), and the 1kb regions around the homologous genes were sequenced. Based on these sequences, gRNAs are being designed and tested to generate the single base pair polymorphisms using the CRISPR/Cas9 gene editing technology. Mice with these targeted mutations will then be thoroughly tested for behavioral phenotypes and scored for wildness compared to WSB wildtype controls.

45. **Colorectal Cancer Susceptibility and *Parabacteroides distasonis* Supplementation in Familial and Carcinogenic Mouse Models**

Camilo Anthony Gacasan (Texas A&M University)

Independent Research Project

Research Advisor: Dr. David Threadgill

Colorectal cancer (CRC) is the second leading cause of cancer-related deaths in the United States. Interindividual differences in genetic background and gut microbiome form a complex and dynamic system that has many potential implications regarding CRC risk. Previous research from our laboratory investigated CRC susceptibility in an azoxymethane (AOM) model of FVB/NJ (FVB) and C57BL/6J (B6) mice fed a ketogenic (high fat, no carbohydrate), American (high fat, high carbohydrate) or standard (moderate fat, moderate carbohydrate) mouse chow. Tumor multiplicity was dependent on both strain and diet with a four-fold increase reported in FVB mice fed ketogenic diet relative to those fed standard chow. This response was not observed in FVB mice fed the American diet or in B6 mice on any of the three diets. A subsequent study that investigated the physiological response to diet in multiple genetic backgrounds revealed a decrease in the abundance of the bacterial species *Parabacteroides distasonis* in FVB mice fed a ketogenic diet. This established an emphasis on the interaction between variable response to diet, gut microbiome and further implications to gut health. To further investigate this relationship in FVB mice, we have initiated two parallel studies using well-established murine models of CRC: the AOM-induced carcinogenic model and the ApcMin/+ genetic model. In both studies, half of the ketogenic-fed FVB mice will be supplemented with biweekly gavage of *P. distasonis*. Ultimately, we aim to determine the relationship between *P. distasonis* and CRC tumorigenesis, which will lead to a further understanding of the etiology of colorectal cancer.

46. **Carbonate Saturation Horizons in the Northwestern Hawaiian Islands: Implications for Deep-Sea Corals**

Ashley Davis (University of South Carolina)

Oceanography REU

Research Advisor: Dr. Kathryn Shamberger

Increasing anthropogenic carbon dioxide (CO2) production has led to a decrease in ocean pH, carbonate ion concentration ([CO32-]), and calcium carbonate saturation state (Ω) in a process referred to as ocean acidification. Ocean acidification negatively impacts marine calcifiers, including deep-sea corals that utilize CO32- to build their calcium carbonate (CaCO3) skeletons. Deep-sea reefs provide crucial habitat for commercially important fisheries and house several endemic species. Carbonate saturation horizons represent the depth in the ocean where $\Omega = 1$, below which dissolution of CaCO3 is thermodynamically favored. Saturation horizons have been shown to be shoaling since preindustrial times due to ocean acidification. This shoaling threatens deep-sea corals and the valuable ecosystems they support by making coral skeletons vulnerable to dissolution. Here, the aragonite and calcite saturation horizons (ASH and CSH, respectively) were examined near the locations of deep-sea coral beds at nine locations along the Northwestern Hawaiian Island chain. Carbonate chemistry data were collected at these sites between 2014 and 2016. Consistent with previous studies of the region, these data show that the ASH and CSH deepen moving from southeast to northwest along the island chain. By comparing these data to those of the World Ocean Circulation Experiment (WOCE) from the 1990s, the Climate Variability and Predictability (CLIVAR) program from the 2000s, and the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP) from the 2010s, our calculations indicate an increase in the shoaling rates of the ASH and CSH over the last 25 years.

47. **Northwest Pacific Planktonic Foraminiferal Biogeography during the Miocene: Indicators of the Kuroshio Current?**

Madeleine Neuhaus (Boston University)

Oceanography REU

Research Advisor: Dr. Yige Zhang

The late Miocene epoch was a period of global cooling. Ocean temperature reconstructions based on a variety of proxies from around the world depict this pattern. However, preliminary data from the Zhang lab based on the alkenone unsaturation index show an anomalous warming of sea surface temperature of about five degrees Celsius at Ocean Drilling Program (ODP) site 884 in the Northwest Pacific Ocean about 12 million years ago, possible reflecting the intensification of the warm western boundary current called Kuroshio. To further examine this warming, we collected core samples between fifteen and five million years of age from ODP site 883B, which is located less than fifty kilometers from site 884. We analyzed these samples by identifying and quantifying the taxonomy of planktonic foraminifera. The resulting assemblage of these foraminifera can indicate sea surface temperature, as some species are specific to polar or tropical waters. The presence of tropical foraminifera at site 883B would suggest that the water was warmer and would further support the preliminary data found at site 884. These tiny fossils would tell a tale of the western boundary current in the North Pacific Ocean with global significance.

