UNDERGRADUATE RESEARCH SYMPOSIUM

April 5th, 2019
11:00 AM – 4:00 PM
Chemistry Building Lower Atrium
University of Michigan

Undergraduate Research Symposium

Friday, April 5th 2019

11:00 AM - 4:00 PM

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University of Michigan

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Program Schedule

Note: *All presenters must check in 15 minutes prior to the beginning of their session*

Time	Activity
11:00 AM -11:55 AM	Session A
12:00 PM -12:55 PM	Session B
12:00 PM -1:00 PM	Lunch
1:00 PM -1:55 PM	Session C
2:00 PM -2:55 PM	Session D
3:00 PM -3:55 PM	Session E

SCHEDULE OF PRESENTATIONS

POSTER SESSION A

11:00 AM - 12:00 PM

Poster 1

Presenter: Dingkun Guo

Advisor: Xun Huan (Mechanical Engineering)

Assessing Uncertainty in Neural Network Models for Predicting Gene Mutation Status in Brain Tumor Patients

Deep learning has emerged as a powerful and prevalent technique for building data-driven models in medical diagnosis. However, most models only report single-value predictions, and are not capable of providing prediction uncertainty resulting from, among other sources, noisy and limited training data. We thus seek to develop computational capability for quantifying uncertainty in neural network (NN) models in a systematic manner. We focus on a particular residual convolutional NN model developed to predict isocitrate dehydrogenase (IDH) mutation status in gliomas from preoperative brain magnetic resonance imaging (MRI) [Chang *et al.*, 2017]. Enabling uncertainty quantification for this model is crucial for supporting subsequent treatment decision making. As a first step, we analyze the sensitivity of model prediction to the trained weights. This is achieved through a Monte Carlo sampling approach, where random noise is added to the trained weights. Preliminary results indicate that a 5% perturbation to the weights can alter the prediction probability of IDH mutation up to 10%.

Poster 2

Presenter: Alexa Roberts

Advisor: Zetian Mi (Electrical Engineering and Computer Science)

Atomic Layer Deposition-Promoted InGaN Tunnel Junction for Photoelectrochemical Water Splitting

Solar-driven water splitting by photoelectrocatalysis is an important emerging technique that aims to help solve the many environmental and energy challenges facing humanity today. InGaN nanowire is emerging as a new-generation of fantastic material for solar-driven water splitting as a result of their tunable and narrow bandgap for effectively absorbing sunlight and high electron mobility. However, current research in water splitting using InGaN has faced challenges including a low solar-to-hydrogen (STH) efficiency and poor stability. Atomic Layer Deposition (ALD) is a high-controlled process which can deposit a wide range of high-quality metal oxides layer on various substrates. Herein, we study the use of ALD Al_2O_3 as a passivation layer to improve the performance of the InGaN nanowire supported on n+-p silicon junction. Scanning electron microscopy characterization illustrates the one-dimension InGaN nanowire arrays are sustained very well after the ALD treatment, which is favorable for the sunlight absorption by anti-reflection. What is more, a nanoscale-thickness Al_2O_3 layer is successfully coated on the InGaN nanowire arrays. It is discovered that the introduction of the nanoscale Al_2O_3 layer by atomic deposition layer can dramatically enhance both the solar-to-hydrogen efficiency and the stability of the device. The thickness of the deposited layer, the atomic layer deposition temperature, the annealing

temperature, and the annealing atmosphere are studied systematically. Under the optimized ALD conditions, the STH of the ALD Al_2O_3 modified InGaN nanowire is ~6.8%, which is more than two-fold improvement compare to that of ~3% for the bare InGaN nanowire.

Poster 3

Presenter: Katie Bertcher
Advisor: Johanna Mathieu (Electrical Engineering)

Modelling the Effects of Electric Vehicle Chargers on the Power Distribution Grid

Electric vehicles (EVs) provide an alternative and potentially more carbon efficient, method of personal transportation. As they become more cost effective, the number of EVs deployed is expected to rise. This accelerating market also brings demands for faster charging and increased capacity. Such high power demands from charging electric vehicles can strain the power distribution network, risking dangerous voltage fluctuations, power quality issues, and equipment failure. Implementing energy storage can offset charger power demands and mitigate these risks. Understanding the effects of charger and storage placement on the grid has particular importance as the University of Michigan considers implementing an electric bus fleet. Our investigation focuses on how the placement and number of EV chargers effects the power grid, and how energy storage can be used in tandem with chargers. To conduct the investigation we created a Matlab program to process network data files into readable formats for OpenDSS, a power flow analysis program. This allows us to quickly and easily test new parameters and configurations. Current results have verified that increasing the number of chargers on a network decreases the voltage at the end of the network, and that chargers on the end of the feeder have greater effect than chargers at the start of the feeder. We are further examining charger placement and the methods by which storage can offset power demands of EV chargers. We will conduct case studies exploring the impact of increased EV charging and fast charging on the University of Michigan North Campus.

Poster 4

Presenter: Joseph Kwon
Advisor: Viswanath Nagarajan (Industrial and Operations Engineering)

Constrained Assortment Optimization under the Paired Combinatorial Logit Model

We study the assortment optimization problem when customer choices are governed by the paired combinatorial logit model. An application example of the assortment optimization problem is for e-commerce: given a number of items that a company is selling, what is the number of items and which items to display on the homepage? We study uncapacitated, capacitated and space constrained versions of this problem, which are all known to be NP-hard. We design efficient algorithms that compute approximately optimal solutions, using a novel relation to the maximum directed cut problem, a fundamental and well-studied optimization problem. We obtain performance guarantees of 87.4%, 50% and ~50% for the uncapacitated, capacitated and space constrained versions respectively. These bounds improve significantly over prior work. We also study the assortment problem under more general constraints (such as multiple space constraints and partition constraints), for which we obtain a performance guarantee of 38.5%. To the best of our knowledge, these constraints have not been investigated previously. In addition, we implemented our algorithms and tested them on random instances

available in the prior literature. Our computational results are very good, demonstrating much better empirical performance than the above-mentioned worst-case bounds.

Poster 5

Presenter: James Shepich

Advisor: John Wolfe (Chemistry)

Palladium-Catalyzed Alkene Difunctionalization of Simple Triflates to Form Substituted 5,6-Fused Carbocycles

Functionalizing unsaturated C–H bonds on many carbocycles is a significant challenge in organic synthesis. Previous Wolfe group research has excelled in using Pd catalysis to form functionalized 5-membered carbocycles in a 5,6 fused system. However, when using the same reaction conditions to try to form a functionalized 6-membered carbocycle, the Heck product was observed.

This project aims to use Pd-catalyzed alkene difunctionalization reactions to produce 6-membered carbocycles. To this end, 5-membered simple alkenyl triflates are being investigated so that the ring strain of a 5,5-fused of a Heck product will prevent it from forming, favoring the alkene difunctionalization product. This reaction could be a powerful method of making two bonds at once to form a functionalized carbocycle with anti-diastereoselectivity. Difunctionalization of the alkene with the internal triflate nucleophile and an exogenous diethyl malonate was found to occur using $Pd(OAc)_2$ with BrettPhos. A wider substrate and nucleophile scope is under examination.

Poster 6

Presenter: Taylor Walker

Advisor: Jason Spence (Internal Medicine)

Investigating the role of SMAD signaling in basal cell specification during murine lung development

During lung development, branching morphogenesis gives rise to a tree-like network of epithelial tubes designed to maximize the surface area available for gas exchange. Previous work has shown that cells located in the tips of the branching airways, called bud tip progenitors, give rise to all lung epithelial cell types in mice, including basal stem cells. However, the cellular mechanisms driving a bud tip progenitor to differentiate into a basal cell are not clear. In mice, basal stem cells are formed by embryonic day (E) 8.5 of development and are located in the trachea, and are critical for airway homeostasis and repair. Previous work in our lab has shown that treating cultured mouse bud tip progenitors with TGFb1 and BMP4 to activate SMAD signaling increases expression of the basal cell marker TP63 by 1,400 fold by qPCR ($p=0.045$). Based on this evidence, we hypothesized that SMAD signaling is critical for the differentiation of bud tip progenitors into basal cells. To test this hypothesis, we utilized a Cre-Lox system to conditionally knock out TGFb1-receptor or SMAD4, essential SMAD pathway components at the receptor and intermediate levels, respectively, in the upper airways between day 8.5 and 11.5 of gestation. We will evaluate the effect of SMAD pathway component deletion on the differentiation of bud tip progenitors into basal cells by staining the tracheas of mutants and littermate controls for basal cell marker TP63. We expect to see significantly fewer TP63+ cells or complete loss of basal cells in the mutant tracheas compared to controls.

Poster 7

Presenter: Ethan Ruwe

Advisor: Scott Leiser (Life Sciences)

Drugs Increasing Stress Resistance and Longevity by Inducing FMO-2

FMO-2 overexpression is sufficient to extend lifespan and improve stress resistance in C. elegans. Using FMO-2 induction as a longevity marker, we are looking for drugs that can extend lifespan and improve stress resistance by inducing FMO-2. Our lab's ongoing work has screened 19 drugs that can induce FMO-2 in C. elegans. If results show positive for FMO-2 induction in certain drugs, we can hypothesize that longer lifespans and higher stress resistance will occur. The ability to extend the lifespan of C. elegans would then be tested on mammalian cells for stress resistance, potentially becoming useful to extend human life in the future. By conducting stress tests with differing concentrations of drugs, we can collect data on the effectiveness of the drugs for stress resistance and lifespan extension. Statistical data for survival rates is then accumulated, providing conclusions on the effectiveness of the drug for stress resistance and lifespan extension. We will also test whether these drugs improve stress resistance and extend lifespan in wild type or FMO-2 knock out C. elegans, providing clues if FMO-2 is the sole contributor of the stress resistance and prolonged lifespans. Preliminary results show that Rotenone, a strong FMO-2 inducer, does not result in increased stress resistance. Rotenone extends both wild type and FMO-2 knock out C. elegans lifespans, suggesting that it could extend lifespan via other signaling pathways besides FMO-2 induction. Further trials will provide more confirmative conclusions. Other FMO-2 inducers will also be tested for effectiveness of lifespan extension and stress resistance.

Poster 8

Presenter: Eliyas Asfaw

Advisor: Rafael Meza (Epidemiology and Otolaryngology)

Longitudinal Analysis of Alcohol Use and its Relationship with Human Papilloma Virus (HPV) and Sexual Activity Among a Cohort of Undergraduates

Objectives:

Human Papilloma Virus (HPV) is a virus that causes 5% of all chronic diseases especially its oncogenic types (namely type 16). The objective of this longitudinal analysis is to access any synergic relationship between alcohol use and HPV along with the sexual activities of participants in the Michigan HPV and Oropharyngeal Cancer Study across three years.

Methods:

The Michigan HPV and Oropharyngeal Cancer Study (M-HOC Study) is a cohort study designed to understand the longitudinal patterns of incidence and prevalence of HPV infections along with its clearance and its association with Oropharyngeal Cancer. The study has more than 400 participants, and about 240 are undergraduate students at the University of Michigan Ann-Arbor. This study consists of a detailed medical and sexual history questionnaire, saliva, and cervical samples. From saliva and cervical samples, HPV was detected using PCR-Mass array method.

Results:

Study participants who drank more than 6-9 drinks per week in significantly riskier sexual behaviors than students who did not drink alcohol, especially among women. Also, the volume of alcohol consumption

has steadily increased across study visits. Oral sex is the more commonly practiced form of sex (92.8%). In addition, HPV status had a significant association with the level of alcohol consumption, especially at higher levels.

Conclusion:
The analysis results show that a high intake of alcohol is heavily correlated with increased sexual activity and HPV infection. Further studies are needed to understand the relationship HPV mechanism and alcohol levels along with tumor suppressors commonly targeted by HPV like p53 and Rb.

Poster 9

Presenter: Vellia Zhou

Advisor: Kimberly Reidy (Pediatric Nephrology)

Par1a Deletion Reduces Tubulointerstitial Fibrosis in the Folic Acid Mouse Model of Renal Injury

Chronic Kidney Disease (CKD) affects 1 out of 7 adults in the United States and causes significant morbidity and mortality. Development of tubulointerstitial fibrosis, and the accompanying loss of functional tubular cells, leads to CKD progression. The Notch signaling pathway is required for renal development, however, sustained Notch activation in adult mice induces tubulointerstitial fibrosis. Dual deletion of Par1a and Par1b, serine threonine kinases, in developing mouse kidneys impaired Notch activation and resulted in the formation of abnormal glomeruli and proximal tubules. Deletion of either Par1a or 1b does not affect kidney development.We hypothesize that Par1a or 1b deletion in mice would protect against folic acid (FA) induced tubulointerstitial fibrosis.

FA models of renal fibrosis were induced in Par1a WT and Par1a KO mice with intraperitoneal injections of 250 mg/kg FA dissolved in 300 nM $NaHCO_3$. Mice were examined 7 days after injection—the time of earliest fibrosis and peak Notch expression. Sirius red collagen staining was used to quantify the severity of fibrosis. Immunohistochemical staining for Notch signaling components and Par1a were performed. It was observed that Par1a expression was increased after FA injection. Par1a colocalized in tubules with increased Jag1 expression. Sirius red staining demonstrated less fibrosis in Par1a KO vs. WT mice.

Together, our results suggest Par1a deletion may be protective against renal fibrosis. Par1-Notch interactions may be mediated by effects on Jag1. Par1-Notch signaling could be a novel target for therapeutic intervention and potentially attenuate CKD progression.

Poster 11

Presenter: Jin Yi Tan

Advisor: Mark Meyerhoff (Chemistry)

Development of Nitric Oxide (NO) Releasing Poly(vinylidene fluoride-co-hexafluoropropylene) Films with Reduced Chemical Leaching

Nitric oxide (NO) releasing polymers have a wide range of use in biomedical implants and devices. However, the chemical leaching of NO donors and their byproduct species is almost always observed during the application of polymer-doped NO donors. One approach to solve this issue is to covalently link the polymer to the NO donor. Herein, we report the first NO releasing poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) fluorinated copolymer by incorporating a fluorinated S-nitrosothiol as

the NO donor. The PVDF-HFP films were fabricated via a solvent casting method. Due to both fluorine-fluorine and electrostatic charge interactions between the fluorinated S-nitrosothiol and PVDF-HFP, the total chemical leaching of the NO donor and its disulfide product after 9 day was only 0.6% (mol%) of the initial amount of NO donor loaded into the film. Furthermore, no free fluorinated S-nitrosothiol was observed in the leaching test. Under physiological conditions, the resulting polymeric films can release NO for 16 days. These NO release PVDF-HFP films can significantly inhibit the growth of both S. aureus and P. aeruginosa on the surface of the polymer films. The NO-releasing PVDF-HFP copolymer can also be coated on the outer and inner surfaces of Teflon tubing. Given the widespread use of fluorinated polymers to prepare certain biomedical materials/devices, this NO releasing PVDF-HFP polymer could possibly lead to creating fluorinated biomedical polymers with even greater biocompatibility and antimicrobial activity.

Poster 12

Presenter: Madhav Kumar

Advisor: Craig Galban (Radiology)

Segmentation and Classification of Explanted CT Lungs Using Mathematical Morphology and Dictionary Learning

Image segmentation and classification is the first step in the process of fully personalizing and automating medicine. Traditional image segmentation methods face complications when presented with medical images. Using pre-processing steps along with multiple complex image segmentation techniques addresses this issue. In this project we are presented with three dimensional CT scans of explanted lungs in ice boxes. The first goal of the project is to segment the lungs from the ice around it and the ice box it is contained in. We then aim to make use of dictionary learning algorithms to be able to classify these lungs as healthy or unhealthy. This "viability test" will help us make decisions on whether a lung is fit to be implanted into another patient. We implemented pre-processing steps like non-local means denoising in order to allow our image segmentation techniques to work better. We followed this by using histogram analysis and multilevel Otsu thresholding to determine which pixels in the image represented our lung data. Finally using mathematical morphological methods, we were able to segment the largest connected component in the image. This gave us a relatively crude shape of the lungs which are helpful for us to test our dictionary learning algorithm on. The next step in our research is to explore means to improve our image segmentation and test our current results against other data to determine the effectiveness of our algorithms. Perfecting this classification will bring us closer to AI based personalized medicine.

Poster 13

Presenter: Faith Chang

Advisor: Ariella Shikanov (Biomedical Engineering)

CUBIC Tissue Clearing and Confocal Microscopy as an Alternative to Histologic Sectioning for Monitoring Human Ovarian Follicle Maturation

When monitoring the process of ovarian follicle maturation in human ovarian tissue, samples are often fixed, paraffin-embedded, sectioned, stained, and imaged in order to evaluate follicle development. A more desirable alternative to this time-consuming, labor intensive histologic processing would be to fix,

stain, and image the intact piece of tissue. This is currently limited by tissue opacity, such that follicles in the center of the tissue are not easily visualized. To overcome the limitation of the inherent opacity of biological tissues, we are applying the previously established CUBIC (clear, unobstructed brain imaging cocktails and computational analysis) tissue clearing protocol to optically clear human ovarian tissue samples. This comparatively simple process employs surfactants, aminoalcohols, and urea to permeabilize and delipidify the tissue, then high concentrations of sucrose (which has a high refractive index) to uniformly match refractive indices across the tissue. We stain the samples with nuclear stain and follicle-specific antibodies and image under a confocal microscope in order to count follicles. To evaluate the follicle count accuracy of this method, we then paraffin-embed, section and stain these cleared samples to recount follicles in the traditional manner. We have successfully employed CUBIC to clear tissue and image follicles in human ovarian tissue samples. We are continuing to optimize our clearing protocol to ensure accurate follicle counts in intact pieces of human ovarian tissue. Should our method prove successful as an accurate alternative to histological sectioning and staining samples, it would save significant working hours, allow for imaging of intact 3D samples, and become a more accessible mode of monitoring follicle maturation.

Poster 14

Presenter: Marissa Martinelli

Advisor: Paul Jenkins (Pharmacology)

Effects of Gut Microbiota on Ankyrin-G Localization and Depression

Depression, both a mental and physiological disorder, accounts for more years lost to disability than any other disease. It is hypothesized that gut microbiota is closely linked to depressive disorder; studies have shown that patients with depression have a different gut microbiota than healthy patients. Research in the Jenkins Lab focuses on the protein ankyrin-G. Ankyrin-G plays a critical role in intestinal epithelial cells where it is localized to the lateral membrane to form tight junctions between cells. Another Pharmacology lab, the Jutkiewicz Lab, observed depressive phenotypes in rats that were stressed for seven weeks. The feces of the depressive-phenotype rats were fed to naïve rats for five days, which then also exhibited depressive phenotypes. The rats with feces-induced depressive phenotypes had decreased levels and loss of localization of ankyrin-G at the base of villi in intestinal epithelial cells. We are now studying tissue from rats that exhibited depressive phenotypes after seven weeks of stressing, instead of five days of feces exposure, to see if loss of ankyrin-G and its localization occurs further towards the end of villi where cells are more differentiated. In this project, we investigate the effects of gut microbiota on ankyrin-G palmitoylation and localization in intestinal epithelial cells to understand the role of gut microbiota in depression. We hypothesize that changes in the gut microbiota inhibit palmitoylation of ankyrin-G, preventing ankyrin-G localization to the lateral membrane and eventually contributing to depressive phenotypes by causing leaky gut.

