Office of
UNDERGRADUATE RESEARCH
THE UNIVERSITY OF UTAH

2017 Summer Symposium

THURSDAY, AUGUST 3, 2017
9:00AM - 12:00PM
OLPIN UNION
UNIVERSITY OF UTAH

2017 SUMMER SYMPOSIUM

Thursday, August 3, 2017
9:00 AM – 12:00 PM
A. Ray Olpin Student Union
University of Utah

The Office of Undergraduate Research is grateful for the generous support of the Office of the Vice President for Research.

We are also thankful for the development of the Summer Research Program Partnership, which is a new collaboration among the Chemistry Research Experience for Undergraduates (REU), the Materials Research Science & Engineering Center REU, the Native American Summer Research Internship (NARI), the Physics & Astronomy REU, and the Summer Program for Undergraduate Research (SPUR). Together, these programs are serving more than 80 undergraduate researchers in Summer 2017.

Finally, we would like to express our utmost pride and congratulations to the students, graduate students, and faculty mentors without whose efforts and dedication this event would not be possible.

PROGRAM SCHEDULE

NOTE: All student presenters MUST check-in

Snacks available at 10:15 AM in the Center Ballroom

8:30 – 9:00 AM	**CHECK-IN & POSTER SET-UP**
9:00 – 10:30 AM	**POSTER SESSION I**
10:30 AM – 12:00 PM	**POSTER SESSION II**
12:00 – 12:15 PM	**POSTER TAKE-DOWN**

SCHEDULE OF PRESENTATIONS

POSTER SESSION I
9:00 – 10:30 AM

CENTER BALLROOM

Poster 1
Presenter: Maggie Yazzie (Montana State University)
Mentor: Jennifer Garvin (Biomedical Informatics)
The use of informatic tools to improve CHF patients within the VA health care system

Chronic heart failure (CHF) is a prevalent condition in the Veterans Affairs (VA) health care system with a percentage of Veterans not receiving guideline-directed beta blocker medical therapy. We developed a clinical reminder (CR) within the VA electronic record to prompt beta blocker titration. We undertook semi-structured interviews with primary care providers (PCP) while they used the CR with clinical scenarios so that we could assess usability, clinical content, and provider acceptance. Our two research questions were: Do providers express they received the right information in the CR to undertake beta blocker titration? Do providers express agreement to initiate beta blocker titration when appropriate? We analyzed the interview transcripts answer our research questions (applied qualitative analysis). Our results included 8 interviews (2 physicians, 4 pharmacists, 2 nurses) associated with two VA hospitals and the related community based outpatient clinics. Four of eight providers expressed that they received the right information in the CR. Six of eight PCPs expressed that they would initiate titration based on the CR. Using the Cabana Framework to analyze provider-specific barriers to titration we found that some providers were confused about guideline contents, some lacked self-efficacy, and some had specific preferences about which medications to use. The results of this usability analysis will be used to further develop the clinical contents of the CR. The views expressed here are those of the authors and not necessarily those of the VA. We thank the VA for funding through the VA HSRD project #CRE 12-037.

Poster 2
Presenter: Matt Conley (Brigham Young University)
Mentor: Jared Rutter (Biochemistry)
Stress Responsive Degradation of mRNA Encoding Mitochondrial Proteins.

The degradation of cytosolic mRNA is crucial to the regulation of gene expression and can be induced by numerous cellular perturbations including glucose deprivation, etc. Although many stressors are known, cytoplasmic mRNA degradation has never been studied in the context of organellar stress. Recent studies have demonstrated that mitochondrial protein import stress activates a cytosolic response that leads to the degradation of proteins bound for the mitochondria. However, in the context of a similar stress, there remains nothing known regarding the fate of cytoplasmic mRNA encoding mitochondrial proteins. Thus, we sought to study mitochondrial stress induced mRNA degradation. In order to assay the induction of mRNA degradation, we engineered several *Saccharomyces cerevisiae* strains, in which GFP was fused to proteins involved in mRNA decapping and degradation. The accumulation of these proteins in subcellular structures termed p-bodies is commonly used to assay active mRNA degradation. We hypothesized that the accumulation of p-bodies would increase in response to mitochondrial stress. In order to induce stress, we chose two methods. First, we treated the cells with small molecules that uncouple the mitochondrial membrane and disable mitochondrial protein import. Second, we used FASII mutant strains, thereby creating a genetic model of mitochondrial stress. In order to assess p-body accumulation, we have employed fluorescent microscopy. Furthermore, we will perform RNA-seq assay and measure the levels of mRNA encoding a subset of mitochondrial proteins and compare the results to the level of said mRNA levels when mitochondrial stress is induced.

Poster 3
Presenter: Hodan Abdi (University of Utah)
Mentor: Jacqueline Pasek-Allen (Chemistry)
Synthesis of Phenylalanine derivatives

This experiment was aimed to synthesis Fluoronaphthalene phenylalanine conjugates. In collaboration with the Yingbin Fu group we tested the aggregate disrupting properties of Naphthaquinone-Phenalyalanine (NQPhe) in mouse model with Leber's Congential amaurosis (LCA) and it showed significantly improved therapeutic activity. LCA is a genetic eye disease that causes early childhood blindness. The cause of this disease is due mutations of different genes that are required for normal vision. These mutations lead to the development of abnormal and degenerative photoreceptors. One of the main mutated genes leads to protein aggregates at the center of the retina. The Fu group has shown that the pi-pi

interactions between phenylalanine residues in the misfolded proteins play a role in their aggregates. Fluoronaphthalene compounds are very hydrophobic so we hypothesized that their hydrophobicity will disrupt the aggregation.

Poster 4

Presenter: MacKenzie Ferron (University of Utah)
Mentor: Ryan Steele (Chemistry)

Quantum Molecular Motion in the Mixed Hydrogen/Hydride Complex, $[Fe(PH_3)_4(H_2)(H)]^+$

Hydrogenation is a chemical transformation utilized in many industrial processes, from edible oils and pharmaceuticals to refined oil products, such as gasoline. The hydrogenation process is often aided by a transition-metal catalyst, in order to accelerate and/or control the reaction progress. Transition-metal hydrides are the standard choice for this catalyst, but H_2-bound structures are also known to exist. This project examines a metal complex containing both H_2 and hydride ligands, with particular focus on the quantum mechanical motion that converts between these two limiting regimes. A computational study of an iron (IV) dihydrogen/hydrogen complex using ab initio molecular dynamics and path integral computational methodology will allow for understanding of molecular motion in these complexes, as well as the underlying electronic structure that drives this motion.

Poster 5

Presenter: Tyson Florence (University of Utah)
Mentor: Bert Uchino (Psychology)
A Longitudinal Analysis of Coping Style and Cardiovascular Reactivity

The association between active and passive coping and cardiovascular reactivity has been of interest because of its implications for health. However, most studies have utilized laboratory manipulations and cross-sectional data. A complementary approach would be to examine individual differences in active and passive coping and their links to lab-based reactivity over time. The present longitudinal study assessed active and passive coping styles, which were used to predict cardiovascular reactivity to a laboratory stressor at a follow-up 10 months later. Consistent with hypotheses, results showed that active coping predicted greater increases in heart rate reactivity, whereas passive coping predicted greater changes in blood pressure reactivity

Poster 6

Presenter: Diana Fierro (University of Utah)
Mentor: Allison Payne (Bioengineering)
Validation and translation of a non-invasive, MRI-guided breast cancer therapy

It is reported that in the U.S. 1 in 8 women will develop invasive breast cancer over the course of her lifetime (U.S. Breast Cancer Statistics), making this a highly significant disease. While treatments have evolved to be more effective and conservative, there is still a need to provide more tolerable, less invasive treatments for patients. High Intensity Focused Ultrasound (HIFU) is a non-invasive potential therapeutic treatment for localized breast cancer that utilizes a set of focused ultrasound beams to target lesions within the breast. This technology allows for the complete ablation of the primary tumor without damaging the surrounding healthy tissues providing a potential alternative to a surgical lumpectomy procedure . While breast cancer has been treated throughout the world with HIFU, results have been mixed due to some technical limitations. The Muse System, a magnetic resonance guided HIFU system has been developed to overcome these limitations. This system has been been preclinically tested to obtain data on ablation rates of the lesion as well as the efficiency and safety of the Muse System. In the current protocol, tumors are being injected into the thighs of rabbits to be treated using the Muse System and the, tumor are then excised and analyzed histologically to measure what percentage of the tumor was successfully ablated and to correlate the MRI results to the cellular damage . This work presents the current status of this preclinical evaluation effort.

Poster 7

Presenter: Ryan Bia (Arizona State University)
Mentor: Sarah Franklin (Biochemistry)
The Role of Smyd5 in the Development of Heart Disease

Epigenetic regulation is the process of altering gene activity without changing DNA sequence including methylation, acetylation, and phosphorylation of histone proteins which modify chromatin structure and allow gene expression or silencing. Heart disease, the leading cause of death in the United States, is accompanied by two hallmark features: specific alterations in gene expression and growth of the myocardium. However, we are only beginning to identify the proteins which regulate these changes in gene expression and contribute to heart disease. The Smyd family is a unique class of methyltransferases whose catalytic SET domain is separated by an MYND domain and consists of 5 members. This family

has been shown to methylate several unique histone and non-histone proteins and has been implicated in regulating cell growth, cardiac development, sarcomere organization, and muscle differentiation. However, little is known about Smyd5, which has never been studied in striated muscle. Therefore, it is completely unknown how Smyd5 regulates gene expression in the heart and how this contributes to cardiac physiology and morphology. My hypothesis is that Smyd5 interacts with a specific subset of proteins to regulate cell growth and gene expression. To evaluate this hypothesis and identify the protein binding partners of Smyd5 I have utilized adenoviral-mediated expression of Flag-tagged Smyd5 in cultured cells (confirmed via western blotting) followed by co-immunoprecipitation and mass spectrometry. These experiments are enabling me to characterize the binding partners of Smyd5, which will lay the ground work to understand the molecular mechanisms by which Smyd5 functions in the heart.

Poster 8

Presenter: Erin Aadland (Minnesota State University Moorhead)
Mentor: David Kieda (Physics & Astronomy)
Observing the Extended Gamma-Ray Source MGRO J1908 using the VERITAS Observatory

Very Energetic Radiation Imaging Telescope Array System (VERITAS) is a ground-based gamma ray instrument that consists of an array of four Davies-Cotton type telescopes for gamma ray astronomy. This system is designed to observe cosmic rays and gamma rays. However, VERITAS' standard analysis technique has a problem detecting extended sources, which provide a challenge to observe due to the spread of the extended emission region. A new analysis method, developed by Andrew Flinders, called the Matched Runs Method (MRM) is developed to increase the sensitivity of the extended sources. This method compares the field of view of the region of interest to another field of view with a known point source in order to estimate the background. MRM was applied to the extended source MGRO J1908 to see if the extended emission region around the source could now be detected. MGRO J1908 is thought to be the pulsar wind nebula from a nearby pulsar, however it is hypothesized that another object is also contributing to MGRO J1908. The data analyzed for MGRO J1908 was taken in May and June of 2012 and consists of roughly 9 hours of data with good (grade A) weather conditions. The matched runs were checked in order to examine whether the background events were accurately representing the background events in the source run. This poster will discuss the Matched Runs Method, the sanity check, and the results of applying the MRM to MGRO J1908.

Poster 9

Presenter: Endora Abreu (Central Connecticut State University)
Mentor: Jennifer Shumaker-Parry (Chemistry)
Light-Matter Orientation Dependencies of Planar Plasmonic Nanocrescents

Localized surface plasmon resonance (LSPR) is observed when light interacts with metal nanostructures inducing an oscillation of electrons at the surface of the structures. This occurs when the frequency of the incident light matches the natural frequency of oscillating surface electrons of a conductive material.[1] These LSPR responses can lead to enhanced near field effects, potentially controlled through nanostructure design, leading to tailorable antenna-like effects. Similarly, strong chiroptical effects can result from the interaction of circularly polarized light (e.g., circular dichroism) with chiral plasmonic nanostructures.[2] Subsequently, chiral plasmonics commonly involves the study of nominally asymmetric nanomaterials. However, our work illustrates the handedness of symmetric planar plasmonic nanomaterials—exhibiting chiroptically responsive orientation dependencies. A suggested key component in practical chiral plasmon-mediated driven scenarios may involve the capability of controlling, or switching, handedness.[3] Light-matter orientation dependencies are reported here via controlled rotations in sample orientation relative to the incident light. These responses potentially demonstrate a simple approach in controlling desired handedness in targeted nanomaterials. In addition, these dependencies also illustrate the necessity for focused, careful control in orientation to confirm and potentially optimize desired optical responses. Discussed here are the responses and orientation dependencies of symmetric nanocrescents.

Poster 10

Presenter: Mu Pye (University of Utah)
Mentor: Akiko Kamimura (Sociology)
Patient Satisfaction and Perspectives of Continuity of Care among Free Clinic Patients in the USA

Free clinics are important resources for those who un- or under insured individual in the United states. The purpose of this study was to explore continuity of care and patient satisfaction from the perspectives of free clinic patients. Since the majority of free clinic providers are volunteers and may not be with a free clinic long-term, continuity of care should not be just seeing the same doctor over time, but also seeing well-coordinated providers. Because free clinics serve a wide variety of underserved populations, cultural competence training in medical education may not wholly t the socioeconomic and/or cultural realities of free clinic patients. And the result of continuity of care was not always perceived positively. There were potential miscommunications between providers or receptionists and patients. Patients

may not be well informed of the available resources at the clinic. More in-person communication would be beneficial to distribute the information about available resources for free clinic patients. Communication among patients and receptionists, providers, and interpreters seemed to be a prevalent recurring topic across groups. The communication of health programs and appointment reminders are the areas to be improved. Training in communications with patients or cultural competence in medical education may need to consider a wide variety of patient backgrounds.

Poster 10

Presenter: Kai Sin (University of Utah)
Mentor: Akiko Kamimura (Sociology)
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Poster 11

Presenter: Kimberly Chapman (University of New Mexico)
Mentor: Owen Chan (Internal Medicine)
The Effects of Recurrent Hypoglycemia on Glycogen Phosphorylase Expression in the Ventromedial Hypothalamus

For patients with diabetes, hypoglycemia is the result of both defective glucose counterregulatory hormone responses and relative insulin excess. The mechanisms that contribute to defective counterregulation are not fully understood. One possible pathway that may contribute to defective counterregulation is excessive glycogen breakdown in the ventromedial hypothalamus (VMH), a major glucose sensing region in the brain. Glycogen phosphorylase (GP) is the major enzyme regulating glycogen breakdown. We hypothesize that recurring exposure to hypoglycemia will increase GP expression in the VMH and enhance glycogen breakdown. To test this hypothesis, rats were made recurrently hypoglycemic using daily insulin (5-10 u/kg) injections. Following three bouts of hypoglycemia (30-40 mg/dL), the animals were euthanized. The brains were rapidly harvested and dissected on a cryostat. We excised the VMH using the frozen micropunch technique and will perform western blots to quantify GP protein levels. A better understanding of the mechanisms that lead to counterregulatory failure will be important to help develop new therapeutic strategies to treat or prevent hypoglycemia in patients with diabetes. Preventing hypoglycemia will allow physicians to lower glycemic targets and reduce the incidence of long-term diabetic complications.

Poster 12

Presenter: Ali Dibble (University of Utah)
Mentor: Taylor Sparks (Materials Science and Engineering)
Evaluating Performance of Sustainable Materials and Design in Feminine Hygiene Pads

Disposable feminine hygiene products are typically made with synthetic materials and chemical additives, which create a tremendous amount of waste that takes nearly a century to degrade under landfill settings. Several companies sell products to mitigate these environmental concerns, but these products are either not completely biodegradable or are bulky and uncomfortable to the user due to a large quantity of cellulose fiber added for absorbency. This project aims to assess the differences in absorbent capabilities between industry products and proposed biodegradable alternatives to determine if a biodegradable product can be created without sacrificing absorbency or user comfort. It is found that biodegradable hydrogels are 4 times less absorbent than industry-processed hydrogels. Boiled cotton is not a sufficient processing method as it only absorbs 45% the amount of fluid as chlorine-bleached cotton, though sustainable H2O2-bleached cotton absorbs 113% the amount of fluid as industry cotton. Preliminary fiber alignment patterns are also investigated to maximize fluid flow through the product and compensate for inferior material performance.