48. **Ocean Acidification and Carbonate Chemistry in Galveston Bay**

Cameron Henderson (University of South Carolina)

Oceanography REU

Research Advisor: Dr. Kathryn Shamberger

Ocean Acidification is defined as the decrease of worldwide surface ocean pH due to an increase in the uptake of anthropogenic atmospheric carbon dioxide (CO2). Ocean acidification also causes a decrease in the concentration of carbonate ions that marine calcifiers, such as oysters and corals, use to make their calcium carbonate shells. This decrease in carbonate ions causes a concurrent decrease in the calcium carbonate saturation state (Ω) of seawater. As Ω decreases, the rate of biogenic calcium carbonate formation also decreases. Ocean acidification therefore negatively affects marine calcifiers by making it more difficult for them to build their skeletons and shells. This project investigated the carbonate chemistry of Galveston Bay by measuring temperature, salinity, dissolved inorganic carbon (DIC), and total alkalinity (TA) at 10 sites across the bay. These data were then used to calculate pH and Ω to characterize acidification levels and the processes affecting acidification levels in the bay, which contains numerous oyster reefs. Our results showed that Galveston does have a decreasing salinity gradient from Gulf to the Trinity River on the north side of the bay. Generally, TA and DIC follow the salinity gradient from high to low, while dissolved oxygen (DO) followed the pattern inversely. However, while parameters in other stations were more variable, the East Bay station had unusually low TA, DIC, and Ω numbers. While there was evidence of calcification near East Bay, the data points to other processes, specifically photosynthesis, as important factors in determining the carbonate chemistry of the bay.

49. **Sterological Study of Neuronal and Glial Cells in BA11/BA4 in PTSD**

Christopher Apgar (University of Texas at Austin)

TAMHSC COM Summer Undergraduate Research Program

Research Advisor: Dr. Keith A. Young

PTSD may impair brain function of the executive system, fear conditioning, and emotional regulation. The medial-orbital prefrontal cortex (Brodmann Area 11; BA11), links emotional processing of the limbic system and "fight or flight" responses. The present investigation will provide an initial quantitative morphological survey of cellular populations in this region in comparison to a control area of the motor cortex (BA4), which has not been identified as an area where functional or structural deficits exist in PTSD. 11 post-mortem human brains collected by the National PTSD Brain Bank were used in the study. The right hemisphere was serially cut and stained with Nissl. Using the Gunderson 1988 fractionator method for stereological analysis, as implemented in the Stereoinvestigator software system (Microbrightfield), neurons, astrocytes and oligodendrocytes in BA11 and BA4 across all lamina w ere counted using a Zeiss AXIO microscope. The experimenter was blinded to the classification of the brains until the data had been collected. The findings showed that there was no difference in the ratios of neurons, astrocytes or oligodendrocytes in PTSD in either area. Examination of available covariates (age, gender, PMI, smoking history) using analysis of covariance (ANCOVA) did not alter the findings. This is of interest because BA11 has been identified as a unique site of anatomical deviation in PTSD in structural MRI studies harboring synaptic deficits in PTSD. Further research into the morphology of these cells may provide a deeper understanding of how cellular pathways are dysfunctional without changes in cell populations.

50. **Effect of Neurosteroid Therapy on Neurodegeneration in the Mouse Pilocarpine Model of Chronic Epilepsy**

Sarah Elmer (Texas A&M University)

TAMHSC COM Summer Undergraduate Research Program

Research Advisor: Dr. Samba Reddy

Epilepsy is characterized by the occurrence of repeated unprovoked seizures and a spectrum of neurodegenerative pathology. It affects about 3 million Americans and approximately 65 million people worldwide. Despite such wide incidence of the disease and the number of drugs available to treat seizures, there is no cure for epilepsy. The objective of this study was to investigate the extent of neurodegeneration in mice with chronic epilepsy, induced by pilocarpine-status epilepticus (SE). Additionally, we sought to determine the effect of augmenting or diminishing available neuroprotective neurosteroids in the brain following SE by administering either a synthetic neurosteroid, ganaxolone (GX), or a 5alpha-reductase inhibitor, finasteride (Fn). Neurosteroids preferentially bind extrasynaptic GABA-A receptors that contribute to tonic inhibition in the hippocampus, a key structure in limbic epileptogenesis. At 90 days after experimental epilepsy induction by pilocarpine-SE, coronal serial sections (30-µm) were cut and processed for Nissl, NeuN+, and PV+ immunoreactivity. An unbiased, quantitative neurostereology protocol was utilized to determine the extent of principal neuron loss (NeuN+) and GABAergic interneuron loss (PV+) in hippocampal subfields CA1, CA2, CA3, DG, & DH. Pilocarpine-epilepsy was associated with massive neurodegeneration (65% NeuN+ & 55% PV+) in the hippocampal subfields. GX-treated animals had significantly less neuronal loss (15% NeuN+ & 10% PV+) compared to the non-treated cohort. However, there was no exacerbation of neurodegeneration following finasteride therapy. Our results suggest that neurosteroid therapy provides beneficial neuroprotection against neurodegeneration, preventing the loss of principal neurons and interneurons, often evident in chronic human epilepsy.