Poster 15

Presenter: Alexandra Wormley

Advisor: Dr. Oliver Sng (Psychology)

If Provided with Additional Physical Barriers to Protect Oneself from Pathogens, Does the Perceived Threat of Disease Decrease?

The behavioral immune system is a series of behaviors and psychological mindsets to help humans avoid infection, and thus increase chances of survival. This system works in tandem with the biological immune system, so manipulations in our behaviors can have an effect on the functioning of the biological immune system. One possible intervention may be providing individuals with greater protection from the disease threat from the world. Protecting the skin, our largest organ and first-line defense in the biological immune system, might be one way to lower perceived vulnerability to disease (PVD). In a pilot study, we measured participants' self-reported exposure to the environment and PVD to seek evidence of an existing relationship. In a follow-up study, we plan to manipulate participant's exposure to the environment in the lab while measuring PVD and beliefs about illnesses. We predict that when an individual's skin is less exposed to the environment (and therefore from pathogens), they will report having a lower PVD. If so, then this provides evidence that PVD can be manipulated in participants without using pathogen threat manipulations.

Poster 16

Presenter: Gillian Rubenstein

Advisor: Francesca Duncan (Women's Studies)

Optimization of Fixation Conditions to Detect Hyaluronan in the Mammalian Ovary

Hyaluronan (HA) is a ubiquitous glycosaminoglycan component of the extracellular matrix (ECM) that, in its high molecular weight (HMW) form, promotes tissue hydration and homeostasis. Under certain pathogenic conditions, HMW HA can fragment into low molecular (LMW) species, resulting in a net loss of HA and activation of signaling pathways that contribute to fibrosis and inflammation. We have shown previously that the ovarian stroma becomes fibrotic and inflammatory with advanced reproductive age, and we hypothesize that a decrease in HA may be an underlying mechanism. HA is non-immunogenic, and therefore no reliable antibodies exist to detect it in mammalian tissues with immunohistochemistry. Instead, HA can be visualized using biotinylated HA binding proteins (HABP). Although this histochemical protocol is straightforward, there are organ-specific fixations conditions described in the literature, with no best practices established for HA detection in the ovary. A review of HABP studies revealed that six fixatives for the HABP assay are commonly used. The goal of this study was to determine which of these fixatives was optimal for visualizing the HA matrix. There were prominent differences in the quality of the HABP signal. Of the six fixatives, Carnoy's Solution and EFG preserved the highest HA signal intensity in the ovary and showed clear HA localization in various sub-ovarian structures including the theca-interstitial layer, the vasculature, cumulus cells, and follicular fluid. These findings will inform future experiments about localization of HA in the ovarian stroma and how it changes with models of aging and correlates with fibrosis.

Poster 17

Presenter: Jiayu Chen

Advisor: Alex Cao and Robert Hampshire (Transportation Research Institute)

Pedestrian Bicycle Risk Exposure Visualization System

UMTRI has created a web visualization tool for pedestrian bicycle risk exposure at pedbikerisk.umtri.umich.edu. The website currently uses the Google Maps JavaScript API and Google

Fusion Tables to display the data at scale. However, there are some constraints imposed on the visualization and data by using these tools. The purpose of the project is to explore the use of ArcGIS as our map tool to achieve similar functionalities.

Poster 18

Presenter: Dylan Hendy
Advisor: James Moon (Pharmaceutical Science)

Treatment of Experimental Autoimmune Encephalomyelitis (EAE) by Inverse Vaccination with Myelin Based Peptide Loaded Nanoparticles

Multiple Sclerosis is an autoimmune disease that affects the central nervous system (CNS). Antigen-specific T-Cells target different proteins related to myelin and the axons which lead to demyelination and paralysis. Most current therapies for MS rely on the global suppression of the immune system, and since these therapies target the whole immune system, there are many undesirable side effects associated with them. Inverse vaccination on the other hand produces immune tolerance with less off target effects. In the present study, we propose the injection of myelin-based peptide loaded synthetic high-density lipoproteins (sHDLs) to promote immune tolerance for the self-antigens that cause MS.

Poster 19

Presenter: Michael Petterson
Advisor: Ginger Shultz (Chemistry)

Exploring Student Mechanistic Reasoning in Organic Chemistry Through Alchemie

The organic chemistry sequence is required for many undergraduate and graduate degree programs. However, this set of courses is challenging for many students because the concepts are new and reasoning unfamiliar. Organic chemistry relies heavily on reasoning through mechanistic processes: the chemical steps through which the reaction proceeds from reactants to products. We are interested in investigating how different molecular representations may impact the way students approach organic chemistry problems. To assess this, we recruited students from a first-semester organic chemistry class at the University of Michigan and assigned them to one of two experimental groups. Students either worked through organic chemistry mechanisms using an interactive, organic chemistry app or on paper. The app, Mechanisms, allows students to practice common organic chemistry mechanisms by working through "puzzles" that provide guiding "task cards" and "hints." The app also displays atoms and molecules in a way that is more dynamic. Conversely, while static, the paper-and-pencil problems more closely resemble what students see in class and on exams. Each student participated in a "think-aloud" interview where they were given a set of four reactions to work through. For each reaction, students were asked to verbalize their thinking as they worked through the problem. The interviews were inductively coded to capture students' mechanistic reasoning processes. Preliminary results indicate that students recognize the steps for specific reaction types and identify relevant concepts, but they do not always apply the concepts correctly.

Poster 20

Presenter: Jonathan Gurkan

Advisor: Arul Chinnaiyan (Pathology)

Evaluating the Efficacy of a STING Agonist in a Murine Model of Prostate Cancer

Despite the promise of checkpoint inhibitor therapy, prostate cancer has remained resistant to this treatment. Innate immune agonists, however, have been shown to have anti-tumor effects in various cancer types, such as melanoma and colon cancer, and have been nominated to be used in combination with approved anti-PD1/PD-L1 drugs. We hypothesized that innate immune agonists may be effective in the MycCaP syngeneic mouse model of prostate cancer. Published data have reported inherent resistance of MycCaP tumors to anti-PD-1 treatment in vivo. Previously, we found that a STING agonist alone showed anti-tumor efficacy against MycCaP tumors. In this study, we hypothesize that the addition of a STING agonist could enhance efficacy of anti-PD-1 therapy in this model. Mice with MycCaP tumors were administered anti-PD1 alone (n=10) or in combination with bilateral injections of the STING agonist (n=14). Combined therapy resulted in significant reduction in tumor size (71%) compared to anti-PD1 alone (9%). Additionally, there was a significant increase in the Ifnb1 (p=.04), Ifng (p=.008), Tnf-α (p=.006), IRF3 (p=.003) and II6 (p<.0001) gene expression in the combination group showing enhancement of the STING pathway genes. Combined, these findings suggest that targeting the STING pathway may have a modest local anti-tumor effect when compared to other innate immune pathways in prostate cancer. The efficacy of anti-PD-1 therapy was significantly enhanced when combined with a STING agonist, possibly through enhancement STING pathway genes. Our data suggest that combination therapy with a STING agonist and anti-PD1 therapy may have potential anti-tumor efficacy in prostate cancer.

Poster 21

Presenter: Geoffrey Jenkins

Advisor: Leonardo Regoli (Climate and Space Sciences Engineering)

Transient Martian Ionospheric Density Depletions as Observed by the MAVEN Mission Spacecraft

Here, we report on occurrences of transient plasma depletions in Mars' ionosphere as observed by the Mars Atmosphere and Volatile Evolution (MAVEN) mission spacecraft. We take a multi-instrument approach as we utilize data collected by the Solar Wind Ion Analyzer (SWIA), the Suprathermal and Thermal Ion Composition (STATIC), the Langmuir Probe and Waves (LPW), the Magnetometer (MAG), and the Neutral Gas and Ion Mass Spectrometer (NGIMS) instruments. Depletion events are defined as short-term decreases in plasma density on the order of >102 cm^{-3} over altitudes of 200 km (i.e. the exobase). Above the exobase, particles cease to be dominated by collisions becoming more susceptible to solar wind interactions and ultimately leading to heightened particle escape from the atmosphere. Preliminary analysis has identified depletion events on the day and night sides, near crustal magnetic fields, along the dawn and dusk terminators, and in close proximity to the magnetic pile-up boundary (MPB). We investigate phenomena currently considered capable of leading to such depletions - plasma-flux rope interactions, magnetic reconnection, MPB-MAVEN proximity, existence of ionospheric holes, and briefly of magnetic field topology. As interest in manned and robotic exploration of the Martian

environment continues to grow, an understanding of physical processes governing the plasma in this region becomes more important as it greatly affects communication between the surface and Earth.

Poster 22

Presenters: Devin Ablow and Claire Novak
Advisor: Edward Chang (Psychology)

Coping Behaviors and Optimism as Predictors of Suicide Risk and Protection in a College Student Population

According to the Centers for Disease Control and Prevention (2017), suicide is the second leading cause of death among college students. Research demonstrates a consistent link between optimism in positive health outcomes, and, importantly, with lesser suicide risk. However, some propose that the behaviors of optimists (i.e., coping) may be more important than personality variables (i.e., optimism) when predicting adjustment. Indeed, coping is also associated with psychological health and lesser suicide risk. Therefore, the present study sought to further determine the relationship between coping and suicide risk and protection, and examine whether optimism would predict any additional variance in this relationship.
252 college students (175 females & 77 males) completed questionnaires measuring optimism, coping, suicidal behaviors, and reasons for living.

We ran two separate regression analyses to examine the role of coping and optimism in predicting suicidal behaviors and reasons for living. Results indicated that coping significantly accounted for 18% of the variance in suicidal behaviors and 27% of the variance in reasons for living. The inclusion of optimism significantly accounted for an additional 3% of the variance in both suicide measures.

Taken together, our findings point to a consistent pattern, namely, that coping and optimism are important, unique predictors of suicide risk and protection. Specifically, substance use and religion were significant predictors for both suicide measures, suggesting that efforts to reduce or prevent suicide in young adults might focus on avoiding substances during times of stress and the encouragement of more mindful or spiritual approaches to life.

Poster 23

Presenter: Nicole Smith
Advisor: Jason De Leon (Anthropology)

Fragmented Realities: The Materiality and Memory of Child Migrants

The Undocumented Migration Project (UMP) is a long-term anthropological analysis of clandestine border crossings between Latin America and the United States that began in 2009. The UMP uses a combination of ethnographic and archaeological approaches to understand the distinct experiences of migrant subpopulations. This study focuses on child migrants and the relationship between their memories and the migrant material culture of the Sonoran desert.

I examine the intricate narratives of child migrants through archival research from federal government websites regarding the statistical evidence of unaccompanied minors, lab analyses conducted on child artifacts that the UMP has collected, and interviews conducted with undocumented youth. Although the archaeological evidence is slim and difficult to correlate with age, it does provide a visual and physical

representation of migration of what can be lost along the way. More importantly, the memories of those interviewed, even if incomplete or unclear, offer first-hand accounts of what happens before, during, and after the migration process. While the materiality and memory of child migrants are their own fragments of these complex experiences, it is when these two things are conceptualized together that we gain a more nuanced perspective of how children contribute to the social process of migration and what it means to be a child crossing borders.

Poster 24

Presenter: Natalie Potter

Advisor: Raoul Kopelman and John Wolfe (Chemistry)

Synthesizing Targeting Moiety for Cardiac Arrhythmia Phototherapy

Cardiac arrhythmia, or the abnormal beating of heat muscle cells, traditionally has been treated through electrical methods such as electric shock intervention and other invasive means, especially surgery. Photodynamic therapy (PDT), using a photosensitizer, is an alternative and efficient noninvasive method developed to target and kill cancerous cells by light activation. To target with the photosensitizer cardiac nerve cells, which are thought to be the contributing factor to heart arrhythmia, N-(4-(guanidineomethyl)-2-iodophenyl)-3-mercaptopropanamide, an analogue of radio-iodinated m-iodobenzylguanidine (MIBG), was prepared. This was done through a 7-step organic synthesis. Structural verification after each reaction was done by ^{1}H NMR. The analogue's heart nerve cell targeting ability was quantified by attaching the analogue to a nanoplatform and tested in the presence of cardiac nerve cells. Observations of its pH sensitivity was also tested using ^{1}H NMR. Storage factors such as light sensitivity and temperature were found to affect the lifetime of each intermediate step. These findings could advance the new method of PDT treatment of heart arrhythmia.

Poster 25

Presenter: Nick Hollman and Grayson Yin (Cognitive Science)

Exploring Realistic Extensions of The Multi-Armed Bandit Problem

The Multi-arm bandit (MAB) problem captures a dilemma in decision-making under uncertainty. Agents are faced with n choices that have various unknown rewards where they can either exploit choices with greater certainty or explore the unknown choices in order to maximize total rewards. Exploiting involves selecting the choice with the highest expected reward from prior information, whereas exploring involves selecting at random to gain more information about the rewards of other choices. Our research aims to add a more realistic extension to the MAB problem. This will come in three forms: (1) Develop a new strategy based on the robustness of a belief on the expected reward. As more information accumulates, the agent's belief consequently becomes more robust and alters how it makes decisions. (2) Modify the original topology of the environment from 1-dimensional n arms to a 2-dimensional grid world, where agents can only gain information locally and explore adjacent choices. (3) Lastly, we modify the interactions between agents to include signalling rewards to others. This allows for transparency in the information between agents. However, additional variables such as trust level and accuracy in signalling complicate this model. For our belief-robustness strategy, we predict agents will reach the optimal choice slower than the other strategies, on average. For the modified topology model, we predict our results will

depend on the formation of the agents. For the reward-signalling model, we predict the speed of convergence to the optimal choice positively correlates with trust and accuracy in signalling.

Poster 26

Presenter: Sanjana Kannikeswaran

Advisor: Jack Parent (Neurology)

Rapid Generation of Human Cortical Glutamatergic Neurons to Model KCNA2-Related Epileptic Encephalopathy in vitro

Though 50 million people worldwide are affected by epilepsy, this disease remains among the hardest to treat, with 30-40% of patients resistant to treatment with the currently available antiepileptic medications (1,4). Uncontrolled epileptic activity can lead to neurodevelopmental delays and dysfunction, known as epileptic encephalopathy, and sudden unexpected death (SUDEP) 3. Postulated causes of intractable epilepsy include genetic mutations and dysfunction in ion channels, known as ion channelopathies (2,4). One such mutation is the de novo mutation of the KCNA2 gene, which leads to alteration of the function and activity of the Kv1.2 voltage-gated potassium channel (2). Because this mutation was only recently discovered, there is relatively little knowledge of the mechanism responsible for the symptoms resulting from the KCNA2 mutation; specifically, how the ion-channel dysfunctions and its consequential effect on the cell. To attempt to elucidate the etiology behind KCNA2-related epileptic encephalopathy, this study uses a neuronal model - made by virally transducing human induced pluripotent stem cells (hiPSCs) with inducible human neurogenin-2 (hNGN-2) - to examine the effect of the KCNA2 mutation on neuronal morphology, cortical neuron markers, and electrophysiological function. Our results indicate that 1) hNGN-2 expression can rapidly and efficiently differentiate hiPSCs into cortical glutamatergic neurons, 2) there is no significant difference in soma size and neuron extensions between cells with and without the KCNA2 mutation, and 3) induced neurons from both patient and control cell lines acquire mature electrophysiology properties in approximately 3 weeks. A detailed analysis of the effect of the KCNA2 mutation on neuronal electrical activity is ongoing.

Poster 27

Presenter: Joshua Kavner

Advisor: Brian Lin (Transportation Research Institute)

Analyzing IVBSS Radar Sensor Data for Autonomous Contextual Awareness

A focus of autonomous vehicle (AV) research has been in designing systems to predict future environments based on what they consider to be stationary or mobile. AVs will first need to recognize their surroundings and distinguish among vehicles and pedestrians before planning an optimal route. In this work, we train machine learning models to recognize vehicles using months of naturalistic driving data from UMTRI's Integrated Vehicle-Based Safety Systems (IVBSS) 2005-2011 study. We first treat this identification task as a sequential prediction problem so that a neural network can effectively evaluate the relevance of our data. We then partition the relevant data to represent likely real-world objects. A visual inspection of our clusters fairly approximates objects pictured in the IVBSS video recording. While our work is still in progress, our process will be used to help AVs interact with each other.

Poster 28

Presenter: Amy Baer

Advisor: Andrew DeOrio (Electrical Engineering and Computer Science)

A Longitudinal View of Gender Balance in a Large Computer Science Program

Computer Science suffers from a persistent lack of women's participation. A gap in our understanding is a fine-grain analysis of the gender disparity as it changes throughout an undergraduate Computer Science curriculum. In this paper, we use a quantitative approach to highlight, with greater specificity, the points in an undergraduate computer science career where gender balance changes. We also examine the role of grades in students' decisions to move on. Our goal is to enable targeted interventions to make Computer Science a more welcoming discipline.

Our study examines 29,354 student records over ten years at a large, public research institution. The data set contains information about gender, majors, minors, courses and grades of students in computer science courses.

At a high level, we observed an increase in women's participation in all courses over the past ten years. Despite this increase, the gender disparity is still large. Through our analysis, we have found that women choose not to continue through the Computer Science sequence at a higher rate than men. We have also found that this decision not to continue in the program is not due to women failing or withdrawing at a higher rate than men.

Our results enable new and more specific research questions about the stubborn gender disparity in Computer Science.

POSTER SESSION B

12:00 - 1:00 PM

Poster 1

Presenter: Ammar Ibrahim

Advisor: Charles McCrory (Chemistry)

A Study on the Dimensionality of a Cobalt Bis(Pyridylmonoimine) Catalyst for Carbon Dioxide Reduction

A cobalt complex with a redox-active bis(pyridylmonoimine) ligand (L-L) has been reported to show catalytic activity for electrochemical CO_2 reduction in acetonitrile. We hypothesize that increasing the dimensionality of this catalyst can improve catalysis by increasing the number of active sites. We propose that a range of 0 dimensional materials can be synthesized for this type of catalyst, including a linear dimer, a trigonal trimer, and a tetrahedral tetramer. In this work, the synthesis and characterization of a monoimine ligand framework has been prepared, which is a compound that is readily convertible to the aforementioned materials via a simple Schiff Condensation. This system has been prepared to compare the extended systems to the original [Co(L-L)] in order to better understand the effect of dimensionality on electrochemical CO_2 reduction.