Poster 13

Presenter: Kiara Camareno (University of Puerto Rico - Mayaguez Campus)
Mentor: Scott Anderson (Chemistry)

Sn Doped Size Selected Pt Clusters as Coking-Resistant Catalysts

Achieving hypersonic speeds in an aircraft requires the use of fuel circulation as an engine cooling system, and at higher speeds, it is essential to exploit endothermic reactions in the fuel to absorb excess heat. Thermal cracking and dehydrogenation tend to generate coke precursors that lead to fuel system clogging. Catalytic dehydrogenation can be effective, provided that it is controlled to avoid deep dehydrogenation to alkynes or other coke precursors, which ultimately poison active catalytic sites and clog fuel lines. The goal of this research is to create a coking-resistant catalyst using size-selected Pt-Sn clusters capable of endothermic dehydrogenation of fuels down to alkenes, but not alkynes. Cluster catalysts are made up of anywhere from 1 to 50 atoms and are less than 1 nm in size. Previous studies have shown that size-selection has a pivotal effect on catalytic activity, where the addition of just one atom to the cluster can change its activity up to 20x. Computational work done by collaborators demonstrates Pt-Sn is efficient at dehydrogenating alkanes into alkenes, but the ability for Pt-Sn to selectively desorb alkenes is unexplored. Pt24 clusters were prepared using laser ablation, and were size-selected using a quadrupole mass spectrometer. The alloy catalyst was prepared by Atomic Layer Deposition using $SnCl_4$ as the Sn ALD precursor. Ethylene was used as a model alkene to study the propensity of the catalyst to dehydrogenate. The effectiveness of the catalyst was analyzed using different analytical methods such as Temperature Programmed Deposition, Temperature Programmed Reaction, X-ray Photoelectron Spectroscopy, and Ion Scattering Spectroscopy. These analysis techniques show that the Sn atoms do not block alkene binding sites, and prevent unwanted dehydrogenation of alkenes.

Poster 14

Presenter: Dulce Torres (University of Utah)
Mentor: Nicola Camp (Internal Medicine)
Identifying Inherited Genetic Variants for Breast Cancer: A Consortium Approach

Research in our laboratory focuses on the identification of inherited genetic variants that increase the risk of breast cancer. Breast Cancer is a huge health burden to society. According to the National Cancer Institute (NCI), there will be 252,710 new diagnoses and 40,610 deaths due to breast cancer in the US in 2017. Discovery of new genetic factors is difficult because of the complexity of the underlying genetic mechanism, and the involvement of environmental factors. Because identification of common, low-risk variants requires large sample sizes, the Camp Lab works together with the worldwide Breast Cancer Association Consortium (BCAC) whose goal is to identify common genetic risk variants of breast cancer in families and to compare tumor and germline mutations. Because of the resources provided by the Utah Population Database (UPDB), Huntsman Cancer Institute (HCI), and Intermountain Healthcare (IMC), we are able to be active in these new phases of discovery. We link breast cancer patients in our studies to tumor biobanks for tumor material and to the UPDB for family information. We then extract, quantify, and prepare DNA and RNA for panel sequencing and genotyping experiments. Overall, our goal is to better understand inherited genetic risks and improve prevention, detection, diagnosis, and treatment strategies for breast cancer.

Poster 15

Presenter: Michelle Eyink (Arizona State University)
Mentor: Jeffrey Bates (Materials Science and Engineering)
Scaling Hydrogels for Mechanical Degradation Tests and Optical Property Analysis

Climate change has posed a serious water scarcity issue in the American-Southwest that is expected to worsen in coming years. Over-watering of commercial and residential lawns wastes copious amounts of water every day. Sensors are needed to detect soil-moisture levels and ensure delivery of the perfect amount of water to prevent waste but nourish grasses and plants. Hydrogels can be used with piezoelectric sensors to capture soil moisture data as they swell; however, the mechanical degradation of these gels after numerous soak-dry cycles has not been studied. To address this issue, hydrogels were created on a much larger scale to test the mechanical properties. Cracking and warping of the larger hydrogels prompted tests using various recipes and mold types to ensure a uniform surface consistency appropriate for testing. In addition, hydrogel optical and mechanical properties were compared using UV spectroscopy. Future research is needed to integrate hydrogel sensors into automated watering systems and monitor other soils parameters such as pH.

Poster 15

Presenter: Serita Sulzman (Arizona State University)
Mentor: Jeff Bates (Materials Science and Engineering)
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the mechanical degradation of these gels after numerous soak-dry cycles has not been studied. To address this issue, hydrogels were created on a much larger scale to test the mechanical properties. Cracking and warping of the larger hydrogels prompted tests using various recipes and mold types to ensure a uniform surface consistency appropriate for testing. In addition, hydrogel optical and mechanical properties were compared using UV spectroscopy. Future research is needed to integrate hydrogel sensors into automated watering systems and monitor other soils parameters such as pH.

Poster 16

Presenter: Kellie Crouse (Syracuse University)
Mentor: Nicole Mihalopoulos (Pediatrics)
Physician Knowledge Gaps in Transgender Healthcare

Background: Pediatric and family medicine (FM) providers are often the initial source of medical advice and care for transgender adolescents. Evidence based standard of care guidelines aim to equip providers with the tools and knowledge necessary to provide care to their patients. The 2011 National Transgender discrimination survey reported that 50% of respondents reported having to teach their providers about their own health care. The purpose of this project is to identify physician knowledge gaps in transgender healthcare among University of Utah Physicians. Methods: We sent an anonymous response validated survey via email to physicians in the Departments of Pediatrics (n=230) and Family and Preventive Medicine (n=46) at the University of Utah. T-test statistics were used to compare pediatricians with family medicine providers. Results: 34 (14.7%) pediatricians and 31 (67.4%) FM providers responded to the survey; 97% of pediatricians and 74% of FM physicians worked at an urban academic medical center ($p<.003$). Most pediatricians (85%) and FM physicians (71%) had never heard of or were not familiar with the standards of care guidelines published by the 2 leading professional organizations ($p=.08$); 17% of pediatricians and 40% of FM providers reported receiving formal training or CME to provide care to transgender patients ($p=.02$). Conclusion: Most respondents have transgender patients. There are more FM providers who reported formal training in transgender healthcare. Overall, physicians are not aware of health care guidelines and have not received formal training in transgender health care.

Poster 17

Presenter: Timothy Bell (University of Utah)
Mentor: Anil Seth (Physics & Astronomy)
What can Globular Clusters tell us about the early universe?

Globular Clusters (GCs) are some of the oldest relics from our early universe. These densely packed groups of stars, containing anywhere from hundreds of thousands to a million stars, are around 13 billion years old. Given that the age of our universe is around 13.8 billion years, this means that GCs may hold key information about the conditions of our early universe. Recent studies of young star clusters have linked their mass with the conditions in which they were born. We hope that by studying the mass of the old GCs we can learn something about the conditions of the early universe. In our research, we separate our sample of GCs into different populations based on their color (metallicity) and look for trends in their masses.

Poster 18

Presenter: Jennifer Chlam (Mount Vernon Nazarene University)
Mentor: Ryan Steele (Chemistry)
Mapping the Structural Landscape of Model Drug Compounds via Quantum Chemistry Simulations

Tropane is the fundamental chemical unit found within a class of secondary metabolites known as the tropane alkaloids. A few notable members of the tropane alkaloid family include the illicit drug cocaine and the ophthalmic drugs atropine and homatropine. Tropane itself is a bicyclic molecule containing a bridged nitrogen, and the flexibility of the tropane ring-and its ligands-allows for the existence of various conformational structures for tropane and its derivatives. Knowledge of the conformational structures of drug molecules, such as the tropane alkaloids, is critical for an understanding of pharmacological mechanisms. Many drugs, including the tropane alkaloids, act physiologically by binding to the cellular receptors for natural chemical messengers in the body, in order to either prevent or elicit the natural cellular responses to those messengers. The drug molecules are nominally able to bind to the receptors because their conformational structures are shaped in such a way that allows them to bind to the receptors, which are, in turn, uniquely shaped to bind with the body's natural chemical messengers. However, the conformational flexibility of the tropane family has not yet been determined, which leaves its binding propensity poorly understood. The purpose of the present study is to identify the structures of the low-energy conformers of the molecules tropane, tropine, homatropine, and atropine, as well as their protonated analogues. Using accurate quantum chemistry computer simulations, the conformational landscape-and the electronic origins of the conformational preferences-have been mapped out for these reference compounds. Comparison to state-of-the-art vibrational spectroscopy experiments will guide future analyses of the resulting structures.

Poster 19

Presenter: Chance Fox (Brigham Young University)
Mentor: Jeff Anderson (Radiology & Imaging Sciences)
Why so Atypical: Typicality of the Default Mode Network as a Measure of Social Function in Autism Spectrum Disorder

The extreme heterogeneity in both symptoms and severity of autism spectrum disorder (ASD) has proven an obstacle to establishing coherent neurophysiological criteria for improving diagnosis and treatment options. Brain MRI measurements in autism have been similarly heterogeneous, and specific differences have not been found to be reliable clinical predictors of severity or prognosis. Functional connectivity MRI evaluates synchronized brain activity to measure relationships between brain regions, estimating a "wiring diagram" for the brain. We hypothesized that the similarity of functional connectivity to mean values across a typically developing population (typicality) might be a useful biomarker for autism that is less sensitive to autism heterogeneity. We used two analyses, {1} a principal component (PC) analysis and {2} a dynamical simulation of brain network activity, to compare typicality of functional connectivity to social function. We calculated principal components of connectivity between 25 million pairs of brain regions and compared principal components from each individual's connectivity in a large (n=487 autism, n=646 control subjects) cohort of autism and control individuals to average values from the Human Connectome Project (n=820 typically developing subjects). We found that nine out of the first ten PCs represented in control subjects were significantly more similar to typically developing population averages than ASD subjects were. For one of these components, which represented the brain's default mode network that processes attention to one's internal thoughts, the atypicality of this component for each autism subject compared to population means correlated with the degree of social dysfunction they exhibited ($p=0.0000093$). A simulation of brain network convergence to the default mode network revealed that an atypical convergence pattern is also indicative of increased social dysfunction ($p=.0012$). These findings suggest that typicality is a potential measure of social function in ASD, and possibly other neuropsychiatric disorders.

Poster 20

Presenter: Annika Young (Academy for Math, Engineering, and Science)
Mentor: Kimberley Evason (Pathology)
An Inducible Liver Cancer Model using Zebrafish

Hepatocellular carcinoma (HCC) is a leading cause of cancer-related death, but there is little understanding of the cancer and how to treat it. In order to study HCC, a zebrafish model has been created in which zebrafish have a mutated, constantly activated beta-catenin gene (Act-Bcat), and will therefore have large livers at a young age and eventually develop liver tumors. Activated beta-catenin mutations are one of the most common gene mutations in HCC patients. We used zebrafish because they are excellent for high resolution imaging, easy to genetically modify, and can be used for drug screens for discovering potential cures. The goal of our experimentation is to develop zebrafish in which we can control Act-Bcat presence, so we can study HCC if this gene were turned on later in the life of the zebrafish. In order to do this, we first used a line of fish in which Act-Bcat was turned on shortly after birth with liver-specific Cre recombinase, which cut part of the DNA allowing Act-Bcat to be expressed, and tested to see if the liver size would still be larger using this Cre-mediated switch. The next step of the study was to use Liver-CreER, a 4-hydroxytamoxifen (4OHT) -inducible Cre recombinase, which will cut a part of the DNA and turn on Act-Bcat only after exposure to 4OHT, acting as a "chemical-induced switch" . By exposing zebrafish to 4OHT at a later stage in development, we can study the liver size when Act-Bcat is turned on in juvenile/adult fish, and in a subset of liver cells. By evaluating liver size in these models, we can develop a robust inducible model for studying HCC. Methods included zebrafish breeding, 4OHT treatments, high resolution imaging, liver size measurement using ImageJ, and data analysis using Prism and Excel.

Poster 21

Presenter: Elizabeth Fine (University of Utah)
Mentor: Janis Louie (Chemistry)
Synthesis of PDAI and PDI Compounds for Electrochemical Analysis

"Pyridine dialdimine" (PDAI) is a ligand that binds to Iron to catalyze the cycloaddition of two alkynes and a nitrile/cyanamide. A molecule analyzed by the Chirik group, PDI, is to virtually identical PDAI. Only two methyl groups on the PDI, derived from a ketone, differentiate it from the PDAI that has two hydrogen groups, originating from an aldehyde, at the same position. However, despite the structural similarities, the PDAI and PDI complexes catalyze different reactions. Iron PDI complexes are utilized in [2+2] cycloadditions of alkenes and hydrogenation of olefins whereas PDAI complexed are used with [2+2+2] cycloadditions between alkenes and a nitrile or cyanamide. The aim is to determine why did these very similar molecules catalyze different reactions by synthesizing PDAI and PDI compounds and determining differences in electrochemistry. By alternating the electronic structure outside of the active pocket, the electrochemical properties will be analyzed to explain the difference in catalytic behavior.

Poster 22

Presenter: Joseph Blanton (University of Utah)
Mentor: Shanti Deemyad (Physics & Astronomy)

Calibration of an AC Susceptometer for Observation of Superconductivity Transitions under Pressure

Superconductivity is a unique state of matter attained at temperatures of 1-100 K in certain materials. Superconductors have numerous applications in research and industry, including having zero DC electrical resistance and exotic magnetic properties. Unfortunately, no known materials superconduct at room temperature. Recently, a new class of unconventional iron-based superconductors have been found that show an unusual response when pressure is applied at low temperature. I am building an AC susceptometer, which is a combination of four copper wire coils wired together with the sample placed inside one of the coils, to observe superconducting transitions under high pressure in a diamond anvil cell (DAC) and under cryogenic conditions. With my device, I have observed the transition of niobium and lead to a superconducting state at temperatures within about 0.5 K of previously values in the literature. Further calibration of the thermometry and signal noise from the circuit must be done to increase the temperature precision and signal to noise ratio of the susceptometer. Once calibration is complete, I plan to measure the superconducting phase diagram of KFeSe, an iron-based superconductor that has been reported to have two distinct superconducting states under different pressure ranges. My goal is to measure the superconducting transition temperature of KFeSe under various pressures to construct its superconducting phase diagram to see if the distinct phases are reproducible. Such an investigation will aid in the quest to produce an overall theory of superconductivity and the search for an ambient pressure superconductor.

Poster 23

Presenter: Andrew Baker (Clarion University of Pennsylvania)
Mentor: Heayoung Yoon (Electrical and Computer Engineering)

Electron Beam Characterization of Topological Insulator Bi2-x Sbx Te3-y Sey

The topological insulator Bi2-x Sbx Te3-y Sey (BSTS) proves to be of interest due to its low bulk electrical conductivity that is independent of sample thickness and this material may have application in quantum computing and as a semiconductor. BSTS is known to vary in composition from top to bottom so it is an ideal candidate to study compositional depth profiling as well. Due to the relatively high costs and destructive nature of compositional depth profiling methods currently in use, a method for non-destructive depth profiling is desirable for materials characterization and is tested with BSTS samples. Comparison of computer simulated characteristic X-ray data and characteristic X-ray data collected via energy dispersive X-ray spectroscopy (EDS) is used as a new technique for non-destructive compositional depth profiling. Monte Carlo simulations were generated for varying compositions according to depth of a Bi2-x Sbx Te3-y Sey ample to model X-ray signal as a function of depth. After generating computer simulations, BSTS samples were analyzed using a scanning electron microscope equipped with EDS. X-ray data was collected from multiple spots on four different samples of BSTS. The accelerating voltage of the electron beam was varied from 5 keV to 30 keV on one spot on each sample to understand how the composition of the samples changed with the depth of the electron beam interaction volume.