51. **Ganaxolone Reduces Electrophysiological High-Frequency Oscillations (Hfos) in a Rat Model of Temporal Lobe Epilepsy**

Srujan Kancharla (Texas A&M University)

TAMHSC COM Summer Undergraduate Research Program

Research Advisor: Dr. Samba Reddy

Temporal lobe epilepsy (TLE) is characterized by the progressive increase in spontaneous recurrent seizures (SRS), which often do not respond to currently available antiepileptic drugs. New and effective drugs are needed to control TLE. Limited biomarkers are available at present for epilepsy detection and therapy monitoring; however, there is evidence suggesting that high frequency oscillations (HFOs) can be EEG biomarkers of epilepsy. The HFOs including ripples (80-200 Hz) and fast ripples (250-500 Hz) are considered as biomarkers in human epilepsy because they represent pathological network activity underlying epileptogenesis in TLE. In this study, we investigated the effect of the synthetic neurosteroid ganaxolone (GX) on interictal spikes (IS) and HFOs in the dentate gyrus. TLE was induced in rats by injecting the organophosphate DFP and animals were monitored by video-EEG system. Rats with SRS were treated with ganaxolone (5 and 10 mg/kg) for one week. From EEG, epochs of 10-min were taken during light and dark periods (non-REM sleep), and analyzed for HFOs by a custom-built MATLAB algorithm. Our data shows increased HFOs (ripples & fast ripples) and IS in epileptic rats. GX treatment significantly reduced fast ripples without affecting ripples and IS. The overall HFOs incidence was lower in GX-groups. Withdrawal from GX treatment triggered a rebound increase in fast ripples, indicating greater seizure susceptibility. Diurnal analysis shows GX reduced HFOs in dark periods only. These results demonstrate that ganaxolone can reduce fast ripples without affecting IS, indicating distinct role of neurosteroid-mediated tonic inhibition in HFOs.

52. **Exosomes: A Potential Therapeutic Delivery Device for Multiple Sclerosis (MS)**

Ashley Tucker (Texas A&M University)

TAMHSC COM Summer Undergraduate Research Program

Research Advisor: Dr. C. Jane Welsh

Muscle paralysis, impaired coordination, and vision loss are some of the many symptoms of Multiple Sclerosis (MS). With over 2.3 million individuals diagnosed with MS in the United States and with the drawbacks of current medications and other drug delivery devices, there is a critical need for a new treatment for MS. Exosomes are nanovesicles ranging from 40-120nm in size with the ability of passing the blood brain barrier (BBB) while being undetected by the immune system. These nanovesicles can be harvested from available cell lines and be loaded with common MS medications for small but direct treatment of MS. In this pilot study, we investigated whether cerebrovascular endothelial cells (CVE) produce exosomes which could then be used for a drug delivery application. Through the usage of electron microscopy (EM) and antibody to CD81 in immunofluorescence studies, we were successfully able to image exosomes within our CVEs. These exosomes were then harvested through the process of ultracentrifugation, producing a small, but pure yield of exosomes. Through the successful imaging and purification of exosomes from CVEs, we look forward to increasing our yield through future experimentation of current purification techniques and exploration into different designs of tissue flasks, so that we can characterize our exosomes for drug delivery.

53. **Determining the Function of Orphan GPCR-158 in the Circadian Clock Mechanism of the Monarch Butterfly**

Kendall Bowen (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Christine Merlin

The eastern North American monarch butterfly (*Danaus plexippus*) undertakes a yearly long distance migration from the United States to the mountains of central Mexico to wait out the harsh northern winters. These migratory monarchs are characterized by: oriented southward flight, reproductive diapause, and increased longevity. This southward migration is proposed to be under the control and regulated by the circadian clock and clock genes that sense and respond to seasonal changes. The cycle begins with sensing blue light by the photoreceptors and initiates, by unknown mechanisms, a signaling cascade for the purpose of activating the expression of circadian genes. Many receptors are responsible for the binding of ligands, which in turn signal for the next modification. G-coupled protein receptors (GPCRs) are receptors that are embedded within the plasma membrane and are critical to the signaling cascades in neural cells. However, not all GPCRs are fully characterized. Characterizing these receptors is critical to understanding the molecular mechanism which drives the clock. From a list of candidate genes generated by RNA-sequencing data, we identify an orphan GPCR. Utilizing the CRISPR/Cas9 system, we intend to knock-out and determine the function of GPCR-158 in vivo in the monarch.

54. **Mechanical Testing of Hydrogels as a Replacement for Articular Cartilage**

Brian Prince (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Moreno

Articular cartilage is a critical component of a healthy joint. Its ideal mechanical properties allow joints to move smoothly without harmful bone to bone contact or scraping. There are many different ways that articular cartilage can become damaged, including injury and progressive degeneration. If left unchecked, damaged articular cartilage can lead to more severe conditions like osteoarthritis. Osteoarthritis is the most common joint disorder in the US, and affects approximately 13% of Americans over age 60. There are presently several methods used to treat damaged cartilage including abrasive stimulus, cell implantation, and tissue transplantation; these methods have varying degrees of efficacy and there is a need for new treatment options that will produce better clinical outcomes. A novel dual network hydrogel has been developed to mimic the mechanical properties of articular cartilage. To compare the mechanical properties of this new hydrogel in physiological conditions to the properties of native cartilage, we are performing various mechanical analyses. The first mechanical analysis is a uniaxial tensile test to study the non-linear pseudo-elastic properties of the material. In addition to this analysis both confined and unconfined compression tests will be done to better gauge the properties of the material under more realistic loading conditions.