Poster 2

Presenter: Linh Le

Advisor: Ilya Volkovich (Electrical Engineering and Computer Science)

The Complexity of Finding S-factors in Regular Graphs

A graph G has an S-factor if there exists a spanning subgraph F of G such that for all v□V: degF(v)□S. The simplest example of such factor is a 1-factor, which corresponds to a perfect matching in a graph. In this paper we study the computational complexity of finding S-factors in regular graphs. Our techniques combine some classical as well as recent tools from graph theory.

Poster 3

Presenter: Tao Huang

Advisor: Abram Wagner (Public Health)

Analyze Epidemic Disease in China

My project topic is that stakeholder analysis of hepatitis E. This project help researchers observe and study Chinese health industry by collecting and clean data. I try to assist the professor Abram to analysis data collected from China to research the public health. There are some literature guided this project like “Risk factors for measles among adults in Tianjin, China: who should be controls in a case-control study” and “Hepatitis Vaccines”. They try to take away how to collect data and apply them into analyzing them.

Poster 4

Presenter: Eli Tukel

Advisor: Zaneta Nikolovska-Coleska (Pathology)

Inhibition of Bcl-2 Family Proteins as a Cancer Therapeutic

The mitochondrial mediated intrinsic apoptosis pathway is an essential component that governs the balance between life and death in a cell. The Bcl-2 family of proteins regulate these cell fate decisions through a network of antagonistic protein-protein interactions between anti- and pro- apoptotic protein members. The upregulation of anti-apoptotic proteins promotes neoplastic progression, evasion of cell death, and therapeutic resistance. Because of these properties, anti-apoptotic proteins are well validated therapeutic targets in a variety of malignancies and the development of small molecule inhibitors of these proteins has become a hot topic in drug discovery.

Mcl-1 and Bfl-1 are homologous anti-apoptotic proteins that are altered together in a variety of cancers, alluding to the possible of benefit of increased efficacy from their dual inhibition. Our group has validated several chemical scaffolds of Mcl-1 inhibitors and further in vitro binding studies revealed equipotent Mcl-1 and Bfl-1 binding affinities for selected core structures. Through data obtained from fluorescent polarization assays, we determined the structure activity relationship of compounds against the Bcl-2 anti-apoptotic proteins, and used this information to optimize dual Mcl-1/Bfl-1 inhibitors. This novel chemical library developed by our group emulates the pro-apoptotic proteins which bind the BH3 hydrophobic domain of Mcl-1 and Bfl-1. The most potent compounds selectively induce cell death in leukemia and lymphoma cell lines, indicated by MTT viability and flow cytometry assays. We have found that these compounds selectively antagonize both Mcl-1 and Bfl-1, and offer promise for future development of a potential cancer therapeutic.

Poster 5

Presenter: Kelly Kendro (Cognitive Science and Psychology)

The Lasting Cognitive Effects of L2 Acquisition

Decades of psycholinguistic research have attempted to determine whether a “bilingual advantage” exists for cognitive abilities (for a meta-analysis, see Grundy & Timmer, 2016). More recent work has shifted away from investigating the broader questions of cognition and working memory (WM) to focus on specific domains within those capacities (e.g., Linck, Osthus, Koeth, & Bunting, 2014,). Despite the multitude of studies examining differences between monolinguals and bilinguals, individuals who have undergone second language loss (attrition) have been overlooked in this literature. The current study utilizes Amazon Mechanical Turk’s TurkPrime service to test English monolinguals (n=29), English-Spanish bilinguals (n=20), and English speakers with an attrited L2 of Spanish (n=27) in Working Memory and Cognitive Control tasks (digit spans, reading span, numerical Stroop) and a test of Spanish language knowledge. Results both confirm the existence of a bilingual advantage on some cognitive tasks and imply some enhanced cognitive capacity in bilinguals that is retained as a cognitive mechanism despite loss of conscious language knowledge.

Poster 6

Presenter: Vivek Peri

Advisor: C. David Remy & R. Brent Gillespie (Mechanical Engineering)

Compact Fluidic Logic Valves for Simplified Control of Soft Robotic Actuators

Fluid-driven soft robots have many useful properties, such as the ability to safely interact with delicate objects, absorb impacts, and passively adapt their shape based on environmental stimuli. However, it is difficult to power pneumatic soft robotic actuators with individual pressure regulators due to their bulkiness, weight, and high cost. Fluidic valves are capable of solving this problem because they have similar capabilities to traditional electronic pressure regulators, but at much lower size, weight, and cost. A fluidic valve is designed similarly to a traditional electronic transistor; however, instead of utilizing an electrical signal to control current, the fluidic valve utilizes a pressure signal to control fluid flow. The two ends of the fluidic valve are exposed to a high pressure source and an atmospheric release, with a third input for control pressure. This control pressure acts like a transistor's gate voltage, and can dynamically close and open the fluidic valve. By connecting two fluidic valves to one pneumatic actuator, it is possible to either inflate or deflate the actuator at will. So far, we have successfully designed, produced, and tested several iterations of fluidic valves with different performance characteristics. In our most recent experiment, we successfully controlled a set of three pneumatic actuators with six fluidic valves using just one pressure source.This valve design could enable the development of soft robotic devices that are significantly more compact, easy to control, and less expensive than current, state-of-the-art devices.

Poster 8

Presenter: Jillian Genova

Advisor: Sarah Keane (Chemistry and Biophysics)

Preparation of oncomiR-1 for Tertiary Structure Determination

microRNAs (miRNAs) are short (~20-22 nucleotides) noncoding RNAs that play essential roles in the regulation of gene expression in higher eukaryotes. Dysregulation of gene expression can lead to disease; therefore, the biogenesis of miRNAs is strictly regulated and follows coordinated steps that allow for miRNA transcription, pri-miRNA cleavage, pre-miRNA hairpin formation and exportation, and miRNA duplex creation. The mature miRNA that forms from this process is then loaded into the RNA-Induced Silencing Complex (RISC) to silence mRNAs. OncomiR-1, or pri-miR-17-92a, is a primary micro-RNA transcript that encodes a cluster of six precursor microRNA (pre-miR) hairpins. This cluster is highly expressed in numerous cancers, including lung, breast, prostate, pancreatic, colorectal, and thyroid cancers. Interestingly, the individual pre-miRNAs are present in varying abundances in different tissues and at different stages in development, even having conflicting oncogenic and tumor suppressive activities in different cancers. We hypothesize that differential pre-miR expression in oncomiR-1 is a result of tertiary structure that restricts access to Drosha cleavage sites on the primary transcript. Here, we describe progress toward oncomiR-1 sample preparation. We synthesize the RNA via in vitro transcription reactions utilizing T7 RNA polymerase with PCR amplified DNA template. RNAs are purified using both preparative, overnight polyacrylamide gel electrophoresis and size exclusion chromatography to obtain highly purified sample for structural analysis. Once purified, the tertiary

structure of oncomiR-1 will be determined using a combination of cryo-electron microscopy and NMR spectroscopy. A high-resolution tertiary structure of oncomiR-1 will provide crucial insights into the structure-based regulation of pri-miRNA processing.

Poster 9

Presenter: Moustafa El-Kashlan

Advisor: Dean Yang (Economics)

Using Administrative Health Clinic Data to Evaluate the Impact of HIV Interventions in Mozambique

This study seeks to analyze the effect of treatment intensity on HIV outcomes in Mozambique using administrative clinic-level data collected from USAID. The treatment of various economic, health, and educational interventions was randomly assigned to different communities using schools as community centers and was implemented between early 2017 until 2019. The intervention sought to provide a holistic development program that improved health directly through increasing healthcare access as well as through indirect channels of educational and economic strengthening. The random treatment assignment allowed us to establish a measure of treatment intensity based on the percentage of each clinic's catchment area that was covered by treatment schools. Health outcome analysis was done on a clinic level for ART enrollment and HIV testing. The results show that treatment intensity had no statistically significant result on healthcare utilization based on the administrative data available. Furthermore, despite the emphasis placed on education in treatment communities, the treatment did not seem to increase enrollment in treatment schools.

Poster 10

Presenter: Jessica Henry

Advisor: Yannis Paulus and Van Phuc Nguyen (Ophthalmology)

In Vivo, enhancement of ocular fundus imaging using contrast agents to detect retinal neovascularization

Diabetes, retinal vein occlusion, and sickle cell disease can instigate neovascularization of the retina, which can result in premature blindness due to hemorrhage or retinal detachment. It is critical to monitor changes in the eye so that angiogenesis can be treated before irreversible damage occurs. Novel multimodal imaging of the eye using photoacoustic microscopy (PAM), optical coherence tomography (OCT), fluorescence microscopy, and fundus photography is an effective way to monitor blood vessel growth and early signs of macular degeneration. These technologies can be enhanced by contrast agent to improve visualization of molecular changes, including fluorescein dye, ICT, and various gold nanoparticles. Angiography and ICT were achieved using an intravenous fluorescein dye injection administered to New Zealand white rabbits. Gold nanoparticles are injected to increase contrast in these two modalities and aid in proactive monitoring of angiogenesis as the peak absorbance of hemoglobin matches the absorbance of the nanoparticles. To ensure safety, the nanoparticles are monitored for several days after injection to determine if there is cellular damage in the lungs, liver, kidney, spleen, heart, or eyes. The objective of these methods is to improve currently approved imaging techniques through increased contrast, depth, and visualization of blood or oxygen movement, while increasing or maintaining the safety. Developing these modalities would make it plausible to use the system frequently

on human subjects in the future allowing optimal monitoring of blood vessel growth to prevent premature blindness.

Poster 11

Presenter: Austin McCall

Advisor: Florian Schaub (Information)

Effects of FERPA Directory Information on Privacy in Higher Education

The Family Educational Rights and Privacy Act (FERPA) governs student privacy in education in the United States. FERPA allows universities to declare 'directory information,' personally identifiable information that can be released without student consent. We analyzed the directory information declared by 311 universities in their FERPA statements. We find that universities use a broad range of terms to describe the same categories of information listed as directory information. We also find that universities tend to use hedge terms obscuring what they consider directory information. Finally, we find that while students can opt out of this directory information, aspects of the opt out process pose challenges to students. We discuss student privacy, educational, and legal implications of our findings.

Poster 12

Presenter: Noor Ghali

Advisor: Dr. Stephanie Bielas (Human Genetics)

Rare pathogenic variants uncover a critical role for histone H2A mono-ubiquitination in neurodevelopment

Autism spectrum disorder (ASD) is believed to result from a disruption of growth and organization of the cerebral cortex. Advancements in human genetics are increasingly identifying pathogenic variants of chromatin regulators as the genetic etiology of autism spectrum disorder. Histone H2A lysine119 mono-ubiquitination (H2AUb1) is an evolutionarily conserved repressive histone modification of the Polycomb group (PcG) proteins. De novo dominant pathogenic variants in the PCG protein ASXL3 (Additional sex comb-like 3) is the genetic basis of Bainbridge Roper Syndrome and ASD. We demonstrated that ASXL3 is a necessary component of the Polycomb repressive deubiquitinase complex (PR-DUB), which deubiquitinates H2AUb1. H2AUb1 dysregulation is a key feature of ASXL3 molecular pathology and re-distribution of H2AUb1 in the genome is accompanied by altered transcriptional profiles in terminally differentiated cells, further confirmed in human neural progenitor cells (NPCs). Our Asxl3 null mouse model exhibits dysregulated H2AUb1 and cortical lamination defects during neurogenesis. In light of these findings, we hypothesize that ASXL3-dependent deubiquitination activity plays a critical role in specifying NPC transcriptional programs which govern the neuronal diversity of the cortex. We are pairing single cell transcriptomics and CUT&RUN analysis of NPCs to test this hypothesis. Our results implicate dynamic exchange of histone H2AUb1 as a critical component of mammalian brain development and a key molecular pathology of ASD.

Poster 13

Presenter: Matthew See

Advisor: Bart Bartlett (Chemistry)

Microwave Synthesis and Photocatalytic Performance of Ternary Ferrite Nanoparticles

The concept of using sunlight and molecular oxygen to carry out oxidation reactions is a common avenue of interest for the upgrading of organic compounds. Within this, the goal of increasing the energy efficiency of organic compounds lies in biomass upgrading. Metal oxide semiconductors are a well-known and studied class of materials whose ability to carry out light-driven reactions, makes them an attractive route for facilitating the above transformations. As opposed to their homogeneous counterparts, these heterogeneous oxides offer easy removal and industrial scalability at a lower cost than when using other expensive metals as catalysts. As well, unlike many studied binary systems, such as CdS or TiO_2, ternary metal oxide systems, like those explored in this study, show improved photo-stability and the ability to absorb lower energy light in the form of visible light. While these materials are robust in their usefulness, routine synthetic methods for catalyst development are harsh and offer little to no control over particle formation. By adapting previously established solvothermal methods for the synthesis of binary metal oxides, our efforts are directed towards producing photocatalytic spinel phase materials. To start we approach this through the lens of spinel iron oxide materials classified as "Ferrites". Utilizing a microwave synthesis workflow, the synthesis of these ternary ferrite materials will serve as a foundation for exploring complex photocatalysts. Examination of the materials size and light absorption properties will be crucial in understanding efficient photocatalytic activity.

Poster 14

Presenter: Emily Krebs

Advisor: Paula Anne Newman-Casey (Industrial & Operations Engineering and Ophthalmology)

Reducing Patient Wait Time Using Radio-Frequency Identification (RFID) Technology in the Kellogg Eye Center Glaucoma Clinic

In the Glaucoma clinic at the Kellogg Eye Center, long wait times and lack of patient adherence to medication protocol leave patients and providers equally frustrated. A typical patient visit can consist of several steps including imaging, visual field testing, or dilations before a patient sees his/her physician. Limited exam room availability and overloaded provider schedules can greatly impact patient wait times throughout the day. The Glaucoma project aims to address both of these issues by reducing patient wait times and implementing educational opportunities through optimization of patient and provider scheduling. Creation of a simulation model for optimization is based on RFID tracking data collected by RFID tags worn by patients and providers in the clinic (with consent). Wait time is defined as any time in which a patient is not with a provider. Patient wait times are tracked and collected as the RFID tags ping off of readers strategically placed around the clinic and data is accessed through a remote web application. The simulation based on this data assists the team in making decisions for improvement of scheduling and daily clinic operations based on recorded bottlenecks that occur throughout the day. With this information, educational opportunities can also be implemented to inform patients about their visit and medications when wait times cannot be decreased.

Poster 15

Presenter: Allison Vittert

Advisor: Stephen Kemp (Plastic Surgery)

Enhancing Peripheral Nerve Regeneration through Long (30 + 40 mm) Autografts by Supplementation of Autologous Unpurified Adipose Tissue

INTRODUCTION: Approximately 360,000 Americans suffer from upper extremity paralytic syndromes annually. The gold standard for peripheral nerve gap repair is autologous nerve grafting. Unfortunately, this approach yields suboptimal functional outcomes resulting in motor and sensory deficits. Adipose-derived stem cells (ASCs) have been previously shown to enhance peripheral nerve regeneration. However, ASC processing leads to both clinical and regulatory burdens. Unpurified fat is whole adipose tissue that is harvested without subsequent ASC isolation. The purpose of the present study was to investigate the effect of unpurified adipose tissue on nerve regeneration through long (30 + 40 mm) autografts in the rat.

MATERIALS & METHODS: F344 rats were used in this study and were randomly assigned to one of four experimental groups: (1) 30 mm autograft; (2) 30 mm autograft + unpurified adipose tissue; (3) 40 mm autograft, and; (4) 40 mm autograft + unpurified adipose tissue. After 12 weeks, terminal outcome muscle measures examined EMG (compound muscle action potentials, nerve conduction velocity) and muscle force parameters (twitch and tetanic forces).

RESULTS: Animals in both the 30- and 40-mm autograft + unpurified fat group displayed enhanced nerve regeneration compared to the non-fat administered autograft groups.

CONCLUSION: Unpurified fat enhanced peripheral nerve regeneration through long autografts. Harvesting of unpurified fat circumvents current FDA regulatory burdens, is easily obtainable, and has the potential to change current clinical management of traumatic peripheral nerve injuries. More specifically, this research can potentially lay the groundwork to change clinical practice of nerve injury.

Poster 16

Presenter: Vidhya Nadarajan

Advisor: Dr. Stephen Kemp (Plastic Surgery)

Mechanisms of Neuropathic Pain Hypersensitivity Following Terminal Neuromas in Rats is Sexually Dimorphic

Introduction: The purpose of the present study was to investigate if sexual dimorphism in both pain behavior and central spinal mechanisms exist following surgical creation of terminal neuromas in rats.

Methods: A total of 23 rats (11 female and 12 male) were randomly assigned to either a tibial nerve neuroma group, or an uninjured control group. All animals underwent baseline functional pain and hypersensitivity testing. Following surgerical intervention, rats were serially tested over 8 weeks for mechanical allodynia (von Frey), cold allodynia (Acetone test), and heat allodynia (Hargreaves test). At study endpoint, nerve and neuroma samples were harvested for histomorphometrical analysis. Spinal cord and dorsal root ganglion (DRG) samples were assessed for both microglia and T-cell immune mediated responses. These included P2X4 upregulation, p38 mitogen-activated protein kinase, and activation of the transcription factor IRF5.

Results: Both male and female rats with tibial neuromas displayed increased mechanical hypersensitivity in the von Frey test. Female rats required less force to generate a pain response in comparison to male rats in the control group; interestingly, the opposite held true in the tibial neuroma group. For cold allodynia, female rats demonstrated increased pain behavior for both control and neuroma groups. Sexual dimorphic responses did not occur for heat allodynia. Spinal mechanisms of neuroma induced hypersensitivity differed between males and females.

Conclusions: This study confirms the existence of sexually dimorphic pain behavior and signaling in rats. Results from this study may lead to viable sex specific therapeutic targets for neuropathic pain.

Poster 17

Presenter: Laria Reynolds

Advisor: Craig Galban (Radiology)

Deep Learning for Air Trapping Detection

Deep learning for image classification, segmentation, and analysis has been widely used in many fields. Deep learning applications for medical imaging presents a challenge because unlike more general-purpose applications, there is not a wealth of labelled data available for training models. The result is that basic image classification tasks have to be performed by hand by medical professionals. One such example is identification of air trapping on lung CT scans. Current methods of identifying air trapping are limited to manual labelling by human professionals and threshold-based methods (quantitative air trapping; QAT), which has various drawbacks. We take advantage of datasets of CT scans of lungs exhibiting air trapping to train a binary classifier using a convolutional neural network as the model. We use data from a Stanford Gas Trapping dataset, where each two dimensional slice is automatically assigned binary labels using QAT thresholds. We generate Class-Activation Maps (CAMs), which highlight the spatial regions which the model uses to make its classifications. CAMs identify regions where gas trapping is present, and are meant to replace QAT maps without their drawbacks. We plan to make use of COPDGene data for training. We also plan to compare the performance of various deep learning architectures. This work is intended to streamline the work of clinicians and radiologists. Our methods of generating labelled datasets from unlabelled data has applications for facilitating deep learning in the domain of medical imaging.