Poster 24

Presenter: Fadi Haroun (University of South Dakota)
Mentor: Alana Welm (Biology)

Understanding the Mechanism of Tumor Remission in Response to a Novel Immunotherapy Treatment for Breast Cancer

Cytotoxic T Lymphocytes (CTL) have an important role in eliminating cancer cells. The immune system has mechanisms to deactivate these cells to prevent excessive inflammation. This deactivation is mainly done through receptors on the surface of the CTL called checkpoint molecules. However, these molecules are often exploited by cancer cells to avoid eradication by the immune system. Based on this, checkpoint blockade has been studied as a method of achieving immune activation to promote CTL function in fighting cancer cells. Checkpoint blockade has been shown to be effective in many clinical trials, where patients who responded to the treatment had durable responses. However, many patients did not respond to this treatment. Therefore, combination of checkpoint blockade with other treatments has emerged as a possible method to potentiate an immune response in more patients. Ron is a receptor tyrosine kinase known to suppress the immune response through several mechanisms such as the attenuation of inflammatory response by promoting M2 macrophage state, and the downregulation of IL-12, among other mechanisms. In addition, Ron is linked to the immune checkpoint axis since Ron activation can upregulate PD-L1 and CD80 checkpoint molecules. Therefore, we combined a checkpoint blocking antibody (anti-CTLA4) with a Ron tyrosine kinase inhibitor to block the suppression of the immune system on two different levels in a mouse model of breast cancer. The combination showed significantly higher response rates compared to the monotreatment. This project was aimed at understanding the mechanism by which this novel treatment improved response rates. Since tumor infiltration by CTLs is an important component of the cancer immunity cycle, we specifically investigated whether our novel treatment caused more tumor infiltration, by immune staining and

analysis of endpoint tumor samples. Our combination treatment showed significant increase in tumor infiltration compared to vehicle-treated mice, but there was no significant difference from the monotreatment.

Poster 25

Presenter: Barry Li (University of Utah)
Mentor: Eric Peterson (Chemistry)
Fluorescence Imaging to Detect DNA Hybridization Kinetics of Individual Molecules

We employ single-molecule fluorescence imaging to detect hybridization of specific DNA sequences and measure the hybridization kinetics at individual immobilized DNA molecules. The target single-stranded DNA molecules in free solution are modified with a fluorescence label, and are complementary with single-stranded DNA immobilized on a glass surface. Because the complementary region of the probe and target DNA strands is only 10 base-pairs, DNA hybridization is reversible at room temperature. By using total-internal-reflection fluorescence (TIRF) illumination, the evanescent wave near the glass surface excites surface-bound molecules and allows us to monitor the association and dissociation of DNA on a single molecule basis without excessive background fluorescence from free-solution. The overall kinetics of on-rate and off-rates are determined by averaging the behavior of many individual molecular binding events. In order to track each molecule more precisely, we correct stage drift by tracking fiducial markers, which are bright beacons that provide information on the relative sample position throughout the experiment. We use quantum dots as fiducial markers because they feature greater photostability than individual organic fluorophores, allowing us to track drift over long observations without photobleaching. Using this methodology, we detect DNA hybridization at individual immobilized molecules and measure the association and dissociation kinetics at concentrations below 1 nM. With the knowledge of the kinetics of DNA sequences, this technology can potentially be applied to the development of single-molecule DNA microarrays.

Poster 26

Presenter: Billy Jeon (Rice University)
Mentor: Lucas Timmins (Bioengineering)
Design and Construction of a Computer-Controlled Biaxial Testing Device for Vascular Tissue

Cardiovascular disease continues to be the leading cause of death in the world, and there is a clear need for research in this area. Exploring the biomechanics of the cardiovascular system, particularly arterial tissue, plays a key role in better understanding the pathogenesis of diseases, which would ultimately lead to better diagnosis and treatment options. Herein, we present the design and development of a computer-controlled, electromechanical biaxial testing device which can simultaneously apply pressure cycles (inflate) and axially stretch (extend) excised arteries. The device consists of four major parts: motion control (via 3-axis stages, motorized actuators, and modular posts), pressure control (via syringe pump and pressure transducer), imaging (monochrome CCD), and computer automation (via programming in LabVIEW). These components allow for the cyclic pressurization at multiple axial stretches, providing pressure/diameter and load/length curves. We tested our device with excised porcine carotid arteries. Data demonstrate a non-linearly elastic behavior under loading, which is commonly observed for soft biologic tissues. Through these experiments, we can better characterize the mechanical behavior of arterial tissue and understand how tissue responds to physiologic and pathologic loading conditions.

Poster 27

Presenter: Reagan Cummings (University of North Carolina at Pembroke)
Mentor: Margit Janat-Amsbury (Obstetrics & Gynecology)
Development of Ovarian Cancer Organoid for Targeted Therapy

In recent years, the use of three-dimensional organoid technology has allowed gaining insights of several facets of disease development and consecutive treatments. Here, we are proposing to establish an organoid model of ovarian cancer and assess its response to various therapies. Ovarian cancer is a rare cancer with an estimated 22,440 new cases and 14,080 deaths predicted in 2017. Epithelial ovarian cancer (EOC) represents over 90% of all ovarian cancer cases, despite an increased understanding of the origin and improved treatments, EOC remains the deadliest gynecological cancer with 5-year survival rates below 45%. Despite an initial response to current treatment, a combination of carboplatin and paclitaxel, most of the patients will eventually recur. Developing organoids derived from tumor tissues of EOC patients may allow a personalized approach to treatment. In our preliminary experiments, we used two established human EOC cell lines to develop organoids and assess sensitivity to various drugs including carboplatin, paclitaxel, a tyrosine kinase inhibitor targeting fibroblast growth factor receptor, vascular endothelial growth factor receptor, inhibitors of phosphatidylinositol-4,5-bisphosphate 3-kinase (PI3K), and mTOR pathways. Our results concluded that the inhibition of the PI3K and mTOR pathways showed high toxicity and abolished organoid formation. Compared to conventional in vivo drug efficacy and toxicity studies in small rodents, the development of organoids allowed a more rapid assessment

of the tumors sensitivity to targeted therapy. This technology may help to develop true personalized therapies, which can result in a reduction of the risk of recurrence of ovarian cancer patients.

Poster 28

Presenter: Josh Bromley (University of Utah)
Mentor: Saveez Saffarian (Physics & Astronomy)
CHMP4B, ESCRT-III protein subcomplex facilitates HIV-1 virion abscission

HIV virions assemble on the plasma membrane and sequentially recruit the endosomal sorting complex required for transport (ESCRT) to catalyse membrane fission which results in virion release. The canonical view is that ALIX and TSG101 bind directly to the late domains of the viral Gag protein and then recruit the downstream CHMP and VPS4 factors to facilitate the budding of virions. CHMP1-7 comprise seven of the eleven ESCRT-III proteins expressed in humans, among which CHMP4B is most important for membrane remodeling and membrane fission during HIV budding. Without CHMP4B viral budding does not proceed. Using PCR, various tagged and mutated forms of CHMP4B subunit can be generated, thereby permitting further studies of protein-protein and protein-membrane interactions. As a first step to generating mutated forms of CHMP4B, we used Sanger DNA sequencing to examine the genome of the eGFP-h37-CHMP4B plasmid previously constructed in our lab. The results show that the observed plasmid doesn't contain an eGFP-N1 backbone rather it contains pCMVD4.5. Knowing the sequence of the plasmids being used in a study is important, as it will aid the selection of the correct restriction enzymes, therefore, allowing the creation of the desired CHMP4B variant.

Poster 29

Presenter: Lori Linares Laguerre (University of Puerto Rico, Rio Piedras Campus)
Mentor: Marc Porter (Chemistry)
Protein Immobilization in Biosensors: Kinetic Rates of Aminolysis and Hydrolysis of DSNB monolayers

Approaches to immobilize proteins on the surface is a key component in the preparation of a wide range of biosensors. One of the most popular approaches for protein immobilization uses N-hydroxysuccinimide (NHS) ester chemistry. This chemistry covalently links proteins to a surface through an amide linkage, formed by the nucleophilic attack of the amine groups in proteins on a NHS ester group in a linker molecule (i.e., aminolysis). However, under the conditions typically used in these preparations, a competing, ester reaction, hydrolysis, limits the effectiveness of aminolysis and ester. In our laboratory, we take advantage of NHS chemistry by the use of dithiobis succinimidyl nitrobenzoate (DSNB) as a bifunctional molecule for linking antibodies to a gold surface and providing surface enhanced Raman scattering (SERS) readout. This project investigates the kinetic rates for the hydrolysis (borate buffer, pH 8.5) and amianolytic coupling of by the addition of ethylamine hydrochloride, to (DSNB) monolayer on gold with infrared reflection spectroscopy (IRS). The as-formed monolayer and underlying substrate was also characterized, using contact angle measurements, linear sweep voltammetry, and atomic force microscopy (AFM). Results show that aminolysis is kinetically favored over hydrolysis for the DSNB monolayer, contrary to a previous finding that hydrolysis dominates aminolysis when using a similar linker molecule, dithiobis succinimidyl propionate (DSP). The potential causes for the observed trends will be discussed. These results will be used as a starting point to explore the effects of covalent protein immobilization on biosensor performance.

Poster 30

Presenter: Aspen Johnson (The University of New Mexico)
Mentor: Micah Drummond (Physical Therapy and Athletic Training)
Seven-days of hindlimb suspension in previously active mice, induces ceramide accumulation and insulin resistance in a TLR4 dependent manner.

Periods of prolonged physical inactivity (i.e. hospitalization, bed rest) lead to muscle atrophy, impaired muscle function, and insulin resistance. While the precise mechanisms responsible for impaired muscle health as a result of physical inactivity are not fully understood, our lab has recently reported a potential link between physical inactivity induction of muscle inflammatory signaling (via Toll-Like Receptor 4 (TLR4)), which then leads to muscle ceramide accumulation. Ceramides are lipid intermediates known to interfere with insulin signaling, and their accumulation in skeletal muscle is strongly associated with metabolic dysfunction. In efforts to build on our recent findings and to study rapid changes due to physical inactivity, we provided 8-week old C57BL/6 mice access to running wheels for 5-weeks. These mice were then exposed to hindlimb suspension for 7-days (HS, n=11) or continued access to the running wheel (Con, n=11) during this 7-day period. To test the involvement of TLR4 signaling in this process, a subset of mice was treated with daily injections of TAK242 (well-established TLR4 inhibitor) during 7-days of HS (TAK242+HS, n=10). We are currently processing samples taken during dissection. Our primary outcomes will be soleus-specific ceramide content, phosphorylation status of proteins involved in Akt signaling, insulin sensitivity, protein abundance of oxidative phosphorylation complexes, and muscle size. We hypothesize 7-days of HS will result in marked ceramide accumulation, insulin resistance and soleus

atrophy. We also hypothesize that inhibition of TLR4 signaling during HS may partially protect muscle health during HS, and this muscular protection will be associated with decreased ceramide accumulation.

Poster 31

Presenter: Sydney Lambert (Vassar College)
Mentor: Alex Shcheglovitov (Neurobiology & Anatomy)
The Regulation of Shank3 in the Absence and Presence of Different Deletions

Phelan McDermid Syndrome (PMDS) is a rare genetic disorder linked to autism that comes with a suite of phenotypes, including decreased muscle tone, developmental delays, and intellectual disabilities. PMDS occurs when the terminal end of chromosome 22 is deleted. This terminal deletion disrupts the function of the gene Shank3. Shank3 is a complex gene that codes for a scaffolding protein in the postsynaptic density. The Shank3 protein coordinates synaptic function and is mainly found in the brain. Its location poses an ethical barrier that prevents direct study. To get around the dilemmas of obtaining live brain tissue, we utilized induced pluripotent stem cells (iPSCs) to grow genetically identical neurons starting from less invasive, less critical tissue. After establishing these lines of neurons from patients with no Shank3 deletion, we employed a CRISPR/Cas9 system to introduce two specific deletions that we wanted to study: one complete heterozygous deletion and one partial homozygous deletion (Table 1). We suspected that the regulation of Shank3 would be changed in the presence of deletions. To test this, we designed promoter-specific sets of primers to target each of the sites that can produce unique isoforms. We then ran PCR and gel electrophoresis to identify the resulting isoform lengths. Preliminary results showed possible deletion-dependent regulation of Shank3. Understanding the regulation of Shank3 in the presence of different deletions will contribute to the overall knowledge of how genetic mutations create a plethora of observed phenotypes.

Poster 32

Presenter: Candace Bryan (University of Utah)
Mentor: Anil Seth (Physics & Astronomy)
Uncovering the Past with Red Giant Stars in the Andromeda Galaxy

The oldest stars in a galaxy can tells us about the early stages of that galaxies history. Discovering the ages of stars plays an important role in research about the early universe and our origins. However, measuring the ages of stars is complicated. The goal of my project is to age date old, bright red giant stars in the Andromeda galaxy, the nearest large galaxy to our own Milky Way. The age of these red giant stars can be measured if we know their luminosity, temperature, and composition. We measure their temperature and luminosity using the PHAT survey, a Hubble Space Telescope imaging survey of Andromeda. However, to obtain information on the composition of a star, known as its metallicity (the total amount of heavy elements in a star), we need additional information. This information comes from spectra of stars from the Keck telescope. Because the stars are faint, we combine or "stack" spectra to measure the average composition and infer the average age of stars at different compositions.

Poster 33

Presenter: Aimee Jones (Oklahoma City University)
Mentor: Lisa Joss-Moore (Pediatrics)
DHA Supplementation Dose-Dependently Improves Lung Function in Postnatal Growth Restricted Rats

Preterm infants receiving respiratory support often experience postnatal growth restriction (PGR). PGR increases the severity and incidence of the chronic lung disease of infancy, bronchopulmonary dysplasia (BPD), with male infants more severely affected. BPD is characterized by impaired lung development, with decreased lung compliance, and increased lung resistance. PGR in human preterm infants is frequently accompanied by decreased circulating docosahexaenoic acid (DHA). DHA is a long-chain fatty acid important for lung development. We previously showed, in a rat model, that PGR causes sex-divergent deficits in lung function, with male rats more severely affected. We also showed that PGR decreases circulating DHA in male rats. However, whether DHA supplementation can improve lung function in PGR rat pups is unknown. We hypothesize that, DHA supplementation will cause dose-dependent improvements in lung function in PGR rats. We induced postnatal grown restriction by randomizing newborn rat pups into litters of 8 (control) and litters of 16 (PGR). Each litter was randomized to receive diets supplemented with DHA at 0.0%, 0.01%, 0.1%, and 0.25%. Pup weights (g) were measured every other day. At d24 of life, lung function was measured using the FlexiVent. The study is ongoing. However, preliminary results suggest that DHA supplementation does not alter rat pup weight in male or female, control or PGR pups. Preliminary data also suggest that DHA supplementation at the highest dose (0.25%) improves measures of lung function in female rat pups. Lung compliance, which was decreased with PGR in both male and female rat pups, appears normalized in female rat pups with DHA supplementation. Data acquired to date suggests that DHA supplementation improves measures of lung function in female PGR rats in a dose-dependent manner. Given the importance of DHA in lung development, we speculate that improved lung function with DHA results from improved lung development.

Poster 34

Presenter: Raquel Maynez (University of Utah)
Mentor: Michael Shapiro (Biology)
MOLECULAR EFFECTS OF A CODING MUTATION IN A PIGMENTATION PATTERNING GENE

Color patterns in birds and other vertebrates are incredibly diverse and can impact fitness by affecting mate choice, crypsis, and survival. However, the genetic and developmental basis of this diversity is not well understood. In order to investigate pigmentation patterning variation, our lab studies the domestic pigeon. Domestic pigeons are immensely diverse in many traits, including pigmentation patterns. All pigeons have one of four major wing pigmentation patterns: T-check, checker, bar, or barless. Barless is the most recessive phenotype, characterized by a lack of the ancestral bars on the wing and an increased incidence of vision defects. Previously, the Shapiro lab found that variation in a gene that encodes a secreted protein is associated with the major wing pigmentation patterns. All barless birds are fixed for a start codon mutation that truncates the protein by 13 amino acids, shortening the signal peptide sequence. We are currently assessing whether this mutation effects secretion of the protein. In order to do this, we have begun constructing a mutant, wild type, and no signal sequence version of the gene with fluorescent tags, the latter two serving as controls for comparison to the mutant. We will then transform each construct into HeLa cells and visualize cellular localization of the tagged proteins using microscopy. We will also separate the supernatant (extracellular fluid) and cells of a liquid culture and use western blots to evaluate whether the protein was secreted into the supernatant or remained in the cells for all three constructs. I hypothesize that the mutant will have reduced secretion because of the shortened signal sequence. By collecting and examining our findings, we will gain insight into the molecular basis of pigmentation patterns found in pigeons and potentially gain insight into similar phenotypes found in wild bird species.