55. **Development of Load Frame and Method for Mechanical Analysis of Soft Tissues**

Christopher Smith (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Moreno

Tissue engineering is a $5 billion market which will experience significant growth until at least 2023. However, “Currently tissue engineering plays a relatively small role in patient treatment” per the NIH NIBIB factsheet on tissue engineering. We believe that many researchers misunderstand and misuse testing data when performing mechanical test on soft materials. This results in a lack of reliable data being published for use in tissue engineering and ultimately adds to the lack of tissue engineered therapies to be used in clinical settings. Biological soft tissues have complex mechanical properties which are unique when compared to other conventional materials. Thus, the testing and modeling of these materials is especially difficult. Therefore, there is a significant need for accessible experimental and mathematical methods that produce relevant mechanical data which is not currently being met. We have developed a system to mechanically test biological soft tissues in uniaxial loading with both load and displacement control.

56. **Variation in Tropical Tree Wood Density as Related to Water Use and Tree Growth**

Kathryn Benson (Texas A&M University)

Ecosystem Science and Management NSF-REU in Costa Rica

Research Advisor: Dr. Georgianne Moore

Tree wood density has been associated with photosynthetic rates and carbon allocation within a tree, and identified as an indicator of hydraulic conductivity variation. However, little is known about the relationship between wood density and tree growth or water use in tropical regions. The purpose of this research project was to relate tree wood density to tree water use (daily sap flow and whole-tree water use) and size variables (height, basal area, sapwood area) within a montane forest in the San Isidro region of Costa Rica. Wood densities averaged 0.564 g/cm3, ranging between 0.33 g/cm3 to 0.78 g/cm3 among 21 tree species. Wood density had nominal relationship with daily sap flow (R2=0.0026) tree height (R2=0.0427), and whole-tree water use (R2=0.0694), but was more closely correlated to tree basal area and sapwood area (R2=0.2158, R2=0.2093, respectively). These relationships suggest that wood density may be related to tree size, but the relationship between density and tree function is less clear, given the range of species at our study site. These results support other studies carried out in tropical regions of the Americas, Asia, and Africa, suggesting that wood density can be attributed more definitely to ecoregions rather than small-scale locations. This study has significant implications for future categorization of tree functional groups, especially in cases where wood density is the main parameter.

57. **Identification of PTEN Modifier Genes Using the Collaborative Cross Mouse Panel**

Rachel Thomas (Texas A&M University)

Independent Research Project

Research Advisor: Dr. David Threadgill

Inactivation or mutation of phosphatase and tensin homolog (PTEN), a tumor suppressor gene, is implicated in unregulated cell proliferation, leading to tumor growth and the development of cancer. Identification of modifier genes, genes that alter the phenotype of another gene, of PTEN and their role in altering PTEN activity could provide insights into relationships between PTEN and cancer. The purpose of this study was to identify PTEN modifier genes by QTL mapping and the effect of their relationship on tumor growth in three cancer models. To do so, we crossed transgenic mice that overexpress PTEN (super-PTEN) to lines of the Collaborative Cross (CC), a mouse population modeling human genetic diversity. We evaluated body weight at weaning as a surrogate for PTEN activity because it has been previously reported that super-PTEN expression is associated with reduced weight at weaning. Difference in body weight at weaning of super-PTEN pups compared to wild-type littermates was used for QTL analysis to identify modifier genes of PTEN. This approach identified candidate genomic intervals harboring PTEN modifier genes. The next part of this project includes understanding the relationship between the PTEN surrogate phenotype, small body weight at weaning, and tumor progression through cancer models, specifically, APC-min induced gastrointestinal carcinoma, PYVT induced metastatic mammary tumors and 3-methylcholanthrene induced chemical carcinogenesis. The results from this project could provide insight into the causes, susceptibility, and prevention of cancer.

58. **Analyzing the Effects of EGFR Inhibition on Cardiac Function in a Murine Model**

Elliot Flint (Texas A&M University)

Independent Research Project

Research Advisor: Dr. David Threadgill

The epidermal growth factor receptor (EGFR) is a chemotherapeutic target due to its frequent overexpression in cancers. Studies from our lab have shown that pharmacological inhibition of EGFR can have cardiotoxic effects on C57BL/6J mice. In our current study, four genetically distinct mouse strains (BALB/cJ, FVB/NJ, C57BL/6J, and A/J) were treated with an EGFR inhibitor (AG1478) for 16 months, modeling the chronic use of EGFR-targeted chemotherapies for treating cancer patients. We evaluated cardiac function through echocardiography using M-mode and Speckle Tracking imaging techniques. Changes in cardiovascular profiles among the four mouse strains indicate an influence of genetic background on drug response. We have evidence of an eccentric hypertrophy response in both the BALB/cJ and FVB/NJ mouse strains, supporting published works that link ERK, one of EGFR's downstream effectors, to protection against hypertrophy. The A/J genetic background responds to treatment by reducing myocardial movement along the radial axis, a change that normally progresses with age but was accelerated in the treatment group. The C57BL/6J mouse strain experienced changes in left ventricular dimension, but not in cardiac function. These results indicate that the various genetic backgrounds utilize different compensatory mechanisms in response to EGFR inhibition. With the results of this research, we hope to better understand the effect of EGFR inhibition on the heart and how this can be transferred from the murine model to the human model to aid in identifying individuals susceptible to cardiotoxicity.