Poster 18

Presenter: Gillian Rubenstein

Advisor: Ariella Shikanov (Biomedical Engineering)

Testosterone Induced Changes to the Rete Ovarii in Adult Female Mice

The rete ovarii has been defined as a vestigial structure of mammalian sex differentiation. It is believed that the rete is a product of the degenerated mesonephric duct, resulting in a conglomeration of mesangial and epithelial cells which remain in and around the post-natal ovary. The rete has been categorized into extraovarian rete (ER), intraovarian rete (IR), and connecting rete (CR) because of morphological patterns. Past analysis has demonstrated alterations of the bovine rete ovarii during pregnancy hypothesized to be a result of gonadotrophic variation during pregnancy, suggesting a connection between the structure of the rete and gonadotropins. Studying the structure of the rete in control and T-treated mice, using immunohistochemical techniques, may allow for insight into hypothesized gonadotropic

impacts on the rete. In our study, 25 mice received twice weekly 100 microliter subcutaneous injections of T-enanthate in sesame oil or sesame-oil only control. After 6 weeks of T therapy mice were sacrificed and organs harvested for histology. The IR of control mice showed pseudo-stratified epithelial cells while the epithelial cells of the ER appeared simple squamous or simple cuboidal. Cells in both T-treated ER and IR appeared slightly more columnar or stratified in comparison to cells of the control group. We hypothesize that this change in cell structure was impacted by the presence of elevated T-levels. Our further analysis will focus on investigation of markers of transdifferentiation, common hormone receptors, and steroidogenic pathway markers within rete epithelial cells.

Poster 19

Presenter: Vincent Thieu

Advisor: Stephen Kemp (Plastic Surgery)

Viability and Signal Transduction with the Composite Regenerative Peripheral Nerve Interface (C-RPNI)

Purpose: There is a need to develop a reliable, human-machine interface that facilitates transmission of efferent motor signals for device control and afferent somatosensory feedback information. The Composite Regenerative Peripheral Nerve Interface (C-RPNI) is a novel biologic interface that demonstrates promise for functional restoration following limb loss. The purpose of the present study was to investigate the viability and bidirectional signal transduction capabilities of the C-RPNI.
Methods: C-RPNIs were surgically implanted on the end of transected common peroneal nerves of thirty rats using de-epithelialized dermal grafts and free skeletal muscle grafts. Thirty animals underwent endpoint testing at three months (n=15) and at six months (n=15). Electrophysiologic testing was performed to determine the in-vivo efferent and afferent signal transduction capabilities of C-RPNIs following electrical stimulation. C-RPNI constructs were also harvested for histologic evaluation at both three- and six-month study endpoints.

Results: C-RPNI constructs remained viable over the study period with regeneration and revascularization evident on histologic analysis. At both three and six months, electrical stimulation of proximal peroneal nerve evoked robust efferent signals (CMAPs) and muscle contractions that were measured from the free muscle graft component of the C-RPNI. In addition, the average conduction velocity indicated healthy function of the motor and sensory nerves.

Conclusions: C-RPNI constructs remained viable with preserved innervation for six months following implantation. The C-RPNI facilitates bidirectional signal transduction of both efferent motor signals and afferent sensory signals. This confirmation of bidirectional signal transduction in the C-RPNI validates the potential role of the C-RPNI in human-machine interfacing.

Poster 20

Presenter: Lauren Hirth

Advisor: Shawn Murphy (Center for Healthcare Engineering and Patient Safety)

Fire and Burn Risk Associated with Fiberoptic Cords

Objective: Fiberoptic light systems are commonly used in endoscopic procedures to illuminate the surgical field. However, the distal end of fiberoptic cords pose significant burn and fire risk in the

operating room. The purpose of this project was to test commonly used fiberoptic cords to document temperature profiles and understand how fires and burns are occurring.

Methods: Temperature profiles of several combinations of fiberoptic light sources and cords were taken. Both new and refurbished fiberoptic cords were tested at light intensities of 30%, 50%, and 100% capacity. Xenon and LED light sources were used, representing light sources found in the operating room. In addition, the distal end of the lit cord was placed on a surgical drape and noticeable effects, such as melting, were recorded.

Findings: Depending upon the light source used, the maximum temperature at the fiberoptic cord tip ranges from 160 to 240 degrees Celsius. For reference, polypropylene drapes ignite at 160 degrees Celsius. Testing also revealed that the drapes also melt from radiant heat being emitted from the end of the cord without physical contact being made.

Conclusions: Audience members will gain knowledge of fiberoptic light systems and the fire and burn risks they bring into the operating room. The maximum temperature attained by fiberoptic cords exceeds the known ignition point of polypropylene, a commonly-used fabric for surgical drapes. Moreover, burns and melting can occur without direct physical contact. The data and information presented may be used to identify mitigation strategies to improve patient safety.

Poster 21

Presenter: Caroline Owens

Advisor: Amy Cohn (Center for Healthcare Engineering and Patient Safety & Acute Care Surgery)

Using Integer Programming to Build Call Schedules for Trauma Surgery Faculty

The purpose of the Trauma Faculty Call Scheduling Tool is to assist the development of call schedules for attending faculty in Acute Care Surgery. The faculty members in Acute Care Surgery take weekly calls on five different units plus nightly calls across the units, according to complex rules and guidelines regarding safe patient care. Currently, the Trauma Call Schedule is created by hand in a time-consuming and frustrating process for the Division Chief, who must schedule for six months at a time while attempting to accommodate each faculty member's many requests for time off. The Division Chief has requested our help in building a tool to develop a schedule based on requirements needed to achieve a feasible schedule. In collaboration with the Division Chief, the team has also established metrics to help improve the overall quality and equity of the schedule. We formulate the problem as an integer programming model. The intended impact of the project is to reduce the amount of time the Division Chief spends scheduling and to improve the satisfaction of the attendings with the overall schedule.

Poster 22

Presenter: Riley McKeown

Advisor: Amy Cohn (Center for Healthcare Engineering and Patient Safety)

Scheduling Residents in the CS Mott Children's Hospital Emergency Department

Scheduling medical residents is a complex and time-consuming task which usually falls upon the chief resident and requires an understanding of many rules and preferences. It is difficult and diverts attention

from tasks directly related to patient care. Additionally, bad schedules can lead to resident fatigue and negatively impact patient safety. The purpose of this project is to build a computerized scheduling system to enable faster construction of high-quality resident shift schedules in an emergency department.

The model our team designed is formulated as a mixed integer programming model, constructed in C++ using CPLEX. It enables the user to input problem parameters and specific rules through input files. Metrics to distinguish the quality of one possible schedule from another are incorporated. Chief residents work with the team to construct schedules using the tool for a typically two-month long planning horizon.

The tool decreased schedule production time from approximately 22-28 hours to 4-6 hours per month, increased adaptability, and improved schedule quality. The assignment of bad sleep patterns (85.7%) and post-continuity clinic shifts (66.7%) decreased significantly. A statistically significant reduction in night shift disparity, but not in total shift disparity, was observed. The reduced production time lightens the burden on the chief resident. The increased adaptability affords the capacity to address preference changes month-to-month. The improved schedule quality mediates risk for resident fatigue by significantly reducing undesirable schedule characteristics.

Poster 24

Presenter: Kikelomo Sekoni and Devki Kothari
Advisor: Anne McNeil (Chemistry)

Incorporating Green Chemistry into Intro Organic Labs

The concept of green chemistry is used to conduct experimentation that minimizes potential risks on human and environmental health, while maximizing efficiency of these processes in the laboratory. Many institutions have begun to realize the benefits of incorporating green chemistry into their curriculum and labs, however as a fairly new topic there is still a need for more material. Our approach introduced a 3-week module, incorporating concepts of green chemistry, into an introductory organic chemistry laboratory course. The module aimed for students to a) learn the principles of green chemistry, b) devise and carry out their own experiments to obtain ‘greener’ results, c) use their understanding of TLC, LLE, and IR to characterize their results. Post-lab assignments and pre- and post-semester surveys were analyzed to assess students’ understanding in green chemistry and confidence level in modifying reaction conditions. The data found will be discussed in this presentation and used to help improve future application of green chemistry to introductory laboratory courses.

Poster 25

Presenter: Sydney Hughes
Advisor: Jacob M. Haus (Kinesiology)

Confirmation and Localization of RAGE in Human Skeletal Muscle

INTRODUCTION: The receptor for advanced glycation end products (RAGE) is found in many cells and contributes to inflammation in T2DM, leading to insulin insensitivity. While much is known about RAGE in immune cells, RAGE is not well understood in skeletal muscle. Skeletal muscle is important to study because it produces and detects inflammatory factors. Therefore, our goal is to explore RAGE expression in human skeletal muscle using two well-established approaches. We hypothesize that RAGE is expressed in skeletal muscle and localized on cell membranes.

METHODS: We explored muscle obtained through the muscle biopsy technique from the vastus lateralis through histological (immunofluorescence; IF) and Western blot (WB) experiments. We used cross-sections and isolated single fiber samples and performed two control experiments: isotype control (IgG) and no primary antibody. In WB experiments, we compared RAGE expression in two healthy individuals and control knockout validation using siRNA.

RESULTS: Our results demonstrate through IF cross-sections, single fiber, and muscle homogenate, RAGE is expressed in skeletal muscle. In our IF experiments, RAGE appeared to be primarily expressed at the cell membrane. Our IF IgG and no primary antibody experiments reveal no fluorescent signal, suggesting antibody specificity. Our WB siRNA experiment show reduction in signal intensity from 24-72h, furthering confidence in antibody detection system.

CONCLUSION: The presence of RAGE in human skeletal muscle shows that inflammation can come from signal pathways in skeletal muscles, causing complications in T2DM. We can further research issues that arise as a result of excessive amounts of RAGE in skeletal muscle.

Poster 26

Presenter: Oscar Mota

Advisor: Anne McNeil (Chemistry)

N-Heterocyclic Carbene Dimers as Materials for Non-Aqueous Redox Flow Batteries

Storage of electrical energy is an increasingly pertinent issue because renewable resources generate energy at different times than when energy is consumed. A potential solution for energy storage is the redox flow battery (RFB), a device that stores and releases energy by using electricity to drive reversible molecular redox events. Organic molecules are attractive compounds for use in RFBs because of the ease of adding electronic and solubility modifying groups meaning properties can be easily tailored to each battery. We are currently examining dimers of N-heterocyclic carbenes for use in non-aqueous RFBs because of their modularity which allows for synthesizing derivatives with distinct electronic properties. This poster will highlight efforts towards synthesizing suitable derivatives of NHC dimers for non-aqueous batteries by studying their electronic properties using typical electrochemical techniques to elucidate redox potentials and cycling stability. Studies on these NHC dimers will lead to important information needed to develop long-lasting, high energy density non-aqueous RFBs.

Poster 27

Presenter: Kiana Sadri

Advisor: Dr. Subramaniam Pennathur (Nephrology)

Dysfunctional High Density Protein Lipoprotein and Exaggerated Heart Disease Risk in Kidney Disease

Heart disease is present in 40% of all kidney patients and is the leading cause of their mortality. Traditional risk factors have failed to explain the aggressiveness of heart disease in kidney patients. Thus, additional kidney disease-specific risk factors are likely responsible for the increased heart disease risk. Myeloperoxidase (MPO) is a heme enzyme that co-localizes with macrophages in human cholesterol plaques and is a common source of oxidative stress. MPO is known to target high density lipoprotein (HDL) making it dysfunctional promoting plaque formation in the general population. We hypothesize that MPO mediated oxidation is involved in making HDL dysfunctional in kidney disease patients. We used 348 stored plasma samples from the cardiovascular sub-study of the Renal Research Institute (RRI-

CKD) (average age of 60.4 years, 32% male, 78.5% Caucasian). 51 patients had cardiovascular events during the 1-year follow-up. HDL was separated using density centrifugation and processed for analysis for mass spectrometry. HDL function was quantified by cholesterol efflux capacity and HDL proteomics. We quantify stable products of MPO oxidation-3-chlorotyrosine and 3-nitrotyrosine in HDL using state of the art LC-MS technology. We have currently isolated close to 100 samples that are in the process of mass spectrometry analysis. We propose that these oxidation products and HDL function will be able to predict cardiovascular events during the study and presence of heart disease measured by indirect ways. Together, the end goal of these studies is to link MPO-oxidation and CKD atherosclerosis in order to provide new approaches to treatment.

Poster 28

Presenter: Elizabeth Strehl

Advisor: Robin Fowler (Engineering)

Experimental Evidence Regarding Gendered Task Allocation on Teams

Student teams negotiate many aspects of collaboration, including task division on teams. Some studies have found that there are gender differences in task allocation, with male team members performing more technical work, and female team members performing more communication and project organization based tasks. It is unknown, however, if this is due to students volunteering for tasks in which they perceive they are competent (and gender differences in real expertise or in self-perception), or whether there is a more insidious tendency for students to assume male students should do the technical tasks and female students should do organizational and communication work, and to encourage teammates to work in these gender-consistent manners. In this student-directed project, participants (n=119) of varying technical backgrounds were surveyed. Participants read about a hypothetical team, with teammates given names (gender-stereotypical white and non-white names: Deondre, Destiny, Jake, and Katie). Critically, the profiles of these team members were kept constant while names were swapped, and participants were asked to assign tasks to team members. This study investigates whether there are gender or race differences regarding task allocation, when experiences/expertise are held constant and self-perceptions are irrelevant. We find no significant difference in technical tasks completed. However, we find a significant difference in who is assigned managerial work (with "Katie" assigned the most, for each set of characteristics) and a marginally significant difference in who is assigned the writing work (with "Katie" again doing more of this than the other names). These results suggest that participants used assumptions about persona demographic information as they made decisions regarding task division, at least regarding who would do managerial and writing work. Differences in assignments of technical tasks were not statistically significant.

Poster 29

Presenter: Morgan Young

Advisor: Anne McNeil (Chemistry)

User-Friendly Method of Synthesizing π-conjugated Polymers

Catalyst-transfer polymerization (CTP) is a living, chain-growth method for synthesizing π-conjugated polymers used in thin-film solar cells, light emitting diodes, and transistors. Current methods require

using a glovebox or Schlenk-ware due to the air- and moisture- sensitive Grignard monomers used in CTP. To further develop CTP, a method was devised that eliminates the use of a glovebox and Schlenk-ware by utilizing moisture-tolerant zinc-based monomers and an air-stable palladium catalyst. This process has successfully synthesized poly(3-hexythiophene), where the living and chain-growth mechanism was confirmed by analyzing polymer molecular weight changes through gel-permeation chromatography. This new, user-friendly method should make CTP more accessible to a broader set of scientists and engineers.

POSTER SESSION C

1:00 - 2:00 PM

Poster 1

Presenter: Yun Gi Hwang

Advisor: Kevin Miller (Education and Psychology)

Eye Movements of Mind-Wandering during Scene Viewing: Insights from Scan-Paths

We examined eye movements of mind-wandering during scene viewing. Overall, fixations were fewer, longer, and less spread during mind-wandering. Moreover, the similarity between scan-paths during mind-wandering was lower compared to the similarity between scan-paths during on-task episodes, suggesting that gaze control is less constrained by the task during mind-wandering.

Poster 2

Presenter: Nathan Lwo

Advisor: John Jonides (Psychology)

Visual Attention Cognitive Training in conjunction with tDCS Minimizes Task Distraction in Adults with and without ADHD

ADHD is a common neurological disorder associated with high inattention. To investigate improving visual attention in adults with attentional deficits, a previous study in our lab conducted a visual-attention training regimen over five daily sessions with adults diagnosed with ADHD versus healthy participants. Participants completed near- and far-transfer tasks before and after training and one month later. Results showed that over training days, distraction, overall reaction time and error rate decreased significantly. This minimized distraction persisted for participants at a one-month follow-up session. The current study added concurrent tDCS to the same training regimen over four daily sessions with ADHD and control participants. tDCS studies report modification of cortical excitability, which might lead to increased connectivity between and within neural networks important for attentional control. From this, we hypothesize that administering tDCS concurrent with the cognitive training regimen would result in stronger and longer lasting minimized distraction. Half of all participants will receive sham tDCS to account for possible placebo effects. During training, participants will receive small amounts of anodal stimulation over their right DLPFC and cathodal stimulation over the contralateral supraorbital area for 20 minutes. We predict that distraction, overall reaction time, and error rate will decrease significantly over training days, and that this will persist for both controls and ADHD participants at one-month and three-month follow-up sessions. In addition, we predict that improvement in visual attention will transfer to near-transfer visual search tasks. Finally, we predict that participants getting active tDCS will receive more robust visual attention benefits.

Poster 3

Presenter: Dhruv Tatke

Advisor: Richard Laine (Energy Institute)

Development of Na3.3La0.3Zr1.7Si2PO12 electrolytic ceramic thin film for use as electrolyte in battery technology

Most modern battery formulations use organic electrolytes, which, while providing reliable performance, come with hazards like flammability and also using sizeable portions of the battery volume and mass. With energy storage becoming an ever more important part of energy solutions for transportation as well as use in grid-scale implementation of renewables, denser and safer alternatives to organic electrolytes are becoming more necessary. Solid-state ceramic electrolytic thin-films have been found to be a suitable replacement. One composition, Na3.3La0.3Zr1.7Si2PO12 for Na-ion batteries, has shown promising preliminary results with conductivities of 0.1 mS/cm with target conductivities of 3-4 mS/cm. To create this composition, a method called liquid feed-flame spray pyrolysis is used to create nano-powders of these compounds, by suspending precursors in ethanol, spraying and igniting them, and then rapidly cooling. The nanopowders are cleaned of carbon and caste into films as thin as 40 μm. These films are pressed and sintered to remove porosity and tested for electrochemical and physical properties. Based on these results, the process is altered to aim for ideal conductivities of 3-4 mS/cm. The 0.1 mS/cm is a very preliminary result. The process continues to be tweaked to reach optimal conductivity. Once desirable conductivities are reached, creation and testing of Na-ion coin cells to learn about the longevity of performance of the electrolyte will begin. Should results return favorably, this technology could find its way into the energy storage market as a solution to pressing energy storage needs.