Poster 35

Presenter: Kimberly Lopez-Zepeda (Fullerton College)
Mentor: Rodrigo Noriega (Chemistry)
Preliminary Spectroscopic Studies of Optically Active Proteins

Understanding the interactions of proteins in their environment at the molecular scale remains a fundamental challenge due to our compact ability to tune their properties. In this work, we analyzed a model protein in solution as a means to optimize sample conditions and benchmark time-resolved experimental setups. Our primary focus was to characterize the optical stability of chemically-reduced heme groups in horseradish peroxidase (HRP). This model protein was chosen for its similarity to cytochrome P450, an enzyme family involved in drug metabolism in the liver and muscles. To this end, we used steady-state and time-resolved optical spectroscopy in the UV, visible, and near IR to analyze the material. Upon obtaining a solution with optimal fluorescence, a 405 nm pico-second laser was used to obtain the fluorescence lifetime and degradation dynamics of the reduced HRP solution as it constantly flowed within a closed loop. A femto-second laser was used to conduct transient absorption spectroscopy (a pump-probe experiment) to study the pathways for energy or electron transfer. This investigation resulted in the construction of an experimental set up which will be used for future protein analysis, and the results obtained here will contribute to the analysis of future experiments on the effects of light onto polymers and proteins.

Poster 36

Presenter: Andrew Jordan (University of North Carolina at Chapel Hill)
Mentor: Simon Fisher (Internal Medicine)
Recurrent Hypoglycemia Reduces Mortality Associated With Severe Hypoglycemia By Preventing Fatal Cardiac Arrhythmias

Hypoglycemia is a condition common among people with insulin-treated diabetes. Severe hypoglycemia can lead to death if left untreated. Previous research in the laboratory has demonstrated that severe hypoglycemia causes fatal cardiac arrhythmias. We tested the hypothesis that recurrent episodes of moderate hypoglycemia may act to precondition the subject to prevent severe hypoglycemia induced fatal cardiac arrhythmias. Type 1 diabetes was induced in all rats using streptozotocin (STZ). Two groups of male Sprague-dawley rats were tested, a recurrent hypoglycemic (STZ+RH) group that experienced hypoglycemia (40-60 mg/dL) for 90 minutes on three consecutive days before a severe hypoglycemic (10-15 mg/dL) clamp for 180 minutes and a control group (STZ) who did not experience the recurrent hypoglycemia. During the severe hypoglycemic clamp of both groups, cardiac arrhythmias were analyzed via continuous electrocardiogram recording. Rats that were preconditioned with recurrent episodes of hypoglycemia had over a four-fold reduction in mortality (STZ:31%, STZ+RH:7%) and five times fewer cardiac arrhythmias per minute (STZ:20/min ± 4.1, STZ+RH:4/min ± 2.6) than the control group during severe hypoglycemia. In summary, antecedent recurrent hypoglycemia in diabetic rats reduces severe hypoglycemia-induced fatal cardiac arrhythmias. In conclusion, recurrent bouts of hypoglycemia appear to act in a preconditioning role to protect against the detrimental effects of severe hypoglycemia on the heart.

Poster 37

Presenter: Maile Burnett (University of Utah)
Mentor: Valeria Molinero (Chemistry)
Following the Nucleation Pathway of Gyroid

Nanostructures and the manufacturing of them are being researched for applications in areas such as controlled drug release, bio-sensors, solar cells, and data storage. The nanostructure known as the gyroid is particularly promising for application in these areas because of the continuous, fully connected channels that spiral through it periodically and uniformly. The gyroid can be manufactured through self-assembling block-copolymers, but the mechanism for the reaction is not well understood. A better understanding of the parameters that control the formation of this structure will tell us how we can better control the synthesis of the gyroid structure, which is important in making this nanotechnology cheaper, more efficient, and commercially viable. Our goal is to use molecular dynamics simulations to find the mechanism behind the formation of the gyroid. We were able to simulate its spontaneous formation and tested the efficiency of a number of order parameters, something that can distinguish between the gyroid and the surrounding mixture. The complexity of the gyroid structure makes it difficult to find an order parameter that can capture the structure at the transition state. However, by using committor analysis methods we were able to characterize the tell us when the gyroid is going to form. We developed several order parameters that can distinguish gyroid from the isotropic mixture, but it's challenging to capture the structure at the transition state. Our next goal is to characterize the transition state and find the reaction coordinate, which will unravel the mechanism of the formation.

Poster 38

Presenter: Rylee Cardon (University of Utah)
Mentor: David Kieda (Physics & Astronomy)
Using the Matched Runs Method to observe an extended gamma-ray source TEV J2032

Very Energetic Radiation Imaging Telescope Array System (VERITAS) has been observing a wide variety of TeV-GeV gamma ray sources for the last 10 years. This research observed an extended gamma-ray object, TEV J2032 a pulsar, with a new analysis method called the Matched Runs Method (MRM). The MRM uses an observation taken under the same conditions as the run you are trying to estimate the background. This technique for estimating the background increases the VERITAS sensitivity to extended sources. TEV J2032 is an extended source with an extent about 0.9°. There were 3 hours of data taken in 2012 used for this project. This research work utilized the MRM to observe TEV J2032. This poster will discuss why the standard analysis is at a disadvantage when analyzing extended sources, highlight the advantages of the MRM, sanity checks to confirm the background is correctly estimated, and the results of the TEV J2032 analysis.

Poster 39

Presenter: Trish Kills Pretty Enemy (Montana State University)
Mentor: H. Joseph Yost (Neurobiology & Anatomy)
Exploring The Range Of Heart Phenotype In Zebrafish kmt2d CRISPR G0 Mutants

Age-adjusted mortality rates from heart diseases are 20% greater in Native Americans than among other races. Moreover, Congenital Heart Diseases (CHD) are 8% greater in newborns in this population. We are using zebrafish to understand the genetic causes of CHD. Mutations in the kmt2d gene lead to heart defects in newborns. Understanding the molecular and cellular mechanisms by which these mutations perturb heart development could lead to clues in prevention and treatment of congenital heart disease. Using CRISPR/cas9 targeting kmt2d, we generated zebrafish (ZF) models for KMT2D that have cardiac phenotypes that mimics KMT2D-related heart defects. This project focuses on (1) characterizing heart phenotypes in kmt2d CRISPR-injected ZF embryos (G0) and deciphering whether particular phenotype are correlated with specific sequence changes, and (2) whether p53-dependent cell death (apoptosis) contributes to the phenotypes. P53 serves as a regulator for genomic homeostasis. We used ZF embryos with p53 wild type and p53 -/- backgrounds to assess the specificity of the heart phenotypes in kmt2d G0 embryos. Immunohistochemistry for cardiac muscle was used to analyze the heart morphology and size. We used anti-active caspase3 immunohistochemistry to identify apoptotic cells. Data was acquired using Confocal Microscopy We concluded that hypoplastic heart phenotypes were specific to kmt2d gene disruptions, not to p53-depedendent apoptosis.

Poster 40

Presenter: Johanna Mora (The University of Texas Rio Grande Valley)
Mentor: Daniel T. Leung (Internal Medicine)
Optimizing Growth Conditions for Clonal Expansion of Mucosal-Associated Invariant T (MAIT) Cells

Mucosal-associated invariant T (MAIT) are innate-like T-cells that recognize microbial riboflavin metabolites presented by the highly conserved MR1 (MHC class-I Related) molecule. In humans, MAIT cells account for up to 10% of the peripheral blood T cells, and are enriched in the intestine and liver. The clonality, function, and activity of MAITs cells are

not well understood. In preliminary experiments, we have found significant functional heterogeneity across different clonotypes. Current methods for expansion of MAIT clones are not well established, and the optimal conditions for cloning MAIT cells are not known. Here, we examine different conditions to determine which are optimal for expansion of MAIT cells. We compared various concentrations and presence of cytokines IL-2, CD3/CD28, and TGF-β. Results are pending at time of this abstract. Determining optimal growth conditions for expanding individual MAIT clones will be essential for better understanding their biology. Our lab is interested in using these techniques to clone MAITs from healthy and infected (HIV and cholera) donors to evaluate their plasticity and functional characteristics.

Poster 41

Presenter: Vincent Morrow (Waynesburg University)
Mentor: Micah Drummond (Physical Therapy and Athletic Training)
Skeletal Muscle Insulin Sensitivity and Cell Stress Signaling during Reduced Activity and Recovery in Older Adults

The Drummond laboratory has previously shown that signaling through the innate immune system contributes to the inflammatory response, ceramide biosynthesis, and metabolic disruptions such as impaired glucose uptake and insulin resistance. These physiological changes are allied with short term skeletal muscle inactivity in hindlimb unloading mice and healthy older adults on bed rest. These models are intended to be representative of short term periods of physical inactivity in older adults resulting from injury or disease that progresses to atrophy, sarcopenia, dynapenia, and eventually, functional dependency. Although insulin insensitivity and muscle atrophy are common in strict bed rest, often hospitalization does not entail strict bed rest and instead hospitalization and recovery in the following weeks can be characterized by reduced physical activity through a reduction in total daily steps. Therefore, we collected muscle biopsies from healthy older adults before (pre) after 2 weeks of step reduction (RA: <75% of normal activity) and 2 subsequent weeks of recovery (REC: return to baseline activity levels). Muscle samples were lysed and run through SDS-PAGE and transferred to a PVDF membrane for assessment of proteins expression related to insulin sensitivity, cell stress and ceramide biosynthesis pathways This will give insight if the insulin insensitivity and muscle atrophy following a period of step reduction are associated with the TLR-4/MyD88 signaling pathway.

Poster 42

Presenter: Katelyn Chase (Oregon State University)
Mentor: Michael Vershinin (Physics & Astronomy)
The Effect of Trimethylamine N-oxide on Mechanochemistry of Kinesin-1 as a Function of Temperature.

There is a long-standing puzzle in the field of kinesin motility. The velocity and processivity of this motor are known to be roughly comparable at room temperature in vivo and vitro. This is key because it suggests that what we learn in single molecule assays in vitro is directly relevant to how these motors work in cells. It is therefore common to use motor parameters from in vitro experiments for in vivo modeling and analysis. However, it is also well- known that kinesin in vitro shows signs of degradation at ~30°C, far below animal body temperature. This is often neglected under the premise that there is some agent in the cells that can stabilize kinesin at higher temperatures. The existence of such an agent and indeed even the possibility of such an agent's existence has never been established. Trimethylamine N-oxide (TMAO) is a chemical known to stabilize biological structures. In this study, I measured the speed of the cargos being carried by the motor proteins as the concentration of TMAO is altered. Once I found the concentration that allows the cargos to move with healthy velocity at room temperature (200 mM TMAO), I then increased the temperature and compared the speeds of the cargos with and without TMAO. Without TMAO, motorized cargos are known to have an average velocity of .6 μm/s at room temperature, .9 μm/s at 30 °C, and be non-moving at 40 °C and higher. My results showed that with a 200 mM TMAO concentration, the motorized cargos had an average velocity of .8 μm/s at room temperature, 1.13 μm/s at 30°C, 1.98 μm/s at 40°C, and I even see motility at 50°C. This study for the first time shows that a chemical can stabilize kinesin at high temperatures and that this can happen without drastic alteration of kinesin velocity.

Poster 43

Presenter: Shane Littlefoot (The University of Arizona)
Mentor: Sihem Boudina (Nutrition and Integrative Physiology)
Redox Regulation of TCA Cycle Flux in Brown Pre-adipocytes

Obesity and diabetes prevalence in Native American adults is 42.3% and 17.5% for respectively. In the body glucose and other metabolites are used for energy production through their breakdown in the citric acid cycle (TCA cycle). In obesity, there is evidence of increased oxidative stress as a result of increased reactive oxygen species (ROS) production that exceeds the rate of detoxification by antioxidants. ROS can damage cells resulting in damaged tissues leading diseases. In mammalian cells, Manganese Superoxide Dismutase (MnSOD) is a mitochondrial matrix enzyme that dismutate superoxide to hydrogen peroxide and oxygen. We recently deleted MnSOD in fat cells and observed that this resulted in increased mitochondrial fatty acid oxidation. We performed snap-shot for metabolomics and found that the ratio of succinate/fumarate was increased. As succinate dehydrogenase has several iron sulfur clusters (ISC) that can be damaged

by ROS, we hypothesized that MnSOD deletion in fat cells damaged ISC in succinate dehydrogenase (SDH) and resulted in succinate buildup, which can by itself increase ROS generation at the level of complex I through reverse electron transfer. Our goal is test if glutamine can be used as an alternative substrate for lipid synthesis when MnSOD is deleted from brown adipocyte under high oxidative stress. This will be done by using 13C labeled glutamine and glucose and follow the carbons in the TCA cycle intermediates and in lipid synthesis via the incorporation of 13C in citrate. We will also be monitoring SDH activity using a colorimetric assay kit. Through this research, we are gaining insights into the possibility of manipulating adipose tissues metabolic pathways to increase fatty acid utilization and to reduce obesity.

Poster 44

Presenter: Kenneth Crossley (Colorado College)
Mentor: Cristoph Boehme (Physics & Astronomy)

Electric Field Control of Optically Detected Magnetic Resonance Signals of Charge Carriers Spin States in Polymer-based Organic Thin-film Capacitors

Organic spintronics is a technology utilizing quantum electron spins (which correspond to the magnetic orientation of electrons) for information processing, rather than the flow of electrons in conventional electronics. The realization of this technology could lead to cheaper, more efficient, flexible electronic devices. This necessitates macroscopic control mechanisms that reproducibly affect quantum mechanical systems. Therefore electric field control of spin manifolds in condensed matter is crucial for the implementation of spintronics. Using Optically Detected Magnetic Resonance (ODMR), we studied how spin states involved in spin-dependent processes within the π-conjugated polymer poly(2-methoxy-5-(2-ethylhexyloxy)-p-phenylene vinylene) (MEH-PPV) are affected by the application of electric fields. These experiments were carried out by preparation of MEH-PPV based thin film capacitors with transparent electrodes which enabled the observation of photoluminescence (PL) within the MEH-PPV layer. The PL was then used to observe ODMR under establishment of magnetic resonant conditions (by application of Radio Frequency radiation in presence of a static magnetic field). We report a strong quenching of the ODMR signal due to the applied electric field that exceeded a simultaneous quenching of the PL emissions by an order of magnitude. This result proves that electric fields are capable of controlling spin-dependent recombination rates.