59. **Urolithin A inhibits Sildenafil-induced Auditory Cell Death by Modulating IGF1R, Mitochondrial Potential, Oxidative Stress and Inflammation**

Maya Girimaji (Texas A&M University)

Independent Research Project

Research Advisor: Dr. M. N. V. Ravi Kumar

Sildenafil is a phosphodiesterase-5 inhibitor used to treat erectile dysfunction and pulmonary arterial hypertension in adults. The off label indications explored for sildenafil include but not limited to cancer, myocardial ischemia, diabetic peripheral neuropathy. Recent literature reports indicate sudden hearing loss in individuals taking sildenafil that could hamper the progress in sildenafil-repurposing. To address the side effects we have recently initiated investigations on combinatorial approaches using plant polyphenols. The proof of concept was demonstrated using mouse auditory cells (HEI-OC1). The HEI-OC1 cells were pretreated with 10 or 20 µm urolithin A 24 h prior challenging with sildenafil (10, 50, 100, 500 µM concentrations). Mitochondrial potential changes were observed using JC1 stain and confirmed by FACS. The expressions of OXPHOS, IGF-1Rβ, AKT, pAKT, NFkB, HSP70, NOS3 and HIF1α were performed by western blotting. Localization and changes of mitochondria was confirmed by JC1 staining using immunofluorescence imaging. The cell viability was assessed by 7AAD staining followed by FACS analysis and the apoptotic features of the nuclei were observed with propidium Iodide staining. Our data indicates urolithin A can prevent sildenafil induced cell death and this combination needs further investigations for establishing risk-benefit profiles in animal models of human pathology.

60. **MiR-20a-3p Promotes Blood-Brain Barrier Endothelial Cell Function in an OGD Model**

Aaminah Farooq (University of Texas at Dallas)

TAMHSC COM Summer Undergraduate Research Program

Research Advisor: Dr. Farida Sohrabji

Stroke is a leading cause of death and long-term disability, with older women at increased risk for stroke and greater post-stroke morbidity and mortality. Previous research by our laboratory showed reduced miR-20a-3p levels in astrocytes from middle-aged female rats. Compared to younger females, middle-aged female rats have a worse stroke outcome, with more infarct and blood-brain barrier permeability. In the present study, we hypothesized that miR-20a-3p is critical for maintaining barrier integrity, and loss of this miRNA in middle-aged rats is related to poor barrier function. To test this hypothesis, human brain microvascular endothelial cells were grown under normoxia (5% CO2), then subjected to oxygen-glucose deprivation (OGD). Concurrent to OGD, cultures were treated with miR-20a-3p mimic or scrambled-control oligos. A media-LDH assay was used to measure necrotic cell death. TEER (trans-epithelial electrical resistance) testing was conducted, to measure the cell monolayer integrity. Cultures were fixed and stained with fluorescent-labeled lectin, then photographed to visualize cell-cell contact. Media from these cultures was analyzed for zymogen activity. Our results showed that while OGD increased LDH, miR-20a-3p did not reduce cell death. However, OGD decreased TEER, with a statistically non-significant trend towards improvement due to miR-20a-3p treatment. MiR-20a-3p treatment maintained cell-cell contact under OGD as the continuous pattern of lectin stained cells indicated. MMP activity examination via zymography is in progress. These results suggest miR-20a-3p may provide protection during ischemia-like conditions by maintaining cellular integrity of the blood-brain barrier, thus improving stroke outcome. Future studies will focus on validating molecular targets of miR-20a-3p. Supported by AG042189 to FS.

61. **Testing of VOC Sampling Rates of the Radiello Cartridge**

Joel Salazar (Texas A&M University)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Gunnar Schade

Volatile Organic Compounds or VOCs are important components in ambient air. Some can be particularly dangerous to human health and their oxidation can lead to ozone and secondary particle formation. VOCs are typically analyzed using active collection into solid adsorbent materials with subsequent thermal desorption (TD) and gas chromatography (GC) with flame ionization detection (FID). Radiello cartridges provide a different way of measuring VOC amounts through passive sampling: a cylinder made of deactivated mesh material filled with an adsorbent compound provides a large surface area for higher uptake rates of ambient air, and it can be reused multiple times. In this project we investigated whether the manufacturer's specified sampling rates correctly reflected the quantities of VOCs the cartridges were exposed to. We tested the Radiello cartridges using an active sampling method with controlled amounts of Toluene and Hexane in order to create a calibration curve for each VOC using the TD-GC-FID system. The peak area of each VOC signal was integrated and quantified using the calibration curve. The expected and observed masses showed differences between 14% and 26%, somewhat higher than expected considering, the combined uncertainties given by the manufacturer, possible flow biases, and peak integration errors. Nevertheless we can conclude that the results demonstrate that the passive sampling values provided are reasonably accurate.