Poster 4

Presenter: Nicholas Watson

Advisor: Corey Stephenson (Chemistry)

Leveraging persistent radicals for the synthesis of resveratrol-derived trimers

The resveratrol oligomer natural product family is endowed with a wide array of biological activities, a characteristic attributed to its equally diverse structural complexity. Trimeric resveratrol oligomers have remained elusive to biomimetic chemical synthesis with de novo strategies being the most prominent in the literature. Previously, the Stephenson group has leveraged persistent radicals formed by the oxidation of resveratrol in order to access dimer and tetramer resveratrol oligomers via biomimetic routes. Advances in the biomimetic synthesis of trimeric resveratrol oligomers, made possible by leveraging these persistent radicals, will be discussed.

Poster 5

Presenters: Estelle Feider-Blazer, Maria Roma, and Daniel Yuan

Advisor: Estelle (Engineering)

Signal processing for the detection, localization, and classification of transient sounds and material properties

Signal processing involves the analysis and modification of signals such as sound, image, or other measurements. This team is analyzing how acoustic signal processing can be applied in three areas. The first is the classification of transients sounds. Beamforming and STR is combined with the k-nearest neighbor algorithm to try to classify sounds based on acoustic properties. The second is the localization of transients in reverberant environments. MFP, SEM, and Beamforming are used to determine the source of transient sounds using both the single path and the reflected path of the acoustic signal. The third is to determine the differences between objects made using rapid prototyping techniques, such as 3D printing, and traditionally manufactured objects.

Poster 6

Presenter: Michelle Lin (Psychology)

Suicidal Behavior in Young Adults: Does Loneliness Still Matter after Accounting for Coping?

Loneliness, defined as the perception of social isolation or disconnectedness from others, and maladaptive coping strategies (e.g., substance use, denial, venting, self-blame, and behavioral disengagement) have been identified as strong predictors of suicidal behavior. While loneliness and coping strategies have been individually examined as predictors of suicidal behavior, they have not been examined in combination. Thus, the present study aims to examine loneliness as a predictor of suicidal behavior when coping strategies are accounted for in a sample of 204 female American college students. Suicidal Behaviors Questionnaire-Revised, Revised UCLA Loneliness Scale, and Brief COPE are used to measure suicidal behaviors, loneliness, and coping strategies respectively. Results show that loneliness and maladaptive coping strategies are significantly and positively correlated with suicidal behavior. When demographics are accounted for, results from a hierarchical regression analysis indicate that loneliness accounts for a small to medium 8% of additional unique variance in suicidal behavior, $F(1, 186) = 22.36$, $p < .001$, beyond a large ($f 2 = .35$) 26% of additional unique variance in suicidal behavior accounted for by coping strategies, $F(14, 187) = 4.68$, $p < .001$. The total prediction model accounts for a large ($f 2 = .52$) 34% of the variance in suicidal behavior, $F(17, 186) = 5.62$, $p < .001$. These novel results suggest that loneliness may be a better predictor of suicidal behavior than coping strategies, emphasizing the importance of both mitigating loneliness and promoting the use of effective coping strategies in young, at-risk adults.

Poster 7

Presenter: Caroline Kelly

Advisor: Sandra Momper (Social Work)

Analyzing Cultural and Linguistic Competency in Twelve Mental Health Agencies in Wayne County

This study examined the comments of the parents/caregivers who completed the Cultural and Linguistic Competency (CLC) Assessment survey distributed at twelve mental health agencies in Wayne County, Michigan. The study participants (N=348) completed a paper-based survey, answering the two comment sections. The two comment sections asked them about the quality of care that they received at their child's mental health agency. The research team hypothesized that the cultural competency of services could be improved, consistent with recent research studies on cultural and linguistic competency at mental health agencies. Through analyzing qualitative survey data, the research team found both strengths that agencies have and challenges that agencies face in providing culturally and linguistically competent

care. This study seeks to examine self-identified needs of parents/caregivers, such as the need for more translators, and pathways that improve the quality of mental health care clients receive.

Poster 8

Presenter: Jacob Florian

Advisor: Bryan Goldsmith (Chemical Engineering)

Probing the V^{2+}/V^{3+} Redox Reaction at Electrified Interfaces for Vanadium Redox Flow Batteries

We are investigating the V^{2+}/V^{3+}+ reaction mechanism for application in aqueous Vanadium Redox Flow Batteries (VRFB). The UV-Vis spectra of Vanadium-Chloride and Vanadium-Sulfate complexes are computed and compared to experimental spectra to determine the complex formed under different conditions. Exchange current density experiments are performed on different electrocatalyst surfaces in order to determine rates of reaction and correlate them to H adsorption energies, with the goal of designing an electrocatalyst to improve VRFB efficiency.

Poster 9

Presenter: Ajay Prasad

Advisor: Ayyalusamy Ramamoorthy (Chemistry)

High Throughput Screen Reveals Unique Chemical Structures that Influence Aβ Aggregation in Drastically Different Ways

Protein misfolding has been linked to numerous diseases throughout the years, with some of the most prevalent being Alzheimer's and type II diabetes. In this research, we analyzed the misfolding of the amyloid beta (Aβ) protein – which is linked to Alzheimer's disease. Small molecules have been known to play a role in the disruption of aggregation of Aβ, effectively decreasing the amount of Aβ fibers created, that may eventually block neuronal signals. Aβ is known to interact with lipid membranes including cell membranes which can act as a nucleus and catalyze the aggregation. In this study, we began with a high throughput screen of 2500 compounds and narrowed this down to a more specific, 21 compound list. Through the use of a fluorescence-based assay, we worked to determine which compounds contribute the most in inhibiting the protein aggregation. We studied the morphology of the aggregates using Transmission Electron Microscopy (TEM), Western Blotting, and cell toxicity tests. At the moment, we were able to narrow the number of viable compounds down to sixteen, which will undergo further tests at different concentrations to narrow it down even more. The impact of this research is two-fold. Primarily, this research allows us to determine what kind of chemical scaffolds contribute to Aβ modulation in the presence of a membrane. Second, this study will allow future research to more accurately predict the qualities needed to find other compounds that can achieve the same task more efficiently.

Poster 10

Presenter: Natalie McMyn

Advisor: Yoichi Osawa (Pharmacology)

Identification of Ubiquitination Sites on Nitric Oxide Synthase

Nitric oxide synthase (NOS) is an enzyme that catalyzes the synthesis of nitric oxide, an important cell signaling molecule. The three isoforms of NOS are neuronal (nNOS), endothelial (eNOS), and inducible (iNOS), which function in the nervous, cardiovascular, and immune systems, respectively. However, dysregulation of NO can contribute to diseases, including septic shock. Therefore, NO production is tightly controlled by many factors. For example, the Hsp90/Hsp70-based chaperone system regulates NOS ubiquitination and proteasomal degradation. Hsp90 stabilizes NOS and prevents ubiquitination, while Hsp70 promotes CHIP-dependent ubiquitination and subsequent proteasomal degradation. CHIP (C terminus of Hsp70 interacting protein) is an E3 ligase that, in conjunction with E1 activating and E2 conjugating enzymes, ubiquitinates proteins targeted by Hsp70. We plan to identify the ubiquitination site on all three NOS isoforms, starting with nNOS. Ubiquitinated nNOS was generated in an in vitro ubiquitination reaction containing nNOS, Hsp70, CHIP, E1, E2, and His-tagged ubiquitin. To isolate ubiquitinated nNOS, the reaction was filtered by size and then ubiquitinated nNOS was pulled down with nickel magnetic beads. The His-tagged ubiquitin nNOS conjugates were eluted with imidazole, digested with trypsin, and will be analyzed by nano-LC/MS/MS for the additional mass of two lysine amino acids that signify modification by ubiquitin. Determining the location of ubiquitination on NOS will be beneficial in understanding how the Hsp70/CHIP chaperone machinery impacts NOS recognition, ubiquitination, and degradation.

Poster 12

Presenter: Lauren Dougherty

Advisor: Steven P. Broglio (Kinesiology)

Long Term Effects of Concussion on Eye Tracking Patterns

Purpose: The purpose of this study is to investigate long-term changes in eye-tracking patterns in previously concussed individuals (>1-year post-injury) compared to non-concussed controls.
Methods: This case control study will include 40 total participants, but currently includes 12 participants with (n=5 concussed, 3.00±1.79 concussions, 4.92±2.43 years post-injury, 22.80+2.23 years, 170.18+6.62 cm, 71.49+9.19 kg) and without (n=7; 27.00+4.96 years, 177.8+9.40 cm, 77.69+12.83 kg) a concussion history were evaluated. Participants were excluded if they only had a previously undiagnosed concussion, were currently playing contact sports, did not have normal or corrected to normal vision without glasses. Participants completed two eye-tracking tasks: an anti-saccade task consisting of 5 test blocks, 40 trials each and a circle tracking task consisting of 3 trials. The anti-saccade task measured saccadic and anti-saccadic movements, while the circle tracking task measured smooth pursuit eye movements. In both groups, results were analyzed using independent T-tests.

Results: The mean reaction and processing times in the saccade task in formerly concussed subjects was significantly different from controls ($p=0.02$ and $p<0.01$). The control group had a 7.41% slower reaction time and 12.64% slower processing time than the concussed group. Other anti-saccade task variables (i.e. movement time, number of correct saccades, number of trials where saccade ended outside of the target zone, percent of accurate saccades, distance from target block, distance from target block for correct trials) and circle tracking (i.e. horizontal root mean squared error (RMSE), vertical RMSE, horizontal delay, mean vertical delay) were not significant ($p's>0.05$).

Conclusions: Counter to work on the acute effects of concussion, the preliminary findings of this study indicate that concussion may not have a long-term effect on eye-tracking reaction and processing time. Additional work in this area with larger samples is warranted.

Poster 13

Presenter: Matthew See
Advisor: Amy Cohn (Industrial & Operations Engineering)
An Adaptable Approach to Improve Chemotherapy Pre-mix Policies

Patients at an outpatient chemotherapy infusion center often go through long processes due to the complexity of their treatment. A significant portion of this process is waiting for their chemotherapy drugs to be prepared, a step typically initiated after a patient arrives at the infusion center and is deemed fit for treatment. Consequently, most drugs are not made ahead due to their short shelf life, high cost, and the chance a patient will not meet treatment requirements upon arrival (i.e. defer treatment) which would cause their made-ahead drug to be wasted. However, the reward of making drugs ahead may outweigh the risk since extended waiting times translate to increased staff overtime and patient dissatisfaction. In collaboration with the University of Michigan Rogel Cancer Center (UMRCC), we present a data-driven approach to determine a make-ahead chemotherapy drug policy which considers demand variability by day of week, drug cost, and drug preparation time. We show that our method decreases patient waiting times and waste costs compared to the current make-ahead policy for chemotherapy drugs at UMRCC.

Poster 14

Presenter: Olivia Chan
Advisor: Ursula Jakob (Molecular, Cellular, and Developmental Biology)
Functionalization of Get3 Protein and its Mammalian Homolog TRC40

Get3, a zinc-binding ATPase with four conserved cysteine residues, is a central role in the Guided Entry of Tail-anchored proteins (GET) pathway in yeast. Under reducing conditions, it binds to the transmembrane domains of tail-anchored (TA) proteins designated for the secretory pathway and mediates them to the Get1/2 receptors at the endoplasmic reticulum membrane. Under oxidizing conditions, Get3 becomes an efficient ATP-independent chaperone, protecting unfolded proteins from aggregation. Oxidation causes disulfide bond formation, zinc release, and formation of higher oligomeric structures, which all lead to activation of the chaperone function and loss of ATPase activity. Characterizing these functions, as well as study the response and activity of Get3, is significant to compare the mammalian homolog of Get3, TRC40, in HeLa cells. TRC40, also widely known as Asna1, is observed to yield similar patterns as yeast Get3 under stress conditions.

Poster 15

Presenter: Mason Faculak
Advisor: John Wolfe (Chemistry)
Palladium-Catalyzed Alkene Diamination Reactions of Amides

Pharmaceutical companies are always looking for ways to synthesize drugs more efficiently by using less steps. This reduces the time and cost of producing medicine. The goal of this research project is to produce 2 new carbon nitrogen bonds and close a heterocycle with stereo-selectivity in one step. This research project involves adapting an amino-palladation reaction, that has been to know to work previously on analogous ureas and guanidines, to work without the extra nitrogen beta to the amide. In order to accomplish this, various reaction conditions that involve various bases, ligands, palladium sources and solvents are being screened to observe a change in yield. Without the beta nitrogen of the urea and guanidine, the electronics of the substrate are changed significantly so the substituents of the amide are also being varied to observe changes in yield. Past research in the Wolfe group showed that the the amino-palladation reaction can yield very stereo-selective products unlike the analogous copper catalyzed reactions that undergo radical chemistry during their mechanisms. The ultimate goal of this research project is to discover reactions that perform multiple changes to a molecule in one step to produce biologically active small molecules.

Poster 16

Presenter: Max Howarth

Advisor: C. David Remy and Brent Gillespie (Mechanical Engineering)

Broadening Soft Pneumatic Gripper Adjustability

Soft robotic grippers made from soft and/or compliant materials can passively adapt their shape to grasp objects, but they lack the adjustability required to grip objects that differ greatly in shape and size. Increasing the number of controllable degrees of actuation can potentially broaden the variety of items a gripper can hold onto. To that end, aided by rapid prototyping, silicon and fiber reinforced elastomeric grippers were developed in a variety of sizes, shapes, and configurations to explore the advantages and disadvantages of each. Then, more advanced soft grippers with individually controllable joints were fabricated to generate more complex and customizable grasping motions. Preliminary experiments suggest that these grippers are capable of grasping a wider variety of objects than those without joints. Future work will include further assessing the effectiveness of such grippers in grasping objects of varying shapes and sizes.

Poster 17

Presenter: Sanika Kulkarni

Advisor: Susan Gelman (Psychology)

Children's Inferences about Digital Tracking as a Result of Ingroup and Outgroup Differentiation

Over the past few decades, a "digital revolution" has created widespread access to technology in society. While recent studies have shown that adults may express concern over the digital privacy implications of current technology use, there has been little research on children's understanding of this same issue. In the present study, 92 children (five- to 16-year-olds) and 40 adults (18- to 22-year-olds) were asked whether it was acceptable for one member of a novel group ("Hibbles" or "Glerks") to use a mobile GPS device to track an object belonging to another member of the same (ingroup) or opposite (outgroup) group. Participants' average response to outgroup tracking was more negative than their response to ingroup tracking, and they viewed tracking of themselves to be more negative than tracking of others.

Additionally, older participants were less accepting of mobile GPS tracking compared to younger participants. The varying level of moral judgments towards digital tracking at different ages has profound implications for understanding the development of digital privacy conceptualization in children, and can shape decisions made regarding children's digital security in the future.

Poster 18

Presenter: Kate Blumenstein
Advisor: Hayley McLoughlin (Neurology)

Longitudinal Characterization of the Spinocerebellar Ataxia Type 3 Mouse Model Transcriptome

Spinocerebellar Ataxia Type 3 (SCA3) is the most common dominantly inherited ataxia. The polyglutamine expansion repeat in the ATXN3 gene encodes a toxic mutant ATXN3 protein that ultimately leads to neurodegeneration. There is currently no effective treatment for this disease. Contributions of altered gene expression to SCA3 pathogenesis have been recognized. However, these studies lack a crucial component: genome profiling over time. Longitudinal assessment allows us to view disease progression at the molecular level, from which we can propose mechanisms of disease. In our study, we compared a transgenic SCA3 mouse model possessing the full-length human mutant ATXN3 gene to wildtype littermates. Through RNA sequencing, we longitudinally characterized the transcriptome during early-, mid-, and late-stage of disease in two highly affected brain regions, the cerebellum and brainstem. Our findings revealed differential gene expression that exacerbates throughout disease progression, with the brainstem being more affected. RNA sequencing identified 37 and 5 differentially expressed (DE) genes shared among all three timepoints in the brainstem and cerebellum respectively. RNA sequencing also identified 228 and 12 DE genes that were significantly different only in the two latter age groups in the brainstem and cerebellum respectively. We are currently applying Weighted Gene Co-expression Network Analysis (WGCNA) to categorize gene sets that significantly correlate over time and are using ingenuity pathway analysis (IPA) to associate biological meaning. Our study concludes the first longitudinal genome profiling in this SCA3 model and will aid us in identifying cellular pathways that may drive pathogenesis as well as disease biomarkers.

Poster 19

Presenter: Jordan Goodman
Advisor: April Maa (Industrial & Operations Engineering)

Improving Veteran Access to Eye Care Using Facility Location Models

Access to healthcare is a major public health issue in the United States, including among veteran populations. Eye care is particularly challenging for veterans to access due to limited providers and high disease prevalence in veterans. The Veterans Health Affairs (VA) in Georgia is expanding eye care screening availability by supplementing existing providers with highly-trained technicians. In collaboration with clinical collaborators, we implement a mixed integer program facility location model to guide the Georgia VA decision-making on where to open eye care clinics and how to staff each clinic. Staffing options include ophthalmologists, optometrists, and technicians. We evaluate a series of models with different objectives, including minimizing cost to the system, minimizing the distance patients travel, and maximizing appointment slot utilization. Our models indicate where to open clinics within the

Georgia VA and how to staff each clinic based on each model's objective. Across the different objectives, our models yield similar clinic opening/staffing decisions, indicating that such decisions are not only helpful to the system (through minimizing cost) but to patients as well (through minimizing distance traveled and maximizing patients who are able to be seen). This work provides the Georgia VA with knowledge to guide decision-making and can be extended to other VA locations. Further, we are working to generalize this model to accommodate other applications so that additional questions related to healthcare access policy can be more comprehensively evaluated.

Poster 20

Presenter: Anne Fitzpatrick

Advisor: Huda Akil (Molecular and Behavioral Neuroscience Institute)

Elucidating the Behavioral and Neuroendocrine Profile of Mice Undergoing Chronic Social Defeat Stress

According to the National Institute of Mental Health, an estimated 10.3 million U.S. adults aged 18 or older had at least one major depressive episode with severe impairment. Stress and its propensity to manifest mood disorders is known to have major effects on future emotional reactivities. Understanding the behavioral profile as to when these differences arise due to environmental stress is key in uncovering how these manifestations arise. Using chronic social defeat stress as a mouse model of adaptive and maladaptive coping, we were able to uncover individual variation in active and passive coping mechanisms that occur during the 10 day paradigm. Moreover, we were able to define the behavioral profile using downstream readouts such as open field, forced swim test, and social interaction to truly capture the variation in phenotype. Preliminary findings indicate that neuroendocrine levels of corticosterone, in response to a social stressor, is differentially regulated and correlated with the overall behavioral phenotype that arises. Going forward, we will be looking at brain-wide activity patterns in previously defined social and stress circuitry to determine neuronal differences in the adaptive and maladaptive traits in the stressed mice.