Poster 45

Presenter: Kade Loveridge (University of Utah)
Mentor: Matthew Kieber-Emmons (Chemistry)

Photosensitization of a Dinuclear Copper Water Oxidation Catalyst

Recent scientific breakthroughs in the study of artificial photosynthesis have shown that the process of capturing energy from the sun and turning it into chemical fuel may be a feasible and clean way to help alleviate the world's energy crisis. The major obstacle of artificial photosynthesis is developing a catalyst that can oxidize water as is done in nature. In this study {[(L)Cu(II)]2](μ-OH)2}(OTf)2 (L =Me2TMPA bis((6-methyl-2-pyridyl)methyl)(2-pyridylmethyl)- amine) was analyzed in a set of experiments to determine if this molecule could be photosensitized to act as a water oxidation catalyst in the presence of [Rull(bpy)3]2+, sodium persulfate, and light. This was accomplished by measuring the amount of oxygen evolved from {[(L)Cu(II)]2](μ-OH)2}(OTf)2, Ru(bpy)3(Cl)2 , and sodium persulfate in presence and absence of catalyst, [Rull(bpy)3]2+, sodium persulfate, and of light at pH 11. These reactions were run in a closed system in which oxygen is not already present. Using pyrogallol as an oxygen scavenger and measuring the changes using UV-vis spectroscopy significant evidence was obtained that strongly suggests {[(L)Cu(II)]2](μ-OH)2}(OTf)2 is able to be photosensitized to catalyze the oxidation of water. In addition, experiments were performed that allowed for the collection of quantitative data in relation to this chemical reaction. In a closed system in which oxygen was not already present the amount of oxygen evolution was measured in pH 11 solutions containing {[(L)Cu(II)]2](μ-OH)2}(OTf)2, [Rull(bpy)3]2+, and sodium persulfate as well as pH 11 solutions of just [Rull(bpy)3]2+ and Sodium Persulfate. Both solutions were exposed to light from five 450 nm lights for two hours and fifteen minutes. This series of experiments lays a groundwork that will enable further studies to obtain more information about the mechanism of this catalyst. A greater understanding of the mechanism will allow for the rational synthesis of related catalysts for water oxidation and make artificial photosynthesis a realistic solution for the energy crisis we are now facing.

POSTER SESSION II
10:30 AM – 12:00 PM

CENTER BALLROOM

Poster 50
Presenter: Sarah Wilmot (University of Utah)
Mentor: Andrea Brunelle (Geography)
Reconstructing paleoecology of Bonneville Basin with multi-proxy data from Simpson Spring sediment core

I have spent my UROP at the University of Utah's Records of Environment and Disturbance (RED) Lab. I have begun to learn how to obtain and analyze sediment cores from the Bonneville basin in order to discover the ecological, climatological, and archeological history of the area. I have focused on a core that was obtained from Simpson Spring near Dugway Proving Ground. Simpson Spring was the closest freshwater source to Camelback Cave, a known archeological site. I have counted the charcoal in order to recreate a fire signal. The amount of charcoal in sediment can lead to inferences about climate, such as temperature, precipitation, and types of plant matter. I have compared my charcoal results to other data that was obtained. These other data include carbon-14 dating, magnetic susceptibility, x-ray fluorescence, loss on ignition, and pollen content. Each of these proxies tells specifics about the content of the depositional material. The top 80 cubic centimeters of this core was the only section to be preserved by the modern wetland. However, the carbon-14 dating show that the preserved material contains deposits from much of the Holocene, about 10,000 years. This period of time is of particular interest because it is known that humans arrived in the area at the beginning of the Holocene.

Poster 51
Presenter: Mikala Lowry (The University of North Carolina at Pembroke)
Mentor: Julia Lewis (Chemistry)
Ribosomally Synthesized and Post-Translationally Modified Peptides: What Actually Happens

The focus of this project revolves around a ribosomally synthesized and post-translationally modified peptides (RiPP) system. Specifically, one that includes a member of the radical S-adenosylmethionine (SAM) enzyme superfamily. These enzymes have a conserved CxxxCxxC motif that coordinates SAM to a [4Fe-4S] cluster. Upon the reduction of the cluster, SAM is radically cleaved producing a 5'-deoxyadenosyl radical (dAdo) which then abstracts a hydrogen atom from its substrate[1]. The RiPP system we are studying has been bioinformatically identified from *clostridium difficle*, which is of biological interest and importance because it causes infections in antibiotic resistant patients in hospitals. The gene cluster of the RiPP system contains a small peptide, a radical SAM enzyme as well as two other enzymes[2]. The enzymes have been grown and purified and we have synthesized the peptide. We then used LC-MS to analyze if any modifications have occurred in the peptide in the presence of the radical SAM enzyme or the other enzymes in the gene cluster. 1. Sofia, H. J.; Chen, G.; Hetzler, B. G.; Reyes-Spindola, J. F.; Miller, N. E. Nucleic Acids Res. 2001, 29 (5), 1097-1106. 2. Haft, D. H.; Basu, M. K. Journal of Bacteriology 2011, 193 (11), 2745-2755.

Poster 52
Presenter: Cullen Irvine (Carleton College)
Mentor: Shelley Minteer (Chemistry)
TBAB Modified Aquivon Polymers to Enhance Enzymatic Biofuel Cells

When modified with quaternary ammonium bromides, particularly tetra-*n*-butylammonium bromide (TBAB), the perfluorosulfonic acid (PFSA) and micellar polymer Nafion has proven effective at immobilizing the enzyme laccase at the surface of a biocathode for oxygen reduction. The addition of TBAB also reduces the acidity of the polymer, which increases the enzyme's lifetime. Aquivon, a new class of PFSA polymers is similar in structure to Nafion, but has shorter side chains. Several tests were done to understand the effects of modifying Aquivon with TBAB. To determine the extent to which TBA^+ could replace the sulfonic acid protons present at the end of the polymer's side chains, an analysis of how many protons came out of the polymer after TBAB was added to Aquivon was done. Titrations of the water used to wash the TBAB modified Aquivon prove that TBA^+ replaced most of the acidic protons present in the polymer. In addition to the titration data, TEM images show that TBAB modification of Aquivon nearly doubles the polymer's micelle size, allowing for easier incorporation of laccase into the polymer. Lastly, when TBAB modified Aquivon D79-25BS was used to immobilize laccase at the surface of a carbon cathode in a biofuel cell with a glucose dehydrogenase (GDH) bioanode, a maximum power density of 62.5 ± 6.9 μW cm^{-2} was achieved, an improvement over the power density attained when TBAB modified Nafion was used as the immobilization polymer for the same biofuel cell (41.6 ± 8.2 μW cm^{-2}). Overall, this

research shows that Aquivon polymers are capable of creating a better microenvironment for laccase and can help enzymatic biofuels generate more power than the standard immobilization polymer Nafion.

Poster 53

Presenter: Elena Mylroie (Fort Lewis College)
Mentor: Kalani Raphael (Internal Medicine)
Higher urine volume is associated with improved renal and survival outcomes in hypertensive kidney disease

Studies in animal models of chronic kidney disease (CKD) suggest that increasing fluid intake preserves kidney function. However, studies in humans have not identified a consistent relationship between fluid intake and clinical outcomes in CKD. We evaluated whether urine volume, as a marker of fluid intake, is associated with death or dialysis in the African American Study of Kidney Disease and Hypertension (AASK). We performed Cox regression models in 1093 AASK participants who submitted 24-hr urine collections. Participants were categorized into <1.5 L, 1.5 to <2.5 L, and ≥ 2.5 L of urine volume groups. We also evaluated the association between every 500 mL higher urine volume and the death or dialysis composite outcome. The average age was 54 years, 61% were men, average GFR was 46 mL/min/1.73m2, mean proteinuria was 326 mg/g, and 64% used diuretics. Mean urine volume was 2.2 L (SD 0.9), and 232, 500, and 361 participants had urine volume <1.5 L, 1.5 to <2.5 L, and ≥ 2.5 L. The hazard ratios of death or dialysis were 0.68 (95% CI, 0.51-0.91) and 0.88 (95% CI, 0.68-1.13) for those with urine volume ≥ 2.5 L and 1.5 to <2.5 L. Each 500 mL higher urine volume was associated with 9% lower risk of death or dialysis (95% CI, 0.85-0.96). Higher 24-hour urine volume was associated with a lower risk of death or dialysis. An interventional study to determine whether increasing fluid intake improves renal and survival outcomes in hypertensive CKD patients are needed.

Poster 54

Presenter: Nina Filippova (Princeton University)
Mentor: Jordan Gerton (Physics & Astronomy)
Applications of Fluorescence Super-resolution Microscopy

Conventional microscopy techniques are limited by the diffraction effects caused by the wavelike nature of light. A microscope with a high numerical aperture lens, using light in the visible range of the electromagnetic spectrum, can achieve resolution of approximately 250 nm. While electron microscopy is capable of attaining resolution several orders of magnitude greater than that achieved by traditional light microscopes, one of the technique's major drawbacks is its inability to image live specimens. Super-resolution microscopy is a field in which several novel methods have been developed which have succeeded in shattering the diffraction barrier, achieving resolution on the scale of tens of nanometers. Consequently, the imaging opportunities provided by super-resolution microscopy techniques are of great importance to researchers studying cellular biology. Many super-resolution microscopy techniques use fluorescent molecules. By selectively exciting fluorophores, it is possible to image the light emitted by a few fluorophores at a time. Because computer algorithms can locate the center of a bright spot much better than the resolution attained by a microscope, time-resolved localization of photoswitchable fluorophores can be used to create high-resolution images. However, such techniques are limited in their choice of usable fluorophores, as generally the spectra of these fluorophores are difficult to distinguish if overlapping. It would therefore be beneficial to develop algorithms capable of accurately distinguishing between small shifts in the frequency of the emitted spectra as well as precisely localizing the fluorophores. Monte-Carlo simulations and minimum variance estimator theory were used to create simulated data in order to compare with actual measurements for the purposes of developing the desired algorithms. Another microscopy technique explored in the scope of this project was the adaption of an existing microscope for dark-field fluorescence microscopy in order to study some interesting fluorescent behavior exhibited by gold nanoparticles.

Poster 55

Presenter: Jake Becker (University of Utah)
Mentor: Christie Toth (Writing & Rhetoric Studies)
Urban Writing Ecologies: Mapping Inter-Instituional Writing Transfer

As of 2014, 7.3 million students were enrolled for credit in the nation's 1,108 community colleges. That is roughly 45% of all U.S. postsecondary students, and 41% of first-time, first-year college students (AACC). Approximately 80% of incoming community college students say they plan to earn a bachelor's degree. Yet only 25% actually transfer to a four-year institution within five years, and just 17% earn a bachelor's degree within six years of transferring (Jenkins and Fink). In light of these figures, our research is locally situated on student transfer between Salt Lake Community College (SLCC) and the University of Utah (UofU), specifically how students adapt writing knowledge across institutional settings. Currently, there has been very little research on how students transfer writing knowledge between postsecondary institutions (Gere et al.). Drawing upon ecological theories of writing, the goal of this research is to increase the pedagogical approaches for fostering successful student writing transitions, while simultaneously bolstering successful student transfer between SLCC and the U of U. To accomplish this, we have curated two pilot courses within the

Department of Writing & Rhetoric Studies, with the goal of developing resources for incoming transfer students. Our research provides new insight on the value of prior knowledge for understanding and navigating new writing contexts, while also showcasing key meta-concepts that facilitate successful writing transfer.

Poster 55

Presenter: Kelly Corbray (University of Utah)
Mentor: Christie Toth (Writing & Rhetoric Studies)
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Poster 56

Presenter: Arthy Narayanan (BMS College of Engineering)
Mentor: Alan Light (Anesthesiology)
Detection of Gene Variants in Chronic Fatigue Syndrome Patients

Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) and Fibromyalgia (FM) are chronic conditions often present in the same patient, characterized by severe physical fatigue, widespread muscle and joint pain, mental fog and post-exertional worsening of symptoms. Patients with ME/CFS and FM experience difficulty in performing daily activities and in some cases are wheelchair-bound. In a pilot sample, the majority of ME/CFS patients had elevated autoantibodies to autonomic receptors and also showed variants (mutations) in genes linked to cellular energy (mitochondria). This study aims to identify some of the gene variants that may contribute to ME/CFS and FM by comparing the genetic sequences of these patients with that of the controls. Our hypothesis is that ME/CFS is both an autoimmune disorder and an energy deficiency disorder, so we have focused on both immune and mitochondrial/energy genes. Blood samples were drawn from ME/CFS patients and controls and the leukocytes were separated from it. The mRNA of these leukocytes, which represents the transcriptome of the cells, was extracted and then sequenced using the RNA-Seq method. The mutations in the genes were ranked as low, moderate or high impact on the function of the gene. In this initial sample of 44 of the planned 340 participants, we identified 3 automunity/immune function variants (LILRA6, RFTN1 and MARCH8) and several different multigene patterns for mitochondrial variants with moderate and high impact that occurred with greater frequency in the ME/CFS patients vs. controls. When the data from all 340 participants is complete, it will help identify biomarkers to make diagnosis easier and may also provide targets for developing new treatments for ME/CFS and FM.

Poster 57

Presenter: Shai-Anne Nalder (Weber State University)
Mentor: Paul Sigala (Biochemistry)
Probing Mitochondrial Function in the Malaria Parasite Plasmodium falciparum

Malaria is caused by *Plasmodium falciparum* parasites, which infect red blood cells during the clinical stage of the disease. Hundreds of thousands of people, mainly pregnant women and children under the age of five in Africa, are killed each year from this deadly disease. Currently there is no effective vaccine, and parasite strains have emerged with resistance to nearly all treatments. Eukaryotic *Plasmodium* parasites retain a mitochondrion with an active electron transport chain (ETC). Its cytochrome b component is a major antimalarial drug target but rapidly acquires resistance-conferring mutations. To explore other ETC components as potential drug targets, we have studied the soluble electron carrier, cytochrome c, which canonically functions downstream of cytochrome b but has not been directly probed in malaria parasites. Curiously, parasites encode two cytochrome c paralogs (c and c-2) for unknown reasons. To unravel their localization and essentiality, we used CRISPR-Cas9 to modify the gene for each cytochrome c paralog to encode an epitope tag and an mRNA module that enables conditional knockdown of protein expression. Immunofluorescence studies using the epitope tag confirm the expected localization of both proteins to the mitochondrion. Down-regulating

the expression of cytochrome c but not c-2 is lethal for parasites, suggesting non-redundant functions. Further studies will explore mechanisms for targeting cytochrome c and test whether cytochrome c-2 is essential in the mosquito stage of *P. falciparum*. These studies will unravel fundamental parasite biology and explore new therapeutic strategies to target this devastating pathogen and combat emerging drug-resistance.

Poster 58

Presenter: Hannah Peterson (Belmont University)
Mentor: Chris Reilly (Pharmacology and Toxicology)

Elucidation of Amino Acids Regulating the Species-Selective Activation of TRPM8 by Coal Fly Ash Particles

Transient receptor protein melastatin-8 (TRPM8) is an ion channel expressed by neurons and epithelial cells in the lungs. TRPM8 is activated by cold temperatures and soluble agonists that produce a "cooling" effect. Human TRPM8 is also activated by particulate matter, specifically coal fly ash (CFA), a calcium-rich material produced from burning coal. Exposure to CFA has been associated with adverse health effects on the respiratory system. When treated with CFA, human bronchial epithelial cells showed an induction of pro-inflammatory cytokines while instillation of CFA into mouse lungs showed minimal pro-inflammatory effects. Additionally, mouse Trpm8 was not activated by CFA. The goal of this project was to determine amino acids within the TRPM8 protein responsible for species-selective activation by CFA. Within the pore loop region of the TRPM8 protein, three residues (921,927, and 932) differed between human and mouse TRPM8. Site-directed mutagenesis was used to introduce corresponding amino acid changes.The mutant TRPM8 plasmid DNA was then transfected into human HEK-293 cells overexpressing the calcium-sensitive reporter gene GCaMP6s.Calcium flux assays were used to determine the activity of the mutant TRPM8 proteins relative to the respective wild type forms. The hG921S human to mouse mutation had little effect on human TRPM8 activity, but the corresponding mS921G mouse to human mutation increased activity compared to the wild-type mouse TRPM8; however, the response was only ~50% that of human TRPM8. The hA927S did not change responses of human TRPM8, but the mS927A exhibited responses comparable to wild-type human TRPM8.Finally, the hT932S and mS932T mutants were both inactive, similar to wild-type mouse TRPM8.These results reveal specific residues on the pore loop region of TRPM8 that regulate its activation by CFA. These findings improve our understanding of how TRPM8 is activated by particulate materials which will facilitate studies into its contribution to lung pathologies by providing the opportunity to develop new genetically modified mouse models.