62. **Diagnostics for Observational and Model Output Data of Global Monthly Mean Temperature Differences**

Alexa Zabaske (Saint Cloud State Univerisity)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. John Nielson-Gammon

One of the primary goals in creating computer models of the atmosphere is for them to match what is continually being observed and recorded by meteorological instruments worldwide. This project compares the global monthly mean temperature differences from observational datasets to model output data from the CMIP5. The differences are created from two separate time periods using various years and spatial elements within the overall global monthly mean temperature. It results in a nearly sinusoidal graph with a period of one year. The problem is that the observational and model datasets are not in phase. Diagnostics of these graphs are created using a Fourier analysis, with a period of 12 months. This allows datasets to be directly compared, because the phase shift given from the Fourier analysis represents which month the warming peaks in. Observational datasets follow the same general trend of phase and amplitude. When the observations are averaged together and compared with the CMIP5, there is a notable difference in phase shift. To further assess this problem, two strategies were developed. The first strategy was to create a time series of phase and amplitude, to see how all the datasets have varied over time. The second strategy was to visualize how the phase shift and amplitude vary with latitude. Once complete, the future work of this project would be to diagnose which models are the most outlying, and the cause behind this behavior.

63. **Creating and Sustaining a Cloud in a Chamber**

Isaiah Tristan (Rice University)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Don R. Collins

Currently, in-cloud production of aqueous secondary organic aerosol (cloud aqSOA) is not accounted for or accurately represented in atmospheric models. In order to study cloud aqSOA, the Multiphase Aging and Production of Particles (MAPP) chamber was developed. The chamber consists of two main parts: a cylindrical Teflon enclosure suspended in a vacuum-sealable stainless steel capsule. Unlike with previous cloud chambers, the temperature surrounding the Teflon enclosure is regulated, which, along with pressure control, allows us to create a cloud through adiabatic expansion. The main focus of this summer's research was to produce a cloud using the chamber. To achieve this, the chamber was filled with zero air, then humidified. Ammonium sulfate particles were then injected into the chamber as a seed aerosol for clouds to form on and the initial size distribution was measured. A cloud cycle followed, where temperature and pressure were lowered to simulate an air parcel rising in the sky until becoming supersaturated, then raised to dissipate the cloud. Afterwards, the size distribution of the cloud-cycled aerosol was measured to assess changes in size and concentration due to aqueous phase reactions and settling losses, respectively. Initial tests confirmed the creation of clouds and were used to determine constraints on initial particle concentration and cloud duration. Future experiments will add various gasses together with the seed aerosol to study the formation of cloud aqSOA.

64. **Statistical Comparison and Simulations of Supercells in Environments with Varying Significant Tornado Parameters**

Erin Jones (Millersville University)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Christopher J. Nowotarski

A Rapid Update Cycle-2 (RUC-2) dataset of proximity soundings from nontornadic and tornadic supercells was categorized based upon the following significant tornado parameter (STP) thresholds: STPs greater than 1, 2, 3, 4, and 5, as well as STPs between 1 and 10, and between 5 and 10. Though in a forecasting setting STPs greater than 1 generally distinguish between nontornadic and significantly tornadic (F2 or greater) supercells, it was determined that 109 out of 443 nontornadic supercell cases in the database have an STP value greater than 1. This study applied the self-organizing map (SOM) statistical clustering technique to vertical profiles of four variables "temperature, dewpoint, and ground-relative u and v wind components" for each STP threshold. These SOMs were compared to others with only u and v wind components considered. Additionally, SOMs which were created after the data had been normalized by variable and height were compared to SOMs with unaltered data to determine if either was more effective at distinguishing between storm type. It was found that the wind-only and non-normalized SOMs slightly outperformed their counterparts. Composite near-storm environments from each node of the best-performing SOM with the STP threshold between 1 and 10 were then used as the base-states for a set of idealized numerical simulations of supercells to ascertain the extent to which characteristics of the resulting storms (e.g., updraft strength, near-ground vertical vorticity) resembled the primary storm type (tornadic or nontornadic) associated with each node.

65. **Raman Microspectroscopy: Surveying Phytoplankton Bloom Emissions and Their Effect on Seeding Clouds**

Kiana McFadden (Jackson State University)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Sarah D. Brooks

Aerosols emitted from phytoplankton blooms contribute to the formation of cloud seeds and climate modulation. Currently, the role of a phytoplankton bloom in producing emissions to more readily produce aerosols for cloud formation is not yet understood. Additional research is needed to quantify the actual impact of a phytoplankton bloom on producing atmospheric aerosols which can act to naturally seed clouds. Therefore, the laboratory mesocosm experiment was designed to sample aerosols from a tank that simulated conditions at sea during the life cycle of a phytoplankton bloom (*T. wessflogii*). The experiment occurred over seventeen days. Aerosol particles were collected through cascade impactors (PIXES). A Thermo Nicolet DXR Raman microscope (controlled by Omnic software) was used to evaluate the composition of these particles. The diameters of the particles used in this experiment were 1-8 microns (supermicron size) and 0.06-1 microns (submicron size). Four samples were taken of each size in the different phases of the phytoplankton bloom. The Raman microscope and CCN camera can be used to generate a map that captures several spectra from different locations on one particle. Composition maps were produced for each supermicron and submicron sample. Then, each peak or Raman shift detected from the spectral map was analyzed to determine composition. The preliminary results of analyzing spectra show that there is a recurring peak around 520 cm-1 which indicates crystalline silicon. Other recurring peaks include carboxylic acid and carboxylate salt, 1400 cm-1 and 1600 cm-1, respectively. Further analysis of the spectra is ongoing.