Poster 21

Presenter: Alexandra Tretyakova

Advisor: Christine Freeman (Pulmonary Function)

Immune Consequences of Pre-natal Smoke Exposure

Maternal smoking during pregnancy is linked to a variety of adverse outcomes involving respiratory health, including small airway dysfunction, wheezing, asthma, increased respiratory infections, and decreased pulmonary function. Surprisingly, little is known about how in-utero smoke exposure alters the immune system of the offspring. To address this knowledge gap, our laboratory has developed a murine model of prenatal cigarette smoke (CS) exposure. Briefly, female C57BL/6 mice were exposed to either CS or air (one hour/day, five days/week) for four weeks prior to breeding. Exposure was continued throughout gestation but halted once pups are born. Pups were used for experiments at 4 weeks of age. We used flow cytometry to characterize lung immune cell populations. We also used a portion of the lung to isolate DX5+ NK cells and CD326+ epithelial cells via immunomagnetic bead separation. We co-cultured NK cells and epithelial cells for 4 hours, then assayed epithelial cell apoptosis using Annexin-V

plus 7-AAD staining. We found that pups exposed to prenatal CS had increased proportions of lung NK cells and dendritic cells, but there were no differences in the other cell types. Furthermore, lung NK cells from CS-exposed pups were significantly more cytotoxic towards their own lung epithelial cells than NK cells from air-exposed pups. This suggests that CS exposure in utero increases lung NK cytotoxicity, even without additional CS exposure, and this can be seen up to 4 weeks of age. Changes to NK cell function could have impacts on long-term respiratory health.

Poster 22

Presenter: Jiaheng He

Advisor: Rachel Goldman (Material Science Engineering)

Identifying Defects and their Electronic Signatures in Regrown GaN Heterostructures

Although silicon-based electronics are used to power light-emitting diodes and electric vehicles, their utility in high power applications is limited by a low breakdown voltage. The most promising alternative power devices consist of vertical GaN devices, which often require regrown active regions. Thus, advances in high power device performance require a detailed understanding of the influence of regrowth processing steps on interfacial defects and their electronic signatures. In this work, we examine a series of GaN p-i-n structures prepared with and without ex-situ ambient exposure and/or chemical etching. To quantify the concentration of various native and extrinsic point defects, we utilize a combination of ion beam analyses in conjunction with x-ray diffraction. For all samples, channeling Rutherford backscattering spectroscopy data reveals minimum yield values < 2%, with displaced atom densities ranging from 0.1 to 4 x 10^20/cm^3. Elastic Recoil Detection Analysis (ERDA) data reveals enhanced [H] near the surfaces of all samples, along with enhanced [H] at the etched/regrown interface. For all samples, cathodoluminescence spectroscopy reveals the GaN near-bandedge and donor-acceptor pair luminescence. For all samples, GaN near-band-edge emission at 3.35 eV and donor-acceptor pair (DAP) emission at 2.85 eV are apparent. Among all samples, "in-situ" exhibits the most intense DAP emission, which indicates the highest amount of Mg in the sample. Meanwhile, the yellow luminescence (YL) at 2.19 eV is only observed in “ex-situ” and “etched/regrowth”, while the infrared luminescence (IRL) at 1.47eV is only observed in “in-situ”.

Poster 23

Presenter: Michael Kalmus

Advisor: Shawn Murphy (Center for Healthcare Engineering and Patient Safety & Michigan Medicine Central Sterile Processing)

Analyzing Surgical Instrument Cleanability to Improve Patient Safety

Proper decontamination and assembly of surgical instruments are essential to maintaining efficient hospital operations and ensuring patient safety. To minimize patient harm and reduce surgical delays, sterile processing units must provide properly decontaminated and assembled instruments to the operating room in a timely fashion. As such, healthcare facilities should consider the complexity and difficulty of instrument cleaning (or “cleanability”) when purchasing surgical instruments. More complex instruments can lead to longer cleaning times, require greater effort in removing bioburden, and increase the likelihood of residual bioburden after cleaning.

A cleanability ranking based on instrument features (e.g., lumens, hinges, grooves) was created. Experiments were conducted to determine the time required to clean these various instrument features by decontamination technicians having varying experience levels. This data is being used to develop a model to predict instrument and instrument set cleaning difficulty and time. The Cleanabilty Index (CI) will enable Central Sterile Processing Department (CSPD) management to more accurately predict and staff for the department's workload. The CI will be embedded within an electronic dashboard shared with CSPD management and operating room service leads to assess reprocessing difficulty, facilitate creating and/or modifying instrument sets to better balance workload, and staff the department according to daily predicted demand.

Poster 24

Presenter: Jessica Jana

Advisor: Sunitha Nagrath (Chemical Engineering)

Detecting Ferroptotic Death in Lung Cancer Cells

Lung cancer is the second most common cancer and the leading cause of cancer related deaths with non-small cell lung cancer (NSCLC) making up for approximately 80% of those cases. Recently, radiation oncology researchers have found a link between the radiation treatment of lung cancer tumors and ferroptosis, a non-apoptotic, iron-dependent form of cell death resulting from a buildup of reactive oxidative species. An understanding of the link between radiation therapy and ferroptotic cell death in lung cancer could allow for the manipulation of radiation treatment to optimize tumor control. The first step toward improving radiation treatment is optimizing the way we detect and study ferroptotic death in lung cancer. This optimization involves two key chemicals: erastin, a ferroptosis inducing molecule, and C11-BODIPY, a fluorescent probe which shifts from red to green as a result of oxidation, which can effectively detect ferroptosis. We use HT1080, a cell line particularly susceptible to erastin-induced ferroptosis, to optimize monitoring and identify the red-green shift that indicates ferroptotic death using fluorescent microscopy instead of standard flow cytometry. These optimized parameters will allow us to next use radiated patient circulating tumor cells isolated from the blood stream using the Nagrath Lab's microfluidic sorting device, the Labyrinth. Further testing will allow a comparison between ferroptosis in radiated patient circulating lung tumor cells and in erastin induced ferroptotic lung tumor cells. Similarity between radiated and erastin treated cells will prove a link between radiation and ferroptosis and allow for radiation treatment optimization to improve tumor treatment.

Poster 25

Presenter: Kaitlin McKernan

Advisor: Kanakadurga Singer (Pediatrics and Communicable Disease)

TLR4 Mediates Inflammatory Responses to Diet-Induced Obesity and Free Fatty Acid Release in Adipose Tissue

Obesity-induced chronic inflammation is associated with a variety of metabolic complications such as insulin resistance, type 2 diabetes, and cardiovascular diseases. Obesity is characterized by adipose tissue (AT) expansion, AT macrophage accumulation, and an increase in inflammatory cytokine circulation. Toll-Like Receptor 4 (TLR4), which recognizes lipopolysaccharide (LPS) and plays a critical role in

innate immunity, has been shown to be involved in promoting inflammation and metabolic dysfunction in obesity. Our lab has demonstrated using reciprocal bone marrow transplants between WT and Tlr4 -/- mice that high fat diet (HFD)-induced TLR4 activation leads to an increase in inflammatory CD11c + AT macrophages. Recent findings have demonstrated that free fatty acids (FFAs) likely bind to TLR4, but results have been contradictory, and the cell type-specific effects of TLR4 have yet to be fully understood. In this present study, we evaluate adipocyte effects of TLR4. WT and Tlr4 - /- ear mesenchymal stem cells (EMSC)-derived adipocytes were evaluated for stimulatory and adipogenic responses to LPS and palmitate, and bone marrow dendritic cells (BMDCs) were assessed for inflammatory responses to EMSC conditioned media. LPS and palmitate-stimulated EMSCs demonstrated impaired adipogenesis and inflammatory signaling. BMDCs stimulated with WT conditioned media are expected to express higher levels of inflammatory cytokines. Induced lipolysis experiments in WT and Tlr4 -/- mice promoted macrophage accumulation in WT but not in Tlr4 -/- gonadal white adipose tissue (GWAT), suggesting that TLR4 plays a role in the inflammatory response to the rapid release of FFA. Our findings suggest that TLR4 promotes AT inflammation in response to FFAs.

Poster 26

Presenter: Teona Velehorschi

Advisor: Darwin Guevarra (Psychology)

Emotional influences of knowing when an unpleasant experience ends

Distressing situations are inevitable and psychological research has tested different interventions to regulate or minimize people's emotional distress. However, these strategies tend to be cognitively demanding and may not work for most people who are unable to exert the right amount of cognitive effort to regulate their distress. To examine effortless alternatives, we tested an easily implementable strategy on two distressing tasks: a 2-minute cold-pressor task and a 15-minute unpleasant image viewing task. We randomly assigned female participants into two groups. The known duration group was informed about the true duration of the tasks, while those in the unknown duration group were told that the amount of time for each task was uncertain. For the cold-pressor task, we find that participants reported less pain in the known duration group compared to the unknown duration group. However, for the image-viewing task, we find that there was no difference in participant's reporting of unpleasantness between groups. It appears that our easily implemented time-cognition strategy may work for certain distressing events and not others. Future research is needed to explore for what types of situations this intervention may or may not be effective.

Poster 27

Presenter: Megan Ann Mitchell

Advisor: Alvaro Rojas-Pena (Psychology)

Extracorporeal Cardiopulmonary Resuscitation After Prolonged Cardiac Arrest: Role of Somatosensory Evoked Potentials to Predict Neurological Outcomes in a Porcine Model

Out-of-hospital cardiac arrest (OHCA) is the leading cause of mortality on a global scale, with devastating consequences for both the patient and their family. Despite the high incidence of these events, neurological outcomes remain poor for the majority of patients. As a result, extracorporeal

cardiopulmonary resuscitation (ECPR) by means of percutaneous veno-arterial extracorporeal membrane oxygenation (ECMO) is rapidly emerging as both a feasible and effective resuscitation strategy for OHCA patients failing standard resuscitation efforts. However, neurological outcomes remain poor for survivors of ECPR due to a loss of microcirculation resulting from the no-reflow phenomenon, which manifests during reperfusion following cerebral ischemia. The present study analyzes the effectiveness of incorporating ECPR into an OHCA model with the dual employment of anticoagulant and thrombolytic therapy targeted at breaking clots in cerebral microcirculation to resolve the no-reflow phenomenon, achieve a return of spontaneous circulation (ROSC), and ultimately achieve good neurological outcomes. To analyze neurological outcomes, somatosensory evoked potentials (SSEPs) were used to document the brain's relay responses to the brain regarding sensation.

Poster 28

Presenter: Mia Gregory

Advisor: Patrick Schloss (Microbiology and Immunology)

Assessing Bias in Alpha Diversity

Microbiota studies have found differences in alpha diversity, or within-sample species diversity, however differences vary between laboratories due to the use of various primers, preservation media and extraction kits. These differences can be seen in the results of 16S rRNA gene amplification, a technique used to analyze the microbiota. This study aimed to assess differences detected in three widely used DNA extraction kits, and from five popular preservation medias. An alpha diversity analysis was conducted to identify differences between DNA extraction kits and preservation methods in regards to SOBS or observed counts of different species (OTUs); Shannon evenness, which refers to how close species are in a given environment; and Shannon diversity, which includes species richness and evenness to create a diversity metric. The extraction kits used were Qiagen Power Microbiome, ZymoBIOMICS DNA Kit, and Qiagen Powersoil. The preservation methods used included fresh fecal samples stored at room temperature with no additional preservations; samples stored at a temperature of -80°C for a week; samples stored at room temperature with OMNIgene gut; and samples stored at room temperature with Zymo DNA/RNA shield. Kruskal-Wallis tests in R were utilized to compare DNA extraction kits within preservation methods, as well as between preservation methods within DNA extraction kits. For all Kruskal-Wallis tests performed there were no differences found (p-values > 0.05). Given the results of the Kruskal-Wallis tests, we conclude that any differences created by the various extraction kits and preservation methods are minimal. Statistical tests at a higher power should be performed.

POSTER SESSION D

2:00 - 3:00 PM

Poster 1

Presenter: Sarah VanDiepenbos

Advisor: Gyorgyi Csankovszki (Molecular, Cellular, and Developmental Biology)

Heterochromatin Anchoring and Male Rescue in the HPL-1;HPL-2 Double Mutants of C. elegans

Many species have a sex chromosomes imbalance that must be corrected for proper gene expression to occur. The mechanism used to regulate X chromosome expression is called dosage compensation. In C. elegans, the Dosage Compensation Complex (DCC) represses both hermaphrodite X chromosomes by half. The mechanism of how the X chromosomes is repressed via binding to the nuclear lamina requires further investigation to understand the role of each protein in this pathway. By mutating two heterochromatin proteins (HPL-1 and HPL-2), our lab discovered an overlap in function that cannot be recovered in hpl-2;hpl-1 double mutants, leading to decondensation of the X chromosome. This expansion in X chromosome volume may lead to a change in gene expression in the hermaphrodites and could be indicative of a mechanism to regulate gene expression in other organisms that also undergo dosage compensation.

Poster 2

Presenter: Aprill Park (Psychology)

Examination of the Association Between Loneliness and Depressive Symptoms After Accounting for Coping Strategies

Studies have indicated that loneliness, the perception of social isolation or disconnectedness from others (Russell, Peplau, & Cutrona, 1980), is significantly and positively correlated with negative psychological health outcomes (e.g., depressive symptoms; Chang, 2017) in college students. To date, the mechanism associating loneliness and depressive symptoms remains unknown. Coping, the process individuals engage in to minimize stress when they encounter challenging situations (Lazarus & Folkman, 1984), stands as a potential mediator of this association. The present study assessed whether engaged and disengaged coping strategies (measured by Coping Strategies Inventory; Tobin et al., 1989) mediate the association between loneliness (measured by Revised-UCLA Loneliness Scale; Russell et al., 1980) and depressive symptoms (measured by Beck Depression Inventory-II; Beck, Steer, & Brown, 1996) in 364 Spanish college students. A multiple mediation analysis found that a portion of the association between loneliness and depressive symptoms can be accounted for by engaged coping strategies (viz., problem solving & cognitive restructuring; indirect effects, $p < .05$) and disengaged coping strategies (viz., problem avoidance, wishful thinking, & self-criticism; indirect effects, $p < .05$). The association between loneliness and depressive symptoms was significant before ($\beta = .40$, $p < .001$) and after incorporating coping ($\beta = .32$, $p < .001$). Additionally, the total prediction model accounted for a large ($f2 = .64$) 39.2% of the variance in depressive symptoms. Overall, these findings highlight the importance of reducing depressive symptoms in Spanish college students by mitigating loneliness, improving engaged coping strategies, and avoiding disengaged coping strategies (Garcia-Alberca et al., 2012; Tobin et al., 1989).

Poster 3

Presenter: Alexandra Baum

Advisor: Kent Berridge (Biopsychology)

Distant Fos activation following corticotropin releasing factor neuron stimulation

Corticotropin releasing factor (CRF) is a stress-related molecule that is released in the brain in response to external stressors, and is associated with negative states of fear, stress, and anxiety. However, some research shows that CRF may also have positive motivational effects as well. In my thesis research under Hannah Baumgartner and Dr. Kent Berridge, I am focusing on answering the question of how CRF-containing circuits may differ for positive vs. negative motivational effects, by examining where distant Fos levels changes following optogenetic stimulation of the Central Amygdala, Nucleus Accumbens, orBed Nucleus of the Stria Terminalis. This will answer neuroscience questions regarding CRF brain circuits, and how certain circuits may be more involved in either positive or negative motivation. We hypothesize that distant Fos activation will differ based on the area being stimulated. Mapping these Fos activation patterns will tell us about overall circuits in the brain that are enhancing or suppressing motivation. If distant Fos activation differs between these 3 brain target areas following CRF neuron stimulation, this would help to explain differences in behavior because the circuits are acting in different ways.

Poster 4

Presenter: Jeremy Tervo

Advisor: Ursula Jakob (Biological Chemistry and Molecular, Cellular, and Developmental Biology)

Characterizing Polyphosphate's Role in Mitigating Oligomerization of Amyloidogenic Proteins

Polyphosphate (polyP) is an inorganic molecule of repeating, covalent phosphate linkages vital in stabilizing protein β-sheet structures. PolyP is a critical molecule in affecting cellular responses from affecting blood clotting to modulating mTOR signaling in bacteria. Recently, progress was made in elucidating polyP's role as a neurofibrillary stabilizing agent for amyloidogenic proteins like Amyloid-β (Alzheimer's) and α-Synuclein (Parkinson's); however, its interactions with distinct macromolecules require further study both in vivo and in vitro to understand polyP's dynamics and where it aggregates in cerebral tissue. To identify polyP's molecular binding characteristics in vivo, we extracted DNA, RNA, and Protein layers from human cadaver cerebellum. We detected polyP from each layer through cleaving the chain into individual phosphates with both endo- and exopolyphosphates where the individual phosphates then interact with molybdate and stain blue to be imaged with a spectrophotometer. Fluorescence imaging of polyP in mouse brains was accomplished with immunohistochemical tags at neuronal nuclei and DAPI staining of polyP. Through use of protein spectrophotometry and fluorescence imaging, it appears that most intracellular polyP is protein-bound after extraction from Alzheimer's positive cadavers and its presence correlates with limbic structures in mouse brains. In mice, aggregation of polyP around the hippocampus is a lead in explaining its role of stabilizing amyloidogenic proteins responsible for common symptoms of neurodegenerative disease (e.g. memory loss). If most polyP is associated with protein in Alzheimer's positive cadavers, this may explain why less free polyP to mitigate detrimental coordination of amyloidogenic proteins is present in Alzheimer's patients.

Poster 6

Presenter: Colleen Hadley

Advisor: Roger Cone (College of Literature, Science, and the Arts and Life Sciences Institute)

Effect of HDAC6 Inhibition on Energy Homeostasis

Overweight and obesity are global concerns affecting nearly 1.2 billion people. With numerous comorbidities associated with the condition, including diabetes and cardiovascular disease, clinical treatments for obesity are of great need. Histone deacetylase 6 (HDAC6) is a cytosolic deacetylase and a major regulator of protein homeostasis. HDAC6 regulates aggresome and stress granule formation, autophagy, heat shock response, and recycling of dysfunctional mitochondria through mitophagy. However, the role of HDAC6 in regulating energy homeostasis is unclear. Here, we tested the effect of long-term treatment of young WT mice with Tubastatin A, a small molecule HDAC6 specific inhibitor. Our results show that Tubastatin A confers protection from the development of high fat diet-induced obesity, primarily by suppressing food intake. Tubastatin A treatment improves glucose homeostasis, and induces a gene expression profile indicative of beiging/browning in the adipose tissue explants. These results suggest HDAC6 inhibitors as potential anti-obesity agents.