Poster 59

Presenter: Cameron Owen (University of Utah)
Mentor: Peter Armentrout (Chemistry)

Holmium (Ho) Oxide, Carbide, Carbonyl, and Dioxide Bond Energies and Evaluation of the Ho + O → HoO+ + e- Chemi-Ionization Reaction Enthalpy

The bond dissociation energy of HoO^+ is valuable for the advancement of telecommunication efforts by the Air Force Office of Scientific Research (AFOSR). By accurately assessing the bond dissociation energy for HoO^+, the exothermicity of the ionospheric chemi-ionization reaction, $Ho + O \rightarrow HoO^+ + e^-$, can be found by combining with the ionization energy of holmium (6.0214 eV). This value of $D_0(Ho^+\text{-}O)$ is being elucidated through the use of a Guided Ion Beam Tandem Mass Spectrometer (GIBMS) and *ab initio* quantum chemical theoretical calculations. GIBMS instrumentation allows for the measurement of the bond dissociation energy of HoO^+ by measuring the kinetic energy dependence of both exchange reactions of Ho^+ with oxidants (CO, CO_2, O_2, and SO_2), and collision induced dissociation reactions of HoO^+ with O_2 and Xe. From these reactions, $D_0(Ho^+\text{-}O)$ can be compared to and verified by theoretical values at the B3LYP, PBE0, PBE0-GD3BJ, MP2(full), and CCSD(t,full) levels of theory. At these levels of theory, the Stuttgart SDD, Segmented, and ANO basis sets with an effective core potential were employed for holmium and the 6311++G(3df,3pd) basis set was employed for carbon and oxygen. Theoretically, bond dissociation energy values are being ascertained for HoC^+, HoO^+, HoO_2^+, and $HoCO$. Employment of GIBMS and theoretical calculations allows for accurate assessment of these bond dissociation energies, most importantly HoO^+, prior to expensive atmospheric releases in the ionosphere.

Poster 60

Presenter: Majid Khan (University of Nevada, Reno)
Mentor: Randy Jensen (Neurosurgery)

Knockout of hypoxia induced factor 1α in meningioma and glioma cell lines via short hairpin RNA interference and the CRISPR-Cas9 system.

Introduction: Hypoxia, a decrease in oxygen perfusion from homeostatic levels, is common in a variety of primary brain tumors including meningiomas and gliomas. It has been found to correlate with more aggressive tumor growth, development of both meningiomas and gliomas, regulation of tumor microenvironment, as well as diffusion restriction and necrosis. Hypoxia-Inducible Factors (HIFs), specifically HIF-1α, are upregulated under hypoxic conditions and after radiation treatment, leading to a greater radioresistance in tumors. Previous work in our lab utilized a HIF-1α shRNA knockdown in a glioma primary cell model, which has been unsuccessfully produced in primary meningioma cells. Methods: A lentiviral-based clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9 construct was used to generate a HIF-1α knockout in a primary human meningioma cell line (GAR). Viral particles were generated in Hek 293T cells. Verification of the transfection was performed using green fluorescence protein (GFP) analysis, morphological analysis of cells, and evaluation of cell proliferation dynamics. An adenovirus-mediated HIF-1α targeting shRNA was also developed and compared. Results: We have generated successful plasmid and concentrated viral particle as verified by GFP expression in Hek 293T cells and infected GAR cells. Generation of a HIF-1α targeting shRNA adenovirus was verified by immunofluorescence analysis of virus producing Hek 293T cells and PCR analysis of generated plasmids. Quantitative analysis of HIF-1α levels was determined via a HIF-1α based ELISA to determine knockout efficiency. Discussion: We successfully created a lentivirus-CRISPR/Cas9 and adenovirus-shRNA knockout model for HIF-1α. Further work will include in vitro characterization of infected cells and in vivo treatment of meningioma and glioma animal models. The impact of radiation on HIF-1α knockout cells will be evaluated. These results will aid in the understanding of HIF-1α on meningioma and glioma dynamics, as well as the impact of radiotherapy.

Poster 60

Presenter: Michael Ruesch (Brigham Young University)
Mentor: Randy Jensen (Neurosurgery)

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Poster 61

Presenter: Jose Porras (University of Texas: Rio Grande Valley)
Mentor: Jason Shepherd (Biology)

GENERATING SYNAPTIC REPORTERS FOR UNDERSTANDING MEMORY STORAGE

Understanding how memories are stored is essential to understanding Alzheimer's Disease as well as normal cognition. In the early 20th century, Richard Semon proposed the engram hypothesis, that connections between neurons were made as a result of stimulation. Recent studies support this hypothesis. However, when the encoding of various events occurs within two hours, these circuits can show overlap, suggesting the engram is not limited to whole cells. We hypothesize that the most basic form of the engram is one distinct set of synapses. To test this, we are developing SLAyR (synaptically localized activity reporter), a genetic tool designed to only label active synapses. We are doing this by modifying FingR (fibronectin intrabody generated with mRNA display), a probe that binds to PSD95, a scaffolding protein found in excitatory synapses. The modifications we plan to make, if successful, will limit binding to only PSD95 in active synapses. This can be achieved by adding a few selected components cloned from Arc (activity regulated cytoskeletal protein). These include an activity dependent enhancer and Arc's UTR (untranslated region). The activity dependent enhancer will regulate transcription of SLAyR to only active neurons while the 3'UTR will guide the mRNA to active synapses. Further

activity will then promote the translation of this mRNA, which will bind to PSD95 in these active synapses where the protein was synthesized. I am assisting in this project by cloning versions of SLAyR with different enhancers and a smaller Dendritic Targeting Element in lieu of using the whole UTR. We are then testing these constructs in cultured neurons to verify that they are showing activity dependent expression and labeling only active synapses. Once the active synapses are targeted, we can elucidate changes in protein and cytoskeletal organization that are associated with memory. SLAyR will be an invaluable tool to guide us closer to understanding the molecular mechanism of memory storage, helping us develop better ways to treat conditions like Alzheimer's Disease.

Poster 62

Presenter: Jennica Peter (Fort Lewis College)
Mentor: Martin McMahon (Dermatology)
Validating RAF-Inducible, Cycloheximide-Sensitive Cell Surface Molecule Genes Expression at the Cell Surface and Protein Levels

RAS and its downstream effector, BRAF, are commonly mutated proto-oncogenes in many types of human cancer. Mutationally activated RAS or BRAF signal through the MEK→ERK Mitogen-Activated Protein kinase (MAPK) pathway to regulate key cancer cell hallmarks such as progress through the cell division cycle, reduced programmed cell death and enhanced cell motility/invasion. Amongst the list of RAS/RAF-regulated genes are those encoding integrins that is linked to a more aggressive melanoma cancer cells leading to shorter patient survival. We have previously shown that during sustained activation of the MAPK pathway by induction of BRAF kinase activity expression of Itgb3 (the gene encoding β3-integrin) is increased significantly. RAS/RAF-mediated induction of Itgb3 mRNA requires sustained, high-level activation of RAF→MEK→ERK signaling mediated by oncogene activation and is classified as "delayed-early", in that it is sensitive to the protein synthesis inhibitor cycloheximide. This regulation has been previously unexplored under this pathway and identifying other genes that have this activation and classification have the potential for use as both biomarkers for metastatic potential and novel therapeutic targets. We identified a list of genes that RAF-inducible and sensitive to cycloheximide using RNA-Sequencing. The aim of this project is to validate the top cell surface molecule genes, Siglec15 and Ceacam1, have increased protein and cell surface expression levels like β3-integrin was shown to have using flow cytometry and immunoblotting techniques. This validation would have implications of furthering precision treatment of various cancers that are also precipitated by an oncogenic MAP Kinase pathway.

Poster 63

Presenter: Abby Scott (Westminster College)
Mentor: Eric Schmidt (Medicinal Chemistry)
Optimizing Cyclization of Peptides for Use on Drug Analogs

Conotoxins, peptides found in cone snail venom, have a variety of potential pharmaceutical applications, such as a treatment for cocaine and nicotine addiction. Some difficulties with using peptides as pharmaceuticals are their large size and instability when linear. PatG and TruD, enzymes found in symbionts of the ascidian *Lissoclinum patella*, can be used to cyclize peptides. The purpose of this project was to optimize the cyclization of conotoxin peptide fragments for use as drug analogs. This was accomplished by assessing the cyclization activity of TruD, PatG, and a S783C PatG mutant in different combinations on 4 test substrates. Liquid Chromatography Mass Spectrometry (LCMS) was used to assess the resulting peptide structures in each of the assays.

Poster 64

Presenter: Kenzie Lach (University of Minnesota Twin Cities)
Mentor: Vikram Deshpande (Physics & Astronomy)
Thermoelectric Properties of Cu-BHT Thin Films

A class of materials known as metal-organi frameworks (MOFs) are of great interest in current condensed matter research. Composed of metal atoms embedded in organic polymers, they have been shown to display metallic properties such as high electrical conductivity. The diverse morphologies of their polymer structures have the potential to be valued over the relatively limited ones of inorganic conducting materials, allowing greater liberties in designing materials for specific purposes. In this study we seek to obtain a value for the thermoelectric figure of merit of the metal-organic framework copper benzenehexathiol (Cu-BHT) in order to assess its potential as a thermoelectric material. This will be done by measuring both its thermal and electrical conductivites as well as its thermoelectric power. Mesoscopic-scale devices will be fabricated that are specifically designed to make these measurements.

Poster 65

Presenter: Valeria Ortiz (University of Puerto Rico)
Mentor: Matthew VanBrocklin (Surgery)
Development and testing of an immune receptor identification system to discover novel receptors for immune signaler, B7H3

Recently, therapies involving immune reactivation have held great promise for melanoma patients. Many of these immunotherapies include immune checkpoint inhibitors or blocking antibodies which reactivate the immune system by removing the malfunctioning brakes on T-cell function. For example, CTLA4 and PD1-targeting antibodies used together in Phase III clinical trials have resulted in tumor diminishing responses in up to 60% of patients. Although responses for combined blockade with CTLA4 and PD1 antibodies have been successful, there are up to 40% of patients which do not respond and additional means for immune activation need to be explored. Our goal in this summer research project has been to develop tools and begin testing the immune nature of the B7H3 signaling molecule and identify its receptors. Importantly, we seek to discover receptors for B7H3 involved in immune suppressive signals which may be targeted for immunotherapy blockade. B7H3 is in the same family as PD-L1 (aka. B7H1) which is the signaling ligand of the PD1 checkpoint receptor and thus is a likely target for successful immune checkpoint blockade. We have been testing eighteen different genes and their protein products in HEK293FT cells to identify binding interactions with B7H3. In this first phase of the overall project we have cloned the genes to be tested into expression vectors, performed E.coli transformations, made large-scale preps (maxi preps) of each DNA plasmid, transfected HEK293FT cells, and given B7H3 treatment and performed flow cytometry to measure binding and assess potential receptors identified.

Poster 65

Presenter: Vaish Thiraviyarajah (Academy for Math, Engineering, and Science)
Mentor: Richard Warner (Surgery)
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Poster 66

Presenter: Josly Pierre-Louis (Virginia Commonwealth University)
Mentor: Bethany Buck-Koehntop (Chemistry)
Investigating DNA Binding Capabilities for the C-Terminal Zinc Finger Domain of the Methyl-CpG Binding Protein ZBTB4

DNA methylation is an epigenetic mark necessary for life functions that in part regulates genomic accessibility and subsequent gene activity. For many genes, DNA methylation regulates transcription through the recruitment of specialized transcription factors called methyl-CpG binding proteins (MBPs), that selectively bind methylated DNA and mediate chromatin rearrangements. Thus, incorrect placement of DNA methylation patterns that can be read by MBPs, has been correlated with causing a number of disease states including cancers and some auto-immune diseases. ZBTB4 is a member of the zinc finger (ZF) family of MBPs, whose biological activities have been implicated in various cancers. ZBTB4 has four N-terminal ZFs, three of which have been shown to selectively bind methylated DNA, and two C-terminal ZFs, the function(s) of which remain to be identified. Here, we used a combined experimental approach to investigate whether the two C-terminal ZFs of ZBTB4 are capable of specific DNA binding. These studies provide initial insight into the function of this protein domain and expand our overall understanding for the biological role of this protein.

Poster 67

Presenter: Emily Plumage (University of Utah)
Mentor: Silvia Illamola (Pharmacology and Toxicology)
Use of Mycophenolate Mofetil in Pediatric Patients Receiving Heart Transplants

Mycophenolate mofetil (MMF) is an immunosuppressant drug used frequently in solid-organ transplant patients. Although its clinical use and pharmacokinetics has been well studied in adult populations, there is very little research of its use in pediatrics, specifically in pediatric heart transplant patients (PHTP). The purpose of this study is to describe the management of MMF treatment in PHTP. This was a retrospective study of PHTP who received MMF as part of their

treatment (Oct 2004 - Apr 2016). Data was collected during one year post-transplant, including: age, sex, height, weight, body surface area (BSA), endomyocardial biopsy (EMB) grades, MMF dose, mycophenolic acid (MPA) concentrations, and other immunosuppressant therapy. Statistical analysis was performed using Excel (2016). A total of 28 PHTP (14 males) were identified. At time of transplant, median age (range) was 9.6 years of age (0.7 - 18.2), and median (range) of MMF dose, 24.2 mg/kg (7.7 - 32.4). A total of 89 MPA concentrations were available for analysis. Additionally, all patients received tacrolimus sometime during treatment, and most of them (71%) at least 2 other immunosuppressants. Analysis of MMF dose in terms of weight (mg/kg) and BSA (m2) showed no correlation with MPA concentration (r2 = 0.01268 and r2 = 0.001, respectively). When analyzed, higher MPA concentrations were associated with lower EMB grades, but no trend could be identified. In conclusion, there is high variability in MMF pharmacokinetics in PHTP, making dose requirements individual dependent. Therapeutic drug monitoring with sequential dose adjustments could help optimize management of MMF treatment in PHTP.

Poster 68

Presenter: Eric Reece (University of Utah)
Mentor: Ilya Zharov (Chemistry)

Synthesis and Characterization of Proton Conducting Silica Nanoparticles for Use in Polymer Electrolyte Membrane Fuel Cells

One of the fastest growing fields in scientific research is alternative energy. This has led to an investigation into the various aspects of fuel cells, due to their highly efficient energy conversion and low CO2 emissions. A subsection of this field is the preparation and study of polymer electrolyte membranes (PEMs) for use in fuel cells. One main issue with many PEMs is swelling of the membrane due to the high level of hydration that is needed to transport the ions through the membrane. [1] Our most recent research involves adding hydrophobic polymer-modified nanoparticles into the sulfonated polymer-modified nanoparticle matrix to help combat the swelling effect while not losing significant proton conductivity. We initially prepared 220 nm silica nanoparticles using the Stöber method. A two-step surface initiation process was then performed to functionalize the surface of the silica nanoparticles with primary amines and initiator molecules. From these surface initiation sites, polymer brushes were grown using atom transfer radical polymerization (ATRP). By growing the polymers individually in two parallel reactions, we could regulate the length of each type of polymer brush by altering the time of the reactions. We were then able to control the ratio of 3-sulfopropyl methacrylate (SPM) to 2-ethoxyethyl methacrylate (EEMA) in the membrane with great accuracy. We discovered that a conductive and mechanically robust membrane could be prepared by suspending the two types of polymer-modified nanoparticles in absolute ethanol and then pressing the resulting dry mixture with a hydraulic press. The conductivity of the membranes was determined using electrochemical impedance spectroscopy (EIS) at temperatures ranging from 20°C to 95°C and relative humidity ranging from 90% to 110%. We found that the conductivity of the membrane with a ratio of 3:1 SPM to EEMA was over an order of magnitude greater than the 2:1 counterpart at 20°C and 101% relative humidity (8.98x10^-4 (S)(cm^-1) compared to 7.29x10^-5 (S)(cm^-1)).