66. **Nexrad Weekly Cycle**

Ryan Sullivan (Gustavus Adolphus College)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Kenneth Bowman

NEXRAD (Next-Generation Radar) level-3 rain rate measurements for the summertime months of 2004 -2013 were found on average to significantly correlate with a weekly cycle, attributable to the rain rate intensification of evening storms produced by the aerosol pollution cycle. A harmonic fit of the NEXRAD rain rate data suggests a sinusoidal weekly pattern with a maximum peak residing during the middle of the work week throughout central to eastern U.S. These findings are in agreement with the results produced by Bell [2008] which found a significant aggrandizement of the TRMM rain rate data for the middle of the work week. Both reports support the theory that aerosol pollution prevents rainstorm precipitation at early stages in cloud formation allowing an increase in convection of water above the freezing isothermic layer which creates large frozen hydrometeors; ultimately, leading to regional convergence and an increase in rainfall.

67. **Long Term Changes in Tropospheric Convective Stability: Saturation Potential Vorticity as a Diagnostic Parameter**

Glenn Liu (CUNY Hunter College)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Robert Korty

Long term changes in the thermal structure and stability of the troposphere are examined through calculating Saturation Potential Vorticity (SPV). The value of SPV and its component terms vary with the local lapse rate; the former is approximately equal to zero when the latter is moist adiabatic. While previous studies have utilized SPV to examine variability in convection for simulations of warmer and past climates, this study focuses on changes in frequency and annual cycle for convective processes in the last half-century. By calculating SPV using data from the NCAR/NCEP reanalysis, our study has found a trend of decreasing stability over land in the Northern Hemisphere winter and an increase in convectively neutral conditions in the corresponding areas.

68. **North America Mean and Extreme Snowfall Change Observed in the Past 60 Years and its 21st Century Model Projection**

Benjamin Johnson (Cornell University)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Yangyang Xu

Extreme snowfall events can devastate local economies. The goal of this research is to quantify the trend in mean and extreme snowfall over North America using a gridded historic (1960-2009) snowfall dataset aggregated from long-term ground station records. We found that mean snowfall, although decreasing in much of the Southern States due to regional warming, has surprisingly increased over many regions, including the Northern Plains, Southwest Plains, Great Lakes, and high latitudes. We found similar increasing trends exist for extreme daily snowfall events across many regions (e.g. Northern and Southwest Plains), yet noticeable differences in others such as the Northeast US, which shows contrast between mean and extreme snowfall trends. Time series of snowfall were compared to various climate variables, such as local temperature and the Multi-variable ENSO Index (MEI). It was found that local winter temperatures, and the associated increase in atmospheric moisture-holding potential, can explain the increase in snowfall in high-latitude regions and high-altitude mountains, where the climatological winter temperature is sufficiently cold for snow formation. We also found that shorter term variability, such as ENSO, plays a significant role in mean and extreme snowfall, with El Nino years leading to higher mean snowfall in the Southern States and a higher likelihood for snowstorms in the Northeast US. We will expand the analysis further using future daily snowfall from climate model output to both improve the prediction of changes in mean and extreme snowfall, and better understand changes in observed atmospheric conditions.

69. **Photoconductivity of Porphyrin**

Meridith Buzbee (Texas A&M University)

Chemistry REU

Research Advisor: Dr. James Batteas

Porphyrin nanostructures have led to biological advancements in medicine due to their highly conjugated nature providing unique electronic properties. Further, serving as a great foundation for self-assembly, TCPP (tetra(p-carboxyphenyl) porphyrin) has the ability to form nanowires with a surface that can easily be modified for medical sensing technologies. While porphyrin based nanowires are an ideal candidate for biological applications, the structures need extended studies to fully understand the electronic properties (e.g. photoconductivity) for further utilization in medical techniques such as photodynamic therapy. Here, nanowires of TCPP self-assembled via titration with hydrochloric acid were studied to better understand their conductive properties. The controlled self-assembled nanowires (at a pH of 1) were drop-casted onto a Au(111) surface to be characterized with atomic force microscopy (AFM) and conductive-probe atomic force microscopy (CP-AFM). Initial IV-curves on the gold reference showed conductive behavior, while the IV-curves of the TCPP/HCl nanowires exhibited semi-conductive behavior.

70. **Replicating the Origin of Life on Earth: The Importance of Hydrothermal Microenvironments**

Yuncheng Yu (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Victor Ugaz

The “primordial soup” is a widely accepted theory of the origin of life on Earth. However, this theory fails to explain how molecules (e.g., proteins and DNA) present at high concentrations in the prebiotic oceans. Since the discovery of the first hydrothermal vents in deep ocean floor and their ability to provide a favorable environment for life, hydrothermal systems have emerged as an alternative to the “soup” theory. In our project, we replicated the conditions for the origin of life in a laboratory scale to understand how hydrothermal vents could produce high concentrations of molecules necessary to form life’s building blocks. Specifically, we constructed pore-like chambers inside which convective flow can be established in a controlled way. Using this approach, we studied different possible flow trajectories that could occur inside such pores, ranging from well-organized patterns to highly disorganized or chaotic flows. The results showed that chaotic flow can quickly accumulate molecules in certain regions of the pore-like chambers, providing necessary high concentrations for the synthesis of life’s building blocks. This study provides evidence for hydrothermal vents as enablers of the first forms of life in Earth’s primitive oceans. Another interesting finding was that two immiscible liquids inside these hydrothermal microenvironments form complex microstructures in a consistent and reproducible fashion due to the presence of convective flow. We are currently investigating properties of these microstructures, potentials for encapsulating different liquids and species, other geometries of the pore-like chambers that could lead to their formation, and their possible applications.