Poster 7

Presenter: Abhisek Pusty

Advisor: Joseph Feldblum (Anthropology)

Relationship Between Male Chimpanzee Cohesion and Aggression

Many group-living primates form dominance hierarchies, which are often mediated by aggression. Studies of male primates in the wild find that during periods of dominance stability, a high dominance rank is not associated with a high frequency of aggression, whereas during periods of dominance instability, the male primates that are the most dominant are found to also exhibit the highest rates of aggression. However, in chimpanzees, high-ranking males consistently maintain high rates of aggression regardless of whether or not the hierarchy is stable. We are testing the hypothesis that this unusual relationship between dominance rank and aggression is due to the "fission-fusion" social organization of chimpanzees, whereby individuals tend to travel in small foraging parties that change frequently over the course of a day. Due to the variability of males being exposed to each other, dominance may need to be reinforced more often. Using nineteen years of data from Gombe National Park, Tanzania, we generated measures of male cohesion and aggression rates, and analyzed the relationship between cohesion and aggression rates, accounting for changes in season and other confounding factors. These results will shed light on the relationship between social structure and competition in our closest living relative.

Poster 8

Presenter: Vinayak Ahluwalia

Advisor: Brian Denton (Industrial & Operations Engineering)

Stochastic Optimization Algorithms for Robust Medical Decision-Making

Healthcare is increasingly reliant on mathematical models, such as Markov Decision Processes, to monitor disease progression and improve patient care. To address the abundance of parameter ambiguity from clinical data, the Multi-Model Markov Decision Process (MMDP) was invented. We designed a custom branch-and-bound algorithm to solve large, practical MMDPs that was orders of magnitude faster than commercial mixed-integer programming software, for a set of test cases. In addition, we implemented various objective functions allowing for different risk preferences towards parameter ambiguity, which can lead to significantly different treatment policies. We present a relevant medical decision-making case study to illustrate our approach.

Poster 9

Presenter: Amos Nissley

Advisor: Sarah Keane (Chemistry and Biophysics)

Understanding the Mechanism of the prfA Thermosensor Through Biophysical Analysis

Non-coding RNAs (ones that do not code for proteins) have myriad important biological roles, including the regulation of gene expression. For example, the 5′ untranslated region (UTR) of some bacterial mRNAs can regulate downstream protein translation in a temperature-dependent manner. These RNA elements are known as RNA thermosensors (RNATs). In the bacteria listeria monocytogenes, there is a master regulatory protein, PrfA, that modulates the transcription of multiple virulence genes. Previous studies found that PrfA expression is controlled by the 5′ UTR of its mRNA, which serves as an RNAT responding to environmental temperature changes. Unlike other characterized thermosensors, the prfA thermosensor is highly responsive to temperature. Translation is turned on in response to a single degree Celsius temperature change – functioning like an on-off 'switch'. However, it is currently unclear how the prfA thermosensor modulates its structure to regulate protein expression. To investigate the temperature dependent structural changes within the prfA thermosensor, we have employed mutagenesis studies, circular dichroism (CD) spectroscopy, and nuclear magnetic resonance (NMR) spectroscopy. CD spectroscopy has allowed us to investigate the overall unfolding of prfA and its mutants while NMR allows us to monitor the structural change on a single residue basis. In addition to traditional biophysical NMR, we have also applied novel approaches, such as deuterium editing, to minimize the challenges associated with NMR spectroscopy of large biomolecules. By elucidating the structure of the prfA thermosensor and understanding its temperature dependent restructuring, we will be able to answer questions about its structure-function relationship.

Poster 10

Presenter: Lynn Eickholt

Advisor: Ioulia Kovelman (Psychology)

Functional Connectivity of the Visual Word Form Area

Learning to read requires children to develop an efficient neural network that connects brain regions implicated in visual processing, language processing, and attention. Prior work indicates that connectivity between these regions is higher in the earlier stages of reading. How might functional connectivity in beginning kindergarten readers predict future reading success? We hypothesize that stronger connectivity between visual processing regions and key language regions of the brain – namely the left superior temporal gyrus, left inferior parietal lobule, and left inferior frontal gyrus –will be associated with

concurrent reading ability, and may predict reading one year later. 48 kindergarteners (48% male; mean age = 5.74) completed a visual word processing task during fMRI neuroimaging and a reading task in the following year. PPI analyses suggest that children with better oral language and decoding ability show greater connectivity with left parietal language regions. This suggests that the connection between the VWFA and left IPL is significant in early reading development, particularly as children learn to integrate spoken and written language.

Poster 11

Presenter: Elizabeth Woelmer

Advisor: Suzanne Dawid (Pediatric Infectious Disease)

Characterizing the Role of the ami Permease and its Homologues aliA and aliB in Genetic Competence for Streptococcus pneumoniae

Streptococcus pneumoniae (pneumococcus) is a persistent cause of community-acquired pneumonia and meningitis. Pneumococcus has several adaptive abilities that have made many interventions ineffective due to acquisition of antibiotic resistance and vaccine escape. Adaptation occurs via horizontal gene transfer that is controlled by the competence system. The com system is primarily controlled by the release of Competence Stimulating Peptide (CSP) which is the signal that initiates competence. The Ami/Ali permease system is a highly conserved peptide importer that is involved in competence development through an unknown mechanism. I have made deletions in the genes encoding the importer and peptide binding proteins and have shown that deletion of the importer results in premature competence stimulation. Our hypothesis is that the Ami/Ali system normally functions to import CSP, thereby sequestering it from signaling competence activation. When ami is removed, the accumulation of extracellular CSP outside the cell stimulates competence earlier than when CSP is sequestered. To test this hypothesis, we are conducting luciferase assays with co-cultures of CSP secreting strains and Ami/Ali deletion strains with and without the ability to produce light when com is expressed. The experiment will allow us to observe the effect the non-luciferase strain has on the luciferase stain and will help us determine if com activation is influenced by the Ami/Ali permease when it is present on neighboring strains.

Poster 12

Presenter: Theodore Endresen

Advisor: Amy Cohn (Center for Healthcare Engineering and Patient Safety)

Using Integer Programming to Build Block Schedules for Medical Residents

The objective of this project is to formulate and implement an integer programming model that creates the yearlong schedules for medical residents across several residency programs at a large, educational hospital. The purpose of this project is to generate high quality yearlong residency schedules, thereby allowing the chief residents to spend their time on other important matters. The model utilizes a five-step iterative methodology to generate the yearlong residency schedules. First, team members meet with the chief residents to establish the rules that govern a feasible and high-quality schedule (typically service coverage, resident education, spacing, sequencing, and resident pairing requirements). Second, the team converts these written/verbal rules into integer programming rules. Third, we solve the resulting integer

programming model. Fourth, once a feasible solution has been generated, we begin to incorporate resident requests hierarchically. Fifth, we report the final schedule to the chief residents. They review the schedule, give us feedback, and we repeat our process iteratively until they are satisfied with the generated schedules. Using our integer programming model, we've been able to generate high quality yearlong residency schedules across multiple hospital departments. The model we've created is flexible and could be implemented in other departments and other hospitals. Audience members should takeaway that the use of operations research techniques can reduce the amount of time to construct complex schedules and improve their quality compared with making the schedules by hand.

Poster 13

Presenters: Mengmeng Chen, Jialin He, and Shihui Wang
Advisor: Sindhu Kutty (Electrical Engineering and Computer Science)
Non-Monetary Incentives in User-Generated Content Websites: a Simulation-Based Analysis

Many websites, including various knowledge-creation, news and educational sites, are driven by user-generated content. It is, therefore, important for these sites to have an effective mechanism to incentivize users to contribute. Non-monetary rewards, called badges, are a common way to recognize and encourage user contributions. There are multiple implementations of these badge mechanisms and it is an open research question on how to pick an optimal design. In this work, we build on existing game-theoretic analysis to study how limited bandwidth may influence the design of an effective badge mechanism. We simulate these models under various assumptions on user behavior and ability. This would provide an increased understanding of which mechanisms work best under different settings. A context-based badge design could increase user participation and thus increase the effectiveness of websites that depend on user-generated content.

Poster 14

Presenter: Justin Rogers
Advisor: Amy Cohn (Center for Healthcare Engineering & Patient Safety)
Optimizing Dermatology Resident Schedules Using a Computerized Decision Support Tool

Chief residents from the Department of Dermatology at Michigan Medicine must staff dermatology residents into half-day clinical activities for each weekday in a month-long planning horizon. The residents' assignments must adhere to educational requirements and staffing requirements must be met for each clinical activity. Additionally, residents should be given weekly administrative time, and their intra-day travel should be limited. Monthly schedules are too complex and time-consuming to create manually, so we develop a computerized decision-support tool to collaboratively assist the chief residents in building the monthly schedule. Use of the decision support tool dramatically improves the quality of the schedule and substantially reduces the time burden on the chief residents associated with building the monthly schedule, enabling them to focus more on meeting the needs of the residents whom they support, improving their training programs, and increasing the time available for their patient care, clinical training, and personal well-being. This project demonstrates both the complexities and challenges of implementing a personnel scheduling problem in a way that 1) adequately captures the detailed and nuanced requirements of the real-world environment; 2) is tractable and easy to use; and 3) can be

maintained and easily modified to adapt to new requirements. In addition, it provides a valuable opportunity for studying how decision makers address ill-defined objectives and make trade-offs between multiple objective criteria, and how decision-support tools can be designed to support this type of amorphous decision making.

Poster 15

Presenter: Ruchica Chandnani
Advisor: Muniba Saleem (Psychology and Communication Studies)

The Effects of How South Asian Women are Portrayed in American and South Asian Media

In American media, ethnic minorities are stereotyped alongside negative depictions of other identities, notably gender. However, it is unknown how the intersection between identities like ethnicity and gender influence communities within America. International media is more representative of their region's own ethnic groups, but gender portrayals are still distorted for reasons ranging from social customs to a lack of opportunity. This is especially prevalent in South Asian media, which entertains South Asians and non-South Asians worldwide but has multiple problems with characterizing women. This study utilizes survey methodology to examine fundamental processes that influence South Asian undergraduate women's self-concepts. It examines how consuming negative media portrayals of their own gender and ethnic identity can impact them psychologically and emotionally. This can show how mainstream and ethnic media portrayals on gender and ethnicity can affect ethnic pride, self-esteem, and enjoyment for the groups they are portraying. Results show negative portrayals of South Asian women inciting more anger and irritation from participants in both conditions. However, there is no significant evidence of less self-esteem or ethnic pride in either condition. While anger from participants could come these portrayals' inaccuracies, a lack of evidence for any effect on their pride needs more examination.

Poster 16

Presenter: Kyle Webster
Advisor: Xianzhe Jia (Climate and Space Sciences and Engineering)

Current Sheet Crossings in Saturn's Magnetosphere – Findings from Cassini

Saturn, like Earth, has an internal magnetic field that protects it from the solar wind and other radiation sources like galactic cosmic rays. Cassini's mission to Saturn gathered new and extensive data of Saturn's magnetosphere, the cavity that describes the magnetic field of Saturn out in space. Saturn's internal structure of the magnetosphere is complex and different from Earth's. This investigation uses almost 12 years of the Cassini mission time series to study the structure of Saturn's current sheet, an interesting internal structure of Saturn's magnetosphere. By using careful visual inspection techniques of the magnetic field from all of the years, this creates a catalog of events of when Cassini crossed the current sheet. From the results, the current sheet crossings vary spatially because they show a general dawn-dusk asymmetry and the current sheet crossings vary temporally as the seasons of Saturn change. The crossings also show periodic behavior as the current sheet oscillates up and down. These planetary period oscillations (PPO) have been previously found in Saturn's current sheet and inner magnetosphere. This catalog of crossings suggests that Saturn's current sheet changes temporally and spatially as expected, but might be tilted towards the dawn sector instead of being axisymmetric.

Poster 17

Presenter: Adam Eckburg

Advisor: Zhan Chen (Chemistry)

MSI-78 Exhibits Increased Alpha-Helical Content when Immobilized and Exposed to Lipid Solution

Circular dichroism spectroscopy was utilized to investigate the secondary structure of a synthetic analogue of the Magainin antimicrobial peptide, MSI-78, free in aqueous solution, immobilized to a glass surface, and when exposed to a 1000 ppm solution of POPG in water. Different time intervals between steps in the three-part sample preparation scheme were tested, alongside varying reagent concentrations, to maximize peptide immobilization. Optimal CD signal was obtained with a 24-hour gap between SAM growth and linker introduction and 22 hours between linker and the addition of 5 μM MSI-78 and 10 μM TCEP. MSI-78 was predominantly random coil in solution to maximize hydrogen bonding, but exhibited increased alpha-helical content when immobilized due to decreased degrees of freedom. Further increases in alpha-helix % when subjected to a highly cationic, gram-negative mimic solution were explained by peptide burying and optimized interactions with the MSI-78 helical wheel projection.

Poster 18

Presenter: Joseph Spielman

Advisor: Ashwin Shahani (Materials Science and Engineering)

Shining New Light on Liquid Metal Embrittlement through Integrated 3D Imaging

The exposure of polycrystalline solid metals to certain liquid metals induces a drastic loss in ductility through a phenomenon known as liquid metal embrittlement (LME). The occurrence of LME is tied to the low mutual solubility and the lack of intermetallic compounds between the solid and liquid metals. Recently, Sun and coworkers suggest that the three-dimensional (3D) grain structure of the polycrystalline solid metal will have a strong influence on the penetration behavior of the liquid metal during LME [Scripta Materialia 163 (2019) 77-81]. Here, by taking advantage of in situ laboratory X-ray tomography at the University of Michigan, we investigated the penetration behavior of liquid gallium in aluminum as a model system. A combination of two different imaging modalities--absorption and diffraction contrast tomography--is used to nondestructively characterize the aluminum's grain structure in 3D, whilst observing the favored pathways of the Ga species during the diffusion process. The influence of grain boundary misorientation, inclination, and connectivity on the dynamics of LME is presented and discussed. Due to the promise of integrated X-ray imaging techniques, we anticipate that this characterization approach can be adapted to broader investigations in physical metallurgy.

Poster 19

Presenter: Emma Vasquez

Advisor: Jacek Debiec (Neuroscience)

Role of Cortical Brain Areas in Maternal Buffering of Fear

Infant-mother attachments in early childhood are important because maternal presence can affect physiological and emotional regulation in infants, such as reducing the release of stress hormones during painful and traumatic events. In a study done in 2017- 2018, we found that maternal presence during fear

conditioning resulted in a lower amount of fearful behavior in rat pups; specifically, rat pups exhibited less immobility when exposed to a fear conditioned stimulus compared to rat pups without a maternal presence. These results suggested that maternal presence during infant fear conditioning can buffer infant's fear. After seeing significant differences between the two groups, our next objective is to examine the pups' neural activity by measuring the protein c-fos in pups' brains after fear conditioning. This will allow us to see which areas of the brains are activated when pups are fear conditioned with or without maternal presence. It has been well-studied that when pups reach an age at which they can learn fear, the amygdala is activated during fear conditioning. Yet, maternal presence of fear suppresses amygdala activity which suggests it has a strong role in fear learning and maternal buffering. However, there are cortical regions in rat pups that have not been investigated in the context of maternal buffering of fear, despite their role in regulating fear in adult rats. In pups, the prelimbic cortex, the cingulate cortex (specifically the anterior cingulate cortex), the infralimbic cortex, and the insular cortex have previously been linked to elements involved with maternal buffering of fear such as activation in response to maternal odor, odor aversion, odor preference, and freezing behavior. Therefore, our main areas of focus will be measuring the protein c-fos in these cortical areas. Since maternal presence is important in buffering of fear and other stressors in early childhood, these findings could help us understand how these brain processes work and could lead to advancement in therapeutics that could act similarly to maternal buffering in treatments for fear or anxiety-related disorders.

Poster 20

Presenter: Sebastian Paz Kitschke

Advisor: Ada Eban-Rothschild (Psychology)

Role of Arousal Circuit Activation In Sleep Quality

While 10-30% of the population worldwide suffers from difficulties initiating and maintaining sleep, very little is known on the neuronal processes naturally preceding sleep. Animals, including humans, exhibit sleep preparatory behaviors such as finding or making a bed to sleep in. Our recent findings suggest that the presence of a nest improves sleep in mice–it reduces latency to NREM sleep, consolidate NREM sleep and increases NREM sleep total duration. However, it is unknown what the neuronal mechanisms underlying sleep disruption in the absence of a nest are. In this study, we aim to reveal the neuronal underpinnings of sleep disruption induced by the inability to properly prepare for sleep. We hypothesize that arousal circuits, specifically dopamine (DA) neurons in the ventral tegmental area (VTA), are hyperactivated by the absence of a nest, and that this hyperactivation results in sleep disruption. To determine whether VTA-DA neurons are hyperactivated in the absence of a nest, we will use simultaneous calcium-dependent fiber photometry recordings from VTA-DA neurons, EEG/EMG recordings and video tracking, all while performing different nest manipulations. To determine a causal role for VTA-DA neurons in sleep disruption induced by the lack of a nest, we will chemogenetically inhibit the neurons while performing EEG/EMG recordings and nest manipulations. Our findings will provide new insights on the role of arousal circuit hyperactivation in sleep dysregulation, and would provide a framework for future studies with the aim of developing new therapeutics to treat people with sleep disorders.

Poster 21

Presenter: Sage Paris

Advisor: Deborah Goldberg (Ecology and Evolutionary Biology)

Evaluating Invasiveness through Morphological Architecture Trait Differences between Invasive and Non-Invasive Phragmites Lineages

One goal in ecological sciences is to identify potential invasive species. Comparisons of the morphological traits of plants between native and non-native invasive variants may lead to improved understanding of which factors indicate invasiveness. Many plants in wetland ecosystems spread through clonal reproduction: they grow horizontal stems underground (called rhizomes) then have shoots that protrude upward. Moreover, a plant's clonality may be a large influence on its invasiveness. In this research, morphological attributes on two distinct lineages of Phragmites plants, a commonly known invader, were measured, such as their rhizome weights, lengths and architecture (branching frequency and locations). We will compare morphology and architecture between native or invasive lineages. For each plant grown in a pot within a controlled lab room environment, we measured its stem heights above and below the soil level, each rhizome's length and number of internodes, and recorded the origin of each stem and rhizome (growth from a rhizome or another rhizome). This data could be used for meta analyses, which uses previously collected data from other studies involving species with native and invasive variants, then compare variations between groups and aid in the general conclusion on trait-indication for invasiveness. We hypothesize that more complex rhizome architecture and shorter rhizome lengths will be apparent in the Phragmites lineage that is known to be invasive. This could suggest that any similarly-natured attributes in other plants should be further investigated for that species' capacity to invade a wetland ecosystem.