Poster 69

Presenter: Alisa Mann (University of Utah)
Mentor: Shanti Deemyad (Physics & Astronomy)

Constructing a portable ruby gauge for measuring pressure inside a DAC

In condensed matter physics, the main tool used to generate high pressure is a Diamond Anvil Cell (DAC), which presses the sample between the tips of two diamonds. Accurately measuring pressure inside the DAC is difficult though because of the small area and inaccessibility of the region of high pressure. The preferred method is the ruby pressure gauge. This technique involves placing small pieces of ruby between with the sample and measuring the fluorescence of the rubies when a laser is shined though the diamonds. Increasing the pressure shifts the characteristic fluorescence peaks to longer wavelengths in a way that has been thoroughly quantified. Many setups used in ruby pressure gauges take up considerable space on a lab's optical table. By using a design created by Yejun Feng published in Review of Scientific Instruments, I have constructed a ruby pressure gauge comprising of a handheld green laser, a small portable optical path, and a spectrometer for taking pressure measurements of DACs. I have observed the fluorescence of a large chip of ruby using my setup. The next step is to test if the path has enough resolution to measuring the fluorescence of a ruby chip inside a DAC, which must be on the order of 10 microns in diameter and gives a much weaker fluorescence signal.

Poster 70

Presenter: Ramon Aparicio (University of Utah)
Mentor: Lisa Aspinwall (Psychology)

Melanoma risk

I am going over interviews of people who have had at least 3 people in their family experience high stages of melanoma. I will be presenting my results that I find interesting.

Poster 71

Presenter: Jaime Richards (Creighton University)
Mentor: Matt Wachowiak (Neurobiology & Anatomy)
Using Pharmacogenetic Tools to Manipulate Odor Perception in Mice.

The olfactory bulb (OB) is the initial area where odor information is processed. The main output neurons of the OB, mitral and tufted cells, together relay odor signals from olfactory sensory neurons to cortex and additional brain areas. However, their role in odor discrimination is poorly understood. In this project, our goal was to examine the inactivation of mitral/tufted cells while mice are performing a learned odor discrimination task. We first targeted Cre-dependent viral constructs such as mCherry fluorophore alone or mCherry tagged to an inhibitory (h4MDi-mCherry) Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) to mitral/tufted cells in the OB, using a transgenic mouse line that expresses Cre only in mitral/tufted cells. DREADDs are engineered G-protein coupled receptors that allow manipulation of neuronal activity within a targeted populating using a highly selective ligand, clozapine-n-oxide (CNO). We then trained mice in a Go/No-Go paradigm to discriminate between two odors by learning to lick at a lick spout to one odor for a water reward, but avoid licking to second odor. After correctly discriminating the two odors the mice were injected with 10mg/ml CNO to inhibit mitral/tufted cells in those mice expressing h4MD(Gi)-mCherry. The results from this experiment will be reported. Expression of DREADDs within the OB will be assessed with confocal, microscopy to correlate with task results. Ultimately, this experiment will highlight the role of mitral/tufted cell activity in odor discrimination, and help to establish a platform to understand surrounding neurons and odor processing.

Poster 72

Presenter: Sean Sandstrom (Humboldt State University)
Mentor: Casey Hawkins (Chemistry)
Perylene Diimide-Based Electrodes for Next-Generation Organic Lithium and Sodium-Ion Batteries

The purpose of this research project is to fabricate, characterize, and assemble lithium and sodium-ion organic batteries based on perylene diimide (PDI) electrodes. Organic compounds possess several favorable attributes over their inorganic counterparts such as flexibility, processability, and structure diversity. These attributes make them promising materials to be used in low cost, greener, and more versatile energy storage systems. Here, we fabricated cathodes by casting a slurry composed of carbon black, polyvinylidene fluoride, and a PDI-based active material onto aluminum current collectors. The batteries were then assembled in a glove box under an argon atmosphere using either sodium or lithium as the second electrode. Data was collected using a computer-controlled battery tester system. The investigated compounds were found to exhibit favorable first discharge capacity and their capacity retention over multiple charge-discharge cycles shows potential application in secondary battery technologies. By creating, analyzing, and characterizing original PDI-based lithium and sodium-ion batteries, an understanding of their physical properties, their use, and potential performance in a variety of applications may be elucidated.

Poster 73

Presenter: Joseph Sheikh (University of Utah)
Mentor: Sophie Caron (Biology)
Mapping Gustatory Sensing Neural Circuits in Drosophila

A key question that remains unanswered in the field of neuroscience is how the brain combines different types of sensory information and generates a meaningful representation of the outside world. The Caron laboratory investigates how the Drosophila melanogaster brain, in particular the mushroom body, integrates sensory information. The first step in understand multimodal integration is understanding neural circuits, therefore the research conducted was to determine whether either the GR64f+ sweet sensing neurons, GR66a+ bitter sensing neurons, or ppk28+ water sensing neurons connect to gustatory projection neuron (gPN1). It was hypothesized that these connections exist due to anatomical evidence from previous research. In order to verify connections between the two neurons, GFP Reconstitution Across Synaptic Partners (GRASP) and fluorescent protein tdTomato were used to mark the neurons, then imaged using confocal microscopy. The results of this experiment have revealed a potential connection between GR64f+ and ppk28+ with gPN1; however, further data is needed to make a conclusion.

Poster 74

Presenter: Milo Marsden (University of Chicago)
Mentor: Dima Pesin (Physics & Astronomy)
Phasebook: Use of machine learning to identify quantum phase transitions

This work aims to contribute to the very recent application of Deep Neural Networks (DNNs) in classifying phase transitions. Many transitions that are not characterized by an "ordinary" order parameter may be distinguishable by machine learning methods, giving a novel technique for studying phase transitions. Ultimately, we aim to classify the

phases of the Berezinski- Kosterlitz-Thouless on a frustrated lattice by confusion with a Deep Neural Network. Here we take the preliminary steps towards this goal by constructing a DNN that we test on the Transverse Field Ising model as is done in (Huber, et.al).

Poster 75

Presenter: Kathleen Marsh (Duke University)
Mentor: Jieying Mao (Physics & Astronomy)
Simulations and Optical Characterization of Aluminum Nanocrescents

The growing field of ultraviolet plasmonics has been motivated by the extensive biomedical applications of optical antennas. While much is known about fluorescence enhancement in the visible range, the ultraviolet has not been thoroughly investigated due to challenges with low quantum yields, surface modification schemes, and low absorption cross sections of metal oxides. Electronic resonances of biomolecules, such as peptides and proteins, are located in the ultraviolet spectrum. Thus, accessing and enhancing the native fluorescent properties of these organic structures will be beneficial for label-free bioimaging. We conducted finite domain time difference simulations and UV/Vis spectroscopy transmission measurements to determine the fluorescence enhancement and optical properties of aluminum nanocrescents. The simulations, only carried out for the ultraviolet, of the aluminum nanocrescent model revealed that enhanced fluorescence is significantly diminished at approximately 300 nanometers, but enhanced at 240 and 330 nanometers. Transmission measurements showed enhanced absorption in both the ultraviolet and visible spectra, which corresponds with enhanced fluorescence. Prominent absorbance peaks of the transmission data were displayed at 360 and 550 nanometers and a prominent absorbance dip at 220 nanometers. The simulation and transmission data differ due to a multitude of factors, such as imperfect fabrication of the aluminum nanocrescents, unequal oxidation of the metal layers, and many other factors. These results indicate the potential for a promising fluorescence enhancement with aluminum nanostructures in the ultraviolet wavelength range. However, multiple challenges still persist to maximize ultraviolet fluorescence enhancement.

Poster 76

Presenter: Samira Rosenthal (University of Minnesota, Morris)
Mentor: Joshua Bonkowsky (Neurology)
A Zebrafish Screen to Find Drugs to Treat Adrenoleukodystrophy

Adrenoleukodystrophy (ALD) is a disease characterized by a degradation of myelin in the central nervous system. ALD causes significant morbidity and mortality, and there are virtually no treatments. We created a disease model for ALD, using the small vertebrate organism zebrafish (*Danio rerio*). The mutant ALD zebrafish develop disease characteristics similar to human patients, including abnormal movement problems. Our goal is to identify compounds that slow or prevent disease progression in the mutant zebrafish, and therefore be possible treatments. We tested a library of 2000 drugs (Microsource Spectrum Collection). At 4 days post-fertilization (dpf), the drugs were added as mixtures of four compounds, and at 7 dpf, the behavior of the fish was measured (including analysis of average velocity, max velocity, duration of total movement, total distance traveled, and active velocity). We tested 1,920 compounds (480 mixtures). 144 mixtures resulted in death for at least half of the fish and no results were scored. Of the remaining 336 mixtures, 49 improved four variables while five improved all five variables. We are individually testing each compound from the lethal mixtures to determine if any show efficacy. We are starting our secondary screen of any compound which showed improvement in 4 or more of the behavior variables (to confirm that they have a positive effect). The results from this experiment can provide a starting place for possible treatments in patients with ALD.

Poster 77

Presenter: Scotty Squire (Brigham Young University - Idaho)
Mentor: Matt Prater (Chemistry)
Palladium Catalyzed Enantioselective Redox-Relay Heck Reactions of Acyclic Enol Ethers

In this work we have utilized a palladium catalyzed redox-relay Heck reaction with several electron deficient vinyl triflates to form a variety of chiral allylic ether products in high regio- and stereoselectivity. The utility of the redox-relay Heck reaction with electron deficient vinyl triflates is broad due to its ability to form several chiral ethers when reacted with acyclic enol ethers. This work will allow for the future synthesis of chiral ether products that can potentially act as prospective medicinal contributions.

Poster 78

Presenter: Shane Tory (University of Utah)
Mentor: Taylor Sparks (Materials Science and Engineering)
A New Sodium Ion Conductor: Processing and Transport Relationships

Sodium based electrochemical cells are gaining interest in industry due to the high availability and abundance of sodium. A sodium ion conducting electrolyte is one essential component of an electrochemical cell. Sodium zirconium gallate ($Na_{0.7}Ga_{4.7}Zr_{0.3}O_8$) belongs to the beta gallate rutile structure type and was recently discovered. Preliminary measurements show it to be a one-dimensional sodium ion conductor. In a similar process, synthesis of Na-β''-alumina + 3 mol.%Y_2O_3-stabilized zirconia (YSZ) by a vapor phase process lead to a textured microstructure with accompanying anisotropic transport. Here, we report on the synthesis of $Na_{0.7}Ga_{4.7}Zr_{0.3}O_8$ + YSZ composites by a vapor phase process and observe no evidence of crystallographic texturing or anisotropy in ionic transport. In addition, the kinetics of vapor phase transformation in $Na_{0.7}Ga_{4.7}Zr_{0.3}O_8$ + YSZ composites were studied. The results showed a similar trend to the kinetic of previously studied Na-β''-alumina + YSZ composites suggesting a similar oxygen transport rate limiting mechanism of transformation.

Poster 79

Presenter: Tyler Vail (Brigham Young University)
Mentor: Kevin C. Brennan (Neurology)

2-photon Microscopy Analysis of Neuronal Ca^{2+} Activity During Cortical Spreading Depression After Traumatic Brain Injury

Traumatic Brain Injury (TBI) is frequent among civilian and military personnel. TBI can result from car crashes, sports, violence, or blast injuries. Despite its relevance, the long-term effects of TBI are not fully understood. Spreading depolarization (SD) is a wave of excitation that passes through the brain that occurs at the time of and following TBI which may exhibit long term effects on brain tissue and cortical networks. The goal of our research is to investigate cellular changes after a traumatic brain injury. Controlled Cortical Impact (CCI) is a well-documented technique that can be used to replicate the injuries similar to TBI. We used CCI combined with two-photon microscopy to observe calcium levels during SD to detect changes on a cellular level. These changes suggest that TBI may be more serious than we thought because of increased damage due to spreading depolarizations.

Poster 80

Presenter: Mica Sloan (University of Utah)
Mentor: Danny Chou (Biochemistry)

Treating Type I Diabetes Through Novel, Hepatocyte Targeting, Insulin Analog

Diabetes has become a global epidemic and the current standard of care for Type 1 Diabetes consists of 1-4 subcutaneous injections of insulin per day. The treatment works but it has some key limitations. One of which is that insulin does not reach the liver in the concentrations that it would in a healthy individual; this leads to the liver continuing to release sugar into the bloodstream and adipocytes and muscle cells receiving too much insulin, which leads to long term insulin resistance. We propose to solve these problems using a multivalent ligand for hepatocytes targeting via the asialoglycoprotein receptor (ASGPR, a liver-specific receptor) to bring our insulin to the liver. Our proof of concept experiment starts with mice which are intravenously injected with a fluorophore tagged, ligand-bound insulin, which are then imaged using fluorescence molecular tomography (FMT) to visualize the biodistribution of our insulin analogs in 20-30 minute intervals. Preliminary data suggests that the ligand-bound insulin does demonstrate a selectivity toward liver while smaller concentrations can be found in other body systems as compared to native insulin. Using the time intervals identified in the FMT testing, we will begin sacrificing our subjects and analyzing the effects of insulin in the organs through Western Blot Analysis (WBA). We expect the WBA to corroborate our FMT results. This concrete proof of concept is a key step as we continue our efforts to develop a more effective insulin therapy to improve patient overall health and longterm outcomes.

Poster 81

Presenter: Alexander Mercaldi (University of Connecticut)
Mentor: Sarah Li (Physics & Astronomy)

Surprising Spin Dynamics of Emerging Semiconductors

Spin is an additional degree of freedom in electrons that can be manipulated to enhance electronic devices. Devices that incorporate spin are known as spintronics, and show promise for future applications in technologies such as quantum computing. An essential property when considering materials for spintronics is their spin-orbit coupling (SOC). This coupling directly affects both the ability to manipulate spin and the relaxation time for any manipulation. These effects are understood to have a trade-off; a higher SOC allows for easier spin polarization but also results in greater precession that will quickly dephase any polarized spins. However, both are necessary for current formulations of spintronic devices. Hybrid organic-inorganic perovskites ($CH_3NH_3PbX_3$, X = Br,I) are a class of semiconductors that have recently garnered interest for their optoelectric properties. Density functional theory calculations have predicted a large SOC effect

in these perovskites that, along with spin splitting from inversion asymmetry, would cause polarized spin states to rapidly dephase. However, measurements of the hybrid perovskite's spin dynamics using time-resolved Faraday rotation (TRFR) have shown a long spin lifetime exceeding 1 ns. Given this unexpected result, we seek to consistently replicate fabrication of perovskites with the same properties and investigate them further. We use an optimized ultrafast pump-probe method to measure TRFR at low temperatures and present more accurate spin dynamics of the hybrid perovskite. In addition to a long spin lifetime, measurements in a range of transverse magnetic fields reveal two distinct frequencies in the exciton states and corresponding *g*-factors attributed to electrons and holes.

Poster 82

Presenter: Rufus Sweeney (Brigham Young University)
Mentor: Scott Summers (Nutrition and Integrative Physiology)
Islet Sphingolipids are Requisite for Maximal Insulin Secretion in Vivo

Pancreatic beta-cells secrete insulin, a peptide hormone that promotes the uptake and storage of carbohydrates and other nutrients in skeletal muscle while simultaneously repressing glucose efflux from the liver. Diabetes mellitus results from insulin availability that is insufficient to meet tissue needs, and both the type 1 and type 2 forms of the disease are associated with decreased beta-cell mass resulting from diminished proliferation, increased apoptosis, and/or de-differentiation. Understanding the regulatory signals governing beta-cell growth and survival is critical for devising strategies to maintain a healthy population of cells in individuals at risk for diabetes. Sphingolipids such as ceramides, which can be produced in response to inflammatory cytokines or saturated fats, have emerged as potential regulators of beta-cell survival and function. Studies in cultured beta cells, for example, reveal that ceramides inhibit insulin gene expression, block proliferation, and induce apoptosis. To test the relevance of ceramides in beta cell function in vivo, we studied mice lacking *Sptlc2*, the rate-limiting enzyme in *de novo* ceramide synthesis, selectively within the pancreatic beta cell using an inducible knockout mouse model. Animals were maintained on both chow or obesogenic diets for 8 weeks. Unlike the aforementioned studies evaluating the role of ceramides in vitro, depletion of *Sptlc2* in vivo decreased maximal insulin secretion associated. Moreover, animals lacking Sptlc2 exhibited increased insulin sensitivity, but no change in body mass or islet morphology. These data reveal unexpected roles for ceramides as a positive effector of insulin secretion.