71. **Using Motion Capture to Analyze the Biomechanics of Quarterbacks and Coach them Using Quantitative Assessments**

Jacob Quick (Texas A&M University)

Independent Research Project

Research Advisor: Dr. Michael Moreno

A football throw is a highly technical motion, and little biomechanical analysis has been done investigating the motion. Using 3D high speed motion capture technology the biomechanics of 15 high school quarterbacks, and middle school quarterbacks were analyzed. That data was used to find measurements such as release time, stride direction, accuracy of throw, shoulder angle, ball release time, maximum hip angle and elbow flexion at release. Coaches as of right now rely on primarily on qualitative assessments and observations in order to improve their players. We asked coaches what their main coaching points are for their players. Using the motion capture data, and the coaching points that the coaches want to focus on. We can provide coaches and players quantitative measurements and assessments of their abilities and progress in a format that an average person would be able to understand. Players will be continually assessed every year to see their development in a particular system.

72. **Assessment of Precipitation in CMIP5 Models using TRMM Data**

Taylor Aydell (University of Louisiana at Monroe)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Courtney Schumacher

General Circulation Models (GCMs) often have difficulty accurately predicting annual rainfall rates in the tropics, specifically when detailing the difference between convective and stratiform precipitation. Five of the Coupled Model Intercomparison Project 5 (CMIP5) models were selected and their corresponding parameterizations for stratiform and convective precipitation were recorded. Parameterizations for both convective and sratiform precipitation describe how the models formulate these processes and can ultimately reveal why the different precipitation types are often forecasted inaccurately. The five chosen CMIP5 models, with data ranging from 1990-2005, were read in, averaged annually for the given years, and plotted in units of mm/day. The data was then looked at in plots of annual total, convective, and stratiform precipitation, stratiform rain fraction, and seasonal averages of all three types of precipitation. Data output from the Tropical Rainfall Measuring Mission (TRMM) satellite was manipulated similarly. Comparing the model data to the observed satellite data will reveal if the five chosen CMIP5 models accurately represent the types of precipitation in the tropics. Preliminary results show that the models are inaccurately predicting stratiform precipitation primarily in the middle latitudes and underestimating stratiform precipitation in the tropics.

73. **Cloud Structures in the Pacific ITCZ using CloudSat**

Nick Slaughter (University of Louisiana at Monroe)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Anita Rapp

Previous studies show that the Intertropical Convergence Zone (ITCZ) has narrowed over the past few decades and that there is large interannual variability in the ITCZ width and precipitation intensity. However, it is currently unknown how the cloud distributions and cloud structures vary with the characteristics of the ITCZ. This project investigates the relationship between the ITCZ width and cloud features by creating a cloud climatology for 2007 - 2010 using the joint radar-lidar 2B CLDCLASS-LIDAR product derived from CloudSat and CALIPSO in the A- Train satellite constellation. Clouds within the Pacific ITCZ region are identified as one of eight cloud types and variables such as mean height, cloud extent, precipitation fraction, and frequency are related to ITCZ extent is investigated through frequency histograms, as well as timeseries and correlation analysis. The cumulus cloud type is the most common taking up 40% of all clouds in the ITCZ while nimbostratus is the least common at less than one percent. The total number of clouds increases across all cloud types as the ITCZ increases in width. However, the relative distribution of clouds in the ITCZ changes in a different manner as deep convection, nimbostratus, and high cloud percentages show the largest increase. Initial findings also show that the mean height, depth, and extent of deep convection and nimbostratus clouds increase with the ITCZ width. Monthly mean cloud variables will also be compared to the Multivariate ENSO Index for a better understanding of the interseasonal changes of the cloud distributions in the ITCZ.

74. **Assessing Storm Surge Parameters for Landfalling Tropical Storms Along the Northern Gulf of Mexico and the Atlantic Coast of the U.S.**

Emma Thomas (University of Missouri)

Atmospheric Science in the Gulf Coast Region at Texas A&M University REU

Research Advisor: Dr. Saravanan

Storm surge is a catastrophic and potentially life threatening by-product of a tropical storm. A variety of factors directly influence storm surge, including: a tropical storm's winds, pressure, and size measured in terms of wind radii. This study analyzes these factors using maximum storm surge data found from the Storm Surge Database (SURGEDAT) and United States landfall data from the Hurricane Research Division's (HRD) Re-Analysis project. The tropical storms surveyed in this research occurred in the Atlantic Tropical Basin from 1980-2014. The primary factors analyzed in this study are a tropical storm's wind, pressure, and wind radii at or near the reported landfall location and the corresponding maximum storm surge associated with each tropical storm. Additionally, this project explores the relationship between the landfall location of a tropical storm and the location of the maximum storm surge by calculating the maximum surge's angle and distance from the landfall location. The ultimate goal of this study is to investigate whether or not a significant correlation exists between a specific storm parameter and the maximum storm surge that is produced. Through analyzing the correlation coefficient of the various storm parameters, preliminary results indicate that a moderate positive correlation exists for a tropical storm's wind and a moderate negative correlation exists for a tropical storm's pressure.

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