Poster 83

Presenter: Sam Tinucci (College of Saint Benedict)
Mentor: Shelley Minteer (Chemistry)
Salinivibrio sp. EAGSL: A Halotolerant Bacterium from Great Salt Lake for Potential Organic Removal in Microbial Fuel Cells

Hypersaline water conditions occur when salt concentration exceeds 35 g L^{-1}, that of which accounts for 5% of wastewater worldwide. In many coastal towns and industrial settings, wastewater treatment facilities are unable to undergo traditional biological treatment under these harsh conditions. However, bacteria in Great Salt Lake (Utah) live and thrive in this unique hypersaline environment and therefore present a viable approach for the degradation of organics. Moreover, it has been shown that some of these bacteria can perform extracellular electron transfer making possible simultaneous water decontamination and electricity production.[1] Herein, *Salinivibrio* sp. *EAGSL* was isolated and identified from a sample obtained from Antelope Island in Great Salt Lake. The electron transfer capabilities were explored in a single chambered microbial fuel cell (MFC), an electrochemical device in which the bioelectrocatalytic activity of microorganisms can be harnessed to clean polluted water and generate current. The MFCs were run in salt concentrations of both 35 g L^{-1} and 100 g L^{-1} using carbon based electrodes for long-term experiments. Obtained results reflect the performance of the microorganism in electron transfer and organic degradation opening up opportunities to apply this approach to hypersaline wastewater treatment technology. These preliminary results set the stage for further microbial fuel cell experiments with *Salinivibrio* sp. *EAGSL* as well as other halotolerant bacterium. 1. Grattieri, M.; Suvira, M.; Hasan, K.; Minteer, S. Halotolerant extremophile bacteria from the Great Salt Lake for recycling pollutants in microbial fuel cells. *Journal of Power Sources*, **2017**, 365, 310-318.

Poster 84

Presenter: Nicole Trometer (University of Florida)
Mentor: Berardi Sensale Rodriguez (Electrical and Computer Engineering)
Characterization of the electrical properties of GaN HEMTs.

Wide bandgap III-Nitride semiconductors have attracted intense interest for high-frequency and high-power electronic applications in recent years. Gallium Nitride (GaN) based heterostructures stands out from most other semiconductors owing to its excellent transport properties and ability to operate at high power levels, allowing GaN based devices to be used in future high frequency electronics. This report is on the fabrication and characterization of the electrical properties

of High Electron Mobility Transistors (HEMTs), based on GaN. The heterostructure consists of a 4.5-micron thick AlN buffer layer, followed by a 200-nanometer GaN layer and a 20nm AlGaN barrier, which were grown on Si (111). A high concentration of electrons, a two-dimensional electron gas (2DEG) is formed at the interface of GaN and AlGaN. In the design, alloyed ohmic contacts were added and placed in contact with the 2DEG; after this a gate electrode was defined. The DC measurements were correlated with high frequency measurements from THz spectroscopy. In conclusion, gallium nitride HEMTs were fabricated and studied, these devices have excellent transport properties at high frequencies that can be used in future advanced electronic communications.

Poster 85

Presenter: Josh Peterson (University of Utah)
Mentor: Gordon Thomson (Physics & Astronomy)
Measuring the Pointing Directions of Fluorescence Detectors in the Telescope Array Experiment

The Cosmic Ray Lab at the University of Utah studies cosmic rays with two methods, one of which uses fluorescence telescopes to detect the UV light that is produced from a cosmic ray air shower event. Currently there are three telescope arrays being utilized. Recent analysis of the data collected with these telescopes shows that one of the telescope arrays gives slightly different results than the other two telescope arrays for any given event. The current leading hypothesis is that the discrepancy in the data could be caused by a systematic misalignment of the mirror segments of the telescopes. To test this hypothesis a simulation of the telescopes in question is being developed. This simulation requires a thorough knowledge of the alignment of the mirror segments before it can be implemented. The focus of this research is to find an efficient method of determining the alignments of the mirror segments. The current method being investigated utilizes a laser pointed to different positions on a camera box centered at the focus point of each mirror. The laser acts as a point source and so, since the telescope mirror is spherical, the mirror reflection on the camera box is a roughly one to one image of some of the mirror segments. By moving the laser pointer to different positions one may see reflections of most of the mirror segments of the mirror. These images can provide useful qualitative information about the alignment of the segments. Additionally, by recording where the corners of the segment reflection are and calculating where the corners should be reflected to on the camera box, it is thought that one can find correct orientations of the mirror segments by minimizing a chi-squared function.

Poster 86

Presenter: Lacey Woods (Southern Utah University)
Mentor: Peter West (Pharmacology and Toxicology)
The Effects of Spontaneously Recurrent Seizures on Dentate Gyrus-Mediated Cognitive Function and Synaptic Plasticity in the Intra Amygdala Kayanate Model of Temporal Lobe Epilepsy

Seizures associated with epilepsy often result in cognitive comorbidities, such as memory loss, that still remain medically untreated. Mouse models have been useful in developing drugs to stop seizures in epileptic patients but not to treat the cognitive comorbidities that significantly affect the patient's quality of life. Commonly used electrically-induced acute seizure models, such as the corneal kindled mouse model of focal seizures, have been shown to have impaired dentate gyrus (DG) mediated spatial pattern processing, learning, memory, and attenuated DG synaptic plasticity (Remigio et al., 2017). However, in the effort to develop treatments of cognitive comorbidities in epilepsy, more advanced models are needed that experience genuine spontaneous recurrent seizures (SRSs) and cognitive dysfunction. Therefore, the aim of this experiment is to evaluate the effects of SRSs on dentate gyrus-mediated cognitive function and synaptic plasticity in a novel model of temporal lobe epilepsy: the intra-amygdala kainate mouse (IAK) (Almeida Silva et al., 2016; Mouri et al., 2008). After a latent period of approximately 3-5 days, a cohort of the IAK mice was shown to experience approximately 1-2 spontaneous seizures per day (n=10). When tested in a task reliant on spatial pattern processing in the dentate gyrus (the metric task), these IAK mice were shown to have significant learning and memory impairments compared to the SHAM surgical and control mice. Finally, in a measure of experience-dependent synaptic plasticity commonly accepted as a model of learning and memory at the level of the synapse (Long-Term Potentiation, LTP), LTP at the perforant path – dentate granule cell synapse in the IAK group was significantly attenuated relative to both the control and SHAM surgical mice. These results strongly suggest that SRSs significantly impact cognitive function both in vivo and in vitro at the level of the dentate gyrus. Therefore, IAK mice may be useful as a tool to evaluate novel treatments for cognitive dysfunction associated with SRSs in patients with epilepsy.

Poster 87

Presenter: Marissa Tutt (Northern Arizona University)
Mentor: Bryan Gibson (Biomedical Informatics)
Emotional Responses to Diabetes Related Data Represented in Virutal Reality Vs. Ipad

Self-care behaviors are critical to reducing risk of poor outcomes from Type 2 Diabetes Mellitus. One determinant of individuals' motivation for self-care is their emotional reaction to their disease. In this project, we sought to compare

emotional responses to virtual reality vs. two-dimensional representation of Diabetes related data. After a demographic questionnaire and a baseline completion of the State Trait Anxiety Index (STAI), participants were randomly assigned to a condition Virtual Reality (VR) vs. iPad (IP). Each condition has three components: the individual's estimated daily glucose curve, the individual's A1C compared to A1C's of 7.0 and 5.7, and an interactive experience where participants can vicariously experience diabetic retinopathy. After each component, participants completed the STAI again. After the experiment, participants completed 6 more questions regarding their preferences and impressions of both the VR and iPad experiences. We calculated Cohen's d+ to estimate the within-subject of VR vs IP on emotional response to diabetes data. To date 13 participants have participated. The overall Cohen's d+= 0.80 suggests a large effect of VR, the A1C experience being the least effective component (Cohen's d+=0.26) and the simulation of retinopathy being the most effective at impacting emotions (Cohen's d+=0.87). 7/10 individuals preferred the Virtual Reality experience instead of the iPad. 8/10 preferred the Virtual Reality for learning about their diabetes data. In this pilot study, we are testing individuals' emotional responses to their diabetes data in different formats, the results of this study will inform the design of a multifaceted diabetes self-management intervention.

Poster 88

Presenter: Dong Wang (Buena Vista University)
Mentor: John Conboy (Chemistry)
Lanthanide Ion Interactions with DPPC Membranes Detected by Sum-frequency Vibrational Spectroscopy

Lanthanide ions are commonly used as a contrast agent in Magnetic Resonance Imaging (MRI) – a medical imaging technique used in radiology. Recently, a computational study has shown that ytterbium, a lanthanide, can adsorb onto the membrane without disrupting the overall membrane structure[1], but experimental evidence is lacking. MRI contrast agents should not alter the behavior of the membrane, but the study suggests that lanthanides strongly interact with the membrane and alter its properties. We hypothesize that through strong interactions of ytterbium with the head group of phospholipids, the membrane should become more rigid and the half-life should increase in the presence of ytterbium. To probe the effects of lanthanide interactions with the membrane, compression moduli and flip flop kinetics of DPPC (dipalmitoylphosphatidylcholine) membranes in the presence and absence of ytterbium chloride are measured. DPPC bilayers are produced by the Langmuir Blodgett Langmuir Schaffer (LBLS) method. Compression moduli are obtained from the pressure-area isotherms, while flip flop kinetics are studied by sum-frequency vibrational spectroscopy (SFVS). SFVS is particularly advantageous in the study of membrane structure and dynamics because it is sensitive to molecular symmetry and label-free. Study biological membrane lipid translocation and lanthanide ion interactions could propel the understanding of the fundamental behavior of the membranes, which could apply to medical and clinical areas. 1. M. Gonzalez, H. Barriga, J. Richens, R. Law, P. O'Shea and F. Bresme, Phys.Chem.Chem.Phys., 2017, 19, 9199.

Poster 89

Presenter: Matthew Quint (University of Florida)
Mentor: Gordon Thomson (Physics & Astronomy)
Measuring the Effects of Aerosols on High Energy Cosmic Rays

Fluorescent detector telescopes are one of the types of detectors used by the Telescope Array Experiment to measure high energy cosmic rays. These work by measuring electromagnetic radiation that is emitted during collisions of cosmic rays with molecules in Earth's atmosphere. A known source of radiation in the form of a controlled laser beam is utilized as a means of calibrating the detectors for the effects of both atmospheric scattering as well as scattering by airborne molecules. The purpose of this research has two goals. First to analyze this type of data from one of the three detector sites to understand how to calibrate the telescopes for aerosol scattering. Secondly to compare those measurements against those made for the other two sites in order to ascertain if the data collected is consistent across all three sites.

Poster 90

Presenter: Lisa Wilson (University of Utah)
Mentor: Lisa Giles (Psychiatry)
Utilization of mental health treatment after ED evaluation: Preliminary results

Background: Children's hospitals are seeing a growing number of patients presenting to the emergency department (ED) in psychiatric crisis. However, there is limited information on youth who get discharged from the ED after a mental health crisis evaluation. Our study examines the rates of mental health follow-up for patients discharged from the ED after a mental health crisis evaluation. We compared patients with suicidal ideation to those seen for a non-suicidal mental health crisis, in addition to a number of other variables. Methods: Parents or guardians of youth discharged home after a mental health crisis evaluation in the ED at Primary Children's Hospital were enrolled in the study. One month after the initial ED visit, parents were contacted to complete a follow-up survey regarding whether patient received follow-up mental health treatment since the ED. Results: We have currently reviewed preliminary data for 56 subjects. 44 patients (71%) received mental health follow-up within one month of ED discharge. Thus far, our study has not shown

any significant differences in age, race, gender, chief complaint, insurance, or the presence of a current mental health provider between patients who did follow-up with mental health compared to those who did not. Conclusion: Thus far, our study cohort has demonstrated a fairly high percentage of mental health follow-up after discharge from the ED, certainly higher than that seen in prior studies. There is as of yet no clear indication of difference between individuals that receive follow-up and those that do not.

Poster 91

Presenter: Konrad Serbinowski (University of Utah)
Mentor: Taylor Sparks (Materials Science and Engineering)
Discovery and Synthesis of Superhard Materials

Superhard materials are materials which have a Vickers's hardness measurement exceeding 40 gigapascals. Currently the most well-know superhard material is diamond, but like most other superhard materials, diamond requires high temperature and pressure to synthesize which leads to high production costs. A promising solution to this is the synthesis of superhard materials which do not require high pressure for synthesis. Most of these materials are heavy transition metal borides and carbides which do not need to form as many short covalent bonds due to the layers of heavy transition metals which have d-valence electrons. Through the use of machine learning we are able to identify the best superhard materials which have low production cost and then cross check with HHI values and other economic factors in order to ensure the possibility of production on a larger scale.

Poster 92

Presenter: Deric Session (University of Utah)
Mentor: Vikram Deshpande (Physics & Astronomy)
Measuring the Diamagnetic signal in Graphene by using Graphene Mechanical Resonators

Graphite is known to have a high diamagnetic susceptibility[1], and theoretically it has been predicted that all odd layers of graphite; namely graphene, trilayer, etc.; have exceptionally high diamagnetic susceptibility at band touching points, that is for graphene a delta function[2]. However, this has never been experimentally shown. Our goal is to detect that signal for graphene by using micron scaled graphene resonators. We stamp BN capped graphene stacks onto the one micron depth cavities, lying over the local gate, of different diameters (3-7μm). These are resonated by applying the RF signal to the gate along with DC bias and resonance frequencies are detected by using a Vector Network Analyzer[3]. Then, because of the Meissner effect if graphene is diamagnetic then its resonance frequency should shift when exposed to a very small external magnetic field. We report the effects observed when the mechanical motion of the graphene is actuated and how the resonance frequency shifts when exposed to an external magnetic field. [1]J. W. McClure, Phys. Rev. **104**, 666 (1956). [2]M. Koshino and T. Ando, Phys. Rev. B 76, 085425 (2007). [3]Xu, Y.; Chen, C.; Deshpande, V.V.; DiRenno, F.A.; Gondarenko, A.; Heinz, D.B.; Liu, S.; Kim, P.; Hone, J. Radio frequency electrical transduction of graphene mechanical resonators. Appl. Phys. Lett. 2010, 97, 243111.

Poster 93

Presenter: Mitchell Wilson (University of Utah)
Mentor: Michael Grünwald (Chemistry)
Self Assembly of Quantum Dot-Gold Satellite Nanocrystals.

Self-assembly of nanoparticles into ordered structures is a simple and cost-efficient method for creating functional nano-materials with a wide range of potential applications from energy to medicine. Achieving control over nanoparticle interactions and thus over the structures that from during self-assembly is the focus of much current research. Here we study the self-assembly of semiconductor nanocrystals that have been decorated with gold "islands", small gold patches arranged in a regular pattern on the surface of the nanoparticles. Experiments performed by the Chen group at Brown University show that the atomistic crystal lattices of the nanoparticles align when particles are self-asembled into close-packed superstructures. Nanoparticles without gold islands do not show this kind of orientational order. Using efficient computer models and molecular simulations, we show that the orientational order is likely caused by weak attractive interactions between gold islands, which tend to aggregate in the inter-particle gaps of the superlattice. Our results suggest that by controlling the number and arrangement of gold islands on the surface of the nanocrystals, different types of orientational order could be realized, opening up new routes toward nano-materials with unique properties.

Poster 94

Presenter: Marianne Newell (University of Utah)
Mentor: Andrea Brunelle (Geography)

Study of Utah's Climate History by Analysis of Lake Cores Collected from Lake Bonneville Sites

This project focuses on paleoenvironmental reconstructions of ancient Lake Bonneville by analysis of lacustrine basin sediment. To examine sediment two main procedures are used, loss on ignition and magnetic susceptibility. These tests show us the chemical changes in sediment, iron-bearing sediments revealing past disturbance events, and percent organic carbon and carbonate component in the sediment. Data from these analyses help us to interpret past climate and disturbance events. This research is a part of a larger study conducted at the Records of Environment and Disturbance Lab utilizing several cores throughout the Bonneville Basin. Having a multi-site study is beneficial because the cores can be compared to obtain a more extensive paleoclimate and paleoecological archive of Western Utah. Data is compared across the basin to better understand this region.

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