Poster 22

Presenter: Joseph Isaac

Advisor: Raoul Kopelman (Chemistry)

Synthesis of Au(BetaMerc) Nanocluster for Photodynamic Therapy Applications

Gold nanoclusters have a great amount of usefulness and applications within the realm of photodynamic therapy (PDT). When synthesizing these clusters, it becomes important to take into account the factors that affect the outcomes of the PDT, such as nanocluster ligand and size. By maximizing the effectiveness of these parameters, the applications of the PDT in turn can be much more versatile and effective. Synthesizing a new nanocluster involves taking into account the optimal conditions for the most precise and highest yielding results for the desired nanocluster size, Au25 in this case. Systematic synthesis experiments were conducted by varying the conditions that were of interest, including temperature, solvents used, and the presence of tetraoctylammonium bromide (TOABr). In order to analyze the results of the synthesis, the product was tested for biocompatibility as well as data was collected for its NMR, DLS, UV-Vis spectra, and fluorescence. Using the data collected from the analytical techniques, information about the size of the nanocluster were deduced and biotoxicity evaluated.

Poster 23

Presenter: Andong Luis Li Zhao

Advisor: Sindhu Kutty (Electrical Engineering and Computer Science)

The Practical Effects of Influence Limits on Recommender Systems

Netflix's movies and Amazon's products are largely recommended through algorithms called recommender systems. Often, these recommendation depend heavily on how previous users have rated these items. Although this can lead to good predictions, one essential assumption that may not hold is that all raters give honest ratings about the items in question. For instance, a seller might generate fake accounts to positively rate an item that they are selling. A system that does not detect these fake reviews can thus be manipulated into recommending the seller's items.In order to limit the influence of these users, researchers Resnick and Sami have proposed an algorithm, called Influence Limiter, that learns to detect fake user accounts and thus theoretically guarantees limited impact by these users. As a consequence of limiting influence, the algorithm also initially limits honest users' influence. This project aims to explore how the Influence Limiter performs in practice by implementing the algorithm and analyzing its performance when it is under attack by clones of honest raters and random raters. Our preliminary results show that our algorithm is able to perform well in settings with and without manipulation attacks despite limiting users' influence. These results indicate that there is potential in using algorithms with theoretical guarantees for improving users' experiences in recommender systems prone to manipulation, which we are looking to corroborate with further experiments.

Poster 24

Presenter: Philip Huang

Advisor: Jean-Francois Rual (Pathology)

Characterization of the Role of L3MBTL3 in Medulloblastoma

Medulloblastoma (MB), which originates in the cerebellum, is the most prevalent brain cancer in children. Prior studies have linked aberrant up-regulation of Notch signaling target genes to an increased prevalence of tumorigenesis within cerebellum cells. L3MBTL3 has been identified as a repressor of Notch signaling activity, and mRNA expression analysis of MB cells indicates low-level expression of L3MBTL3, suggesting a potential link between reduced L3MBTL3 activity and higher rates of MB tumorigenesis. We hypothesize that L3MBTL3 is a tumor suppressor of MB through its repression of Notch pathway signaling. Our investigation utilizes the ND2-SmoA1 mouse model of MB in combination with our L3mbtl3 KO mouse to assess the effect of L3mbtl3 KO on MB tumorigenesis. Survival rates are compared between L3mbtl3 heterozygous KO and L3mbtl3 WT ND2-SmoA1 mice. In order to characterize the L3mbtl3 and ND2-SmoA1 genotypes of newborn mice, Polymerase Chain Reaction (PCR) is performed to amplify the L3mbtl3 WT and KO alleles as well as the SmoA1 allele from mouse tail genomic DNA. The PCR-amplified inserts are separated according to size by gel electrophoresis, enabling assessment of the presence or the absence of the SmoA1 allele and identification of either the L3mbtl3 WT or KO allele for each mouse. Survival times of mice genotyped as L3mbtl3 heterozygous KO were recorded as significantly lower than the survival rates of L3mbtl3 WT mice, suggesting that L3mbtl3 functions as a tumor suppressor in ND2-SmoA1 mice models.

Poster 25

Presenter: Ella Yazbeck

Advisor: Evgueni Filipov (Civil Engineering)

Curved-Crease Origami: Reconfigurable Arch Structures

Origami is an ancient art form that has recently become a new direction for research in civil engineering. Using curved crease origami, deployable arches can be erected quickly with minimal actuation. They can then be reconfigured to adapt to different purposes. The objective of this research was to create large, deployable arch structures from the curved folding of thick, flat sheets, and to evaluate their capacity for carrying loads and maintaining structural integrity after redeployment. A series of paper arches were built and tested to evaluate their load capacity. Two sheets were curved-folded, cut to size, and attached together to create a hollow, curved tube. We then increased the thickness of the arch material from 0.1 mm to 5 mm by using foam panels connected with fabric and hinges in the same geometry as a near-to-zero-thickness arch. Finally, we designed the dimensions of the arch to a 1.5-meter-scale to determine whether the paper arch principles can be scaled up for a large arch of non-negligible thickness. The results of load testing show it is possible to create a large-scale, stiff arch structure which can carry a load greater than its own weight without significant deformation or global buckling. We concluded that a foam 1.5-meter-wide model arch replicates the deployment characteristics of an arch without thickness. These findings will contribute to further research into scaling up curved crease arches for feasible real-world applications where load-bearing capabilities, thickness, and large-scale constructability are of importance.

Poster 26

Presenter: Allison Batka

Advisor: Nicolai Lehnert (Chemistry)

Copper BMPA- and BEPA-Carboxylate Catalysts for the Electrochemical Production of Nitric Oxide

Though once known chiefly for its toxicity, nitric oxide (NO) is synthesized in the human body to prevent platelet aggregation and bacterial growth. These benefits make NO an ideal candidate for certain biomedical applications like the intravascular catheter, as blood clotting and bacterial infections are current complications with its use. The production of NO in such applications can be modulated electrochemically with a catalyst that reduces nitrite to NO. A series of six copper BMPA- and BEPA-carboxylate catalysts have been synthesized to find more efficient and selective catalysts for nitrite reduction. The copper complexes were characterized by UV-vis spectroscopy as well as cyclic voltammetry, and then tested for their ability to produce NO by bulk electrolysis using a Nitric Oxide Analyzer. All six complexes have been prepared, and results on their electrocatalytic performance for nitrite reduction are presented.

Poster 27

Presenter: Sheridan Tobin

Advisor: Jennifer Meddings (Industrial & Operations Engineering)

Improving Awareness of Catheters and Pressure Wounds to Reduce Hospital-Acquired Infection

Catheters are often necessary for patients who have prostate problems, who have just had surgery, or who need medications over a long period of time. However, prolonged catheter placement poses an increased risk of infection, which contributes to lengthened hospital stays. Unfortunately, the literature shows that physicians are often unaware of the presence of catheters in their patients and that communication between nurses and physicians is often limited due to lack of physical interaction and dependence on the Electronic Medical Record (EMR). Pressure ulcers can also develop in hospitalized patients and, like catheters, may be hidden from providers underneath bed sheets. In collaboration with the University Hospital 8DNS unit at Michigan Medicine, the M-Safety Lab Project 1 focuses on developing and evaluating a bedside display that will show real-time data on presence and duration of catheters and pressure wounds. This technology aims to improve provider awareness of risks due to catheter placement, pressure wounds, and other skin cautions in order to prompt swift delivery of risk-reducing interventions, such as catheter removal and targeted skin care or repositioning. Our intervention will also work to improve communication between clinicians (MD-MD, RN-RN, RN-MD) about catheters and skin and will supplement conversations about implementing workflow strategies to prompt and sustain MD and RN behavior change. To measure the effectiveness of our bedside display, we will conduct pre and post-intervention surveys of healthcare providers about the catheter and pressure wound status of their patients.

POSTER SESSION E

3:00 - 4:00 PM

Poster 1

Presenter: Tommy Lau

Advisor: Janilla Lee (Multicultural Health)

Prevalence of Diabetes among Chinese and Chinese American

Purpose: The purpose of this study was to compare and understand the difference in prevalence of diabetes among the Chinese living in China and Chinese Americans living in the United States.

Method: The study collected data on the prevalence of diabetes among the Chinese in China and Chinese Americans living in the United States in the PubMed database through the University of Michigan.

Results: After reading through various research studies, the most relevant papers showed that the overall prevalence of diabetes was 9.9% and pre-diabetes was 7.4% for the Chinese living in Hong Kong between 2012 and 2013. The prevalence data for Chinese Americans in the Sacramento County was 11.4% (95 % Confidence Interval = 7.0 – 15.8 %) for diabetes and 35.2% (95 % Confidence Interval = 27.0 – 43.4 %) for pre-diabetes.

Conclusion: The data suggests there is a higher prevalence of diabetes and pre-diabetes among the Chinese Americans than the Chinese.

Poster 2

Presenter: Anati Alyaa Azhar

Advisor: Patricia Wittkopp (Molecular, Cellular, and Developmental Biology)

Visualizing Spatial and Temporal Expression Patterns of MicroRNAs in Drosophila Melanogaster

MicroRNAs are an important class of post-transcriptional gene expression regulators. Further study of miRNAs will help us understand the role of gene regulation in development and evolution. However, existing methods of detecting miRNAs are expensive, labor intensive, and complicated. Thus, we are currently designing and constructing a fluorescent reporter system that fluoresces in the presence of miRNAs in Drosophila melanogaster. This fluorescent reporter system will then be compared to two other existing methods of detecting miRNAs; a genetically encoded sensor that produces reduced signal in the presence of a specific miRNA and a visualization technique involving Hybridization Chain Reaction (HCR) that amplifies signalling in the presence of a specific miRNA. The comparison of these three methods will be done by analyzing the visualization of miRNAs in wing imaginal discs as well as pupal abdomens since the miRNAs in this experiment are thought to be expressed in these tissues and affects abdomen pigmentation of D. melanogaster.

Poster 3

Presenters: Alaina Gregory and Miranda Schaffer

Advisor: Edward Chang (Psychology)

Self-destructive outcomes and history of sexual assault: Is perfectionism an additional factor to consider?

Adolescents and young adults are at a heightened risk of engaging in the serious social problems of both non-suicidal self injury (NSSI) and suicidal behaviors; females are also more likely to engage in these self-destructive behaviors relative to males, thus identifying female college students as an at-risk population. Prior sexual assault history is social issue on the college campus a known predictive factor for these behaviors. There are reasons to consider other factors worth investigating within this context; particularly, perfectionism, which may be broken into two functionally distinct dimensions, positive strivings and maladaptive evaluative concerns. Maladaptive evaluative concerns have been associated with self-destructive outcomes. What is unknown is whether perfectionism is a significant factor beyond more robust predictors, such as sexual assault history. The present study sought to examine the relationships between sexual assault, perfectionism, and the outcomes of NSSI and suicidal behavior, and if perfectionism was a significant factor beyond sexual assault. 287 female college students were surveyed utilizing several different measures (e.g. Self-Harm Inventory) to calculate several hierarchical regression analyses. Both sexual assault and perfectionism accounted for a significant amount of variance. Maladaptive evaluative concerns were important among both NSSI and suicidal behavior, while positive strivings was only significant to suicidal behavior. These results indicate that the presence of sexual assault history and perfectionism are both important variables, and that in clinical work, it may be useful to expend energy both in the bolstering of positive strivings, as well as the reduction of maladaptive evaluative concerns.

Poster 4

Presenter: Joshua Afshani (Economics and Business)

Cyberterrorism and its Dramatic Impact on Insurance and Security Companies

Cyberterrorism has come to be one of the most threatening forms of terrorism in the current age of technology. Recent technological developments and events in the real world have revealed unexpected effects and aspects of the encroachment of terrorism into the worlds of business and science. Criminals can now disrupt the commerce of any company offsite, holding companies ransom with the threat of compromising or outright destroying their confidential databases. In the face of the negative implications cyberattacks can have on affected firms and consumers, this article focuses on the flip side of the coin: I hypothesize that cyberattacks can produce abnormal positive returns for the stock prices of insurance and security companies. Heretofore practically ignored by most businesses, companies that specialize in insurance and security dealing with cyberterrorism are understandably suddenly experiencing increased positive interest and attention. I conducted an event study analysis to investigate how the stock prices of insurance and security companies changed one day and one week after major cyberattacks on large firms. I used events beginning in 2013 from the Yahoo attack that affected more than three billion users to the recent Petya Ransomware attack that struck companies around the world in 2017. Using the P-value as our measure of significance, I found that, on average, the companies realized a consistent, positive abnormal return in 11 of the 15 events one day after an attack. However, I also found that one week after an attack, there were no consistent abnormal returns in any of the cases I researched. This evidence

supported my hypothesis as investors understand that increased cyber activity results in increased cyber-awareness for companies on a large scale and consumers at a small scale. With increased cyber awareness, both insurance and security companies will likely increase premiums and experience higher quarterly revenues. Furthermore, after comparing the level of significance for insurance and security companies separately, I found that the security companies I researched experienced more positive, abnormal returns than the insurance companies I researched. This is presumably because security is more vital in the fight against cyber terrorism. Insurance is a coverage in case security fails and thus investors reacted to this logic. Prevention is always better than amelioration. These results support my hypothesis that security companies yielded higher abnormal returns than insurance companies.

Poster 5

Presenter: Emily Roberts

Advisor: Bruce A. Palfey (Biological Chemistry)

Flavoenzyme Database for Predicting Isoalloxazine Cofactor Reactivity

Flavoproteins play many important roles: in metabolism of toxins in the liver and the soil, in nucleic acid repair processes, programmed cell death, cell signaling, intermediary metabolism, immune defense, neural development, bioluminescence in bacteria, phototropism in plants – a list that spans biology. The flavin prosthetic group, a derivative of vitamin B2, performs enzymatic oxidation-reduction reactions and covalent catalysis. The isoalloxazine ring core of the flavin cofactors can perform many diverse functions due to its inherent reactivity, which is specifically enhanced by its surrounding protein matrix. We are building a database to gather and organize the vast amount of information on flavoenzymes. Our database will bring together data on structure, solvent accessible surface area, absorbance spectra, reduction potentials, and kinetics from existing literature and databases, enabling the discovery of patterns of reactivity. We will use computer science techniques to plot electric potential maps and do principal component data analysis to look for clusters that might lead help us answer important questions, such as whether different classes of flavoenzymes work in different ranges of reduction potential. Our database would be a tool for biochemical researchers that could lead to a better understanding of how flavoenzyme structure relates to function, evolutionary phylogenic relationships, and a predictive model of isoalloxazine interactions. Predicting how cofactor reactivity is affected by the protein matrix and environment could lead to the development of new drugs that function through covalent mechanisms, and could assist in engineering enzymes for biotechnological applications.

Poster 6

Presenter: Ruth Azaria

Advisor: Andrew Lieberman (Pathology)

Synthetic High-Density Lipoprotein Nanoparticles for the Treatment of Niemann-Pick Diseases

Niemann-Pick Disease type C is a fatal and progressive neurodegenerative disorder characterized by the accumulation of unesterified cholesterol in late endosomes and lysosomes. We sought to develop new therapeutics for this disorder by harnessing the body's endogenous cholesterol scavenging particle, high-density lipoprotein (HDL). Here we design, optimize, and define the mechanism of action of synthetic HDL (sHDL) nanoparticles. We demonstrate a dose-dependent rescue of cholesterol storage that is

sensitive to sHDL lipid and peptide composition, enabling the identification of compounds with a range of therapeutic potency. Peripheral administration of sHDL to Npc1 I1061T homozygous mice mobilizes cholesterol, reduces serum bilirubin, and corrects body weight deficits. Additionally, a single intraventricular injection into adult Npc1 I1061T brains significantly reduces cholesterol storage in Purkinje neurons. Since endogenous HDL is also a carrier of sphingomyelin, we tested the same sHDL formulation in the sphingomyelin storage disease Niemann-Pick type A. Utilizing stimulated Raman scattering microscopy to detect endogenous unlabeled lipids, we show significant rescue of Niemann-Pick type A lipid storage. Together, our data establish that sHDL nanoparticles are a potential new therapeutic avenue for Niemann-Pick diseases.

Poster 7

Presenter: Madison Kent

Advisor: Andrew Shuman (Bioethics and Social Sciences in Medicine)

Patient and Provider Perspectives on Personalized Head and Neck Cancer Care

Genomic sequencing and precision oncology have been rapidly gaining momentum as potential considerations in the diagnosis and treatment of head and neck cancer. Patient and provider perspectives on participation in these genomic sequencing studies are critical to understanding the ethical implications behind these new and elusive initiatives. In this study, translational biology, social science, and bioethics merge in a multidisciplinary collaboration to examine how patients and their oncologists perceive the utility and evaluate the decision to participate in the Michigan Otolaryngology Sequencing Study (MiOTOSeq). This analysis sought to examine how these perspectives influence motivations, affect risk-benefit analysis, and drive expectations for study goals and participation. Through a series of semi-structured interviews, patient views and those of his/her referring physician were obtained. Interview transcripts were then double coded by study team members through content analysis to observe themes. Overall, patients tend to see benefits of genomic sequencing through the lens of their own experience, whereas risks are hypothetical possibilities attributed to the experiences of general "others." This contrast often led to readily enthusiastic decisions to participate motivated by altruism. In order to understand whether genomic sequencing efforts will meaningfully impact patient care, it is essential to understand the impact of the decision-making process from the perspective of patients and providers alike. In general, physicians and their patients both have realistic perceptions of how applicable genomic information may be to current or future treatment options. However, physicians express concern that their patients may have unrealistic expectations of personal benefit.

Poster 8

Presenter: Laura Goo

Advisor: Sofia Merajver (Hematology and Oncology)

Effects of the small GTPase RhoC on inflammatory breast cancer metabolism

Inflammatory breast cancer (IBC) is an extremely aggressive and rare form of cancer that disproportionally affects African American and younger women. We have previously shown that the metabolic characteristics of IBC, specifically in the triple negative (TN) and inflammatory breast cancer cell line SUM149, are significantly altered from those of normal breast cancer cells. We have also found

that the small GTPase RhoC contributes to the metastatic IBC phenotype and acts as a regulator of the metabolite N-acetyl aspartate (NAA) in SUM149 cells. NAA is the second most abundant metabolite in the brain and has been used for the diagnosis of neurodegenerative disorders. The fundamental role of NAA outside of the CNS, especially in the context of cancer, remains elusive yet intriguing.

We have previously shown that NAA levels are significantly higher in IBC-derived TN SUM149 cells than TN MDA-MB-231 cells. Interestingly, recent studies have also implicated high levels of tumoral NAA with significantly worse survival rates in ovarian cancer patients. To further understand RhoC's role in the modulation of NAA, we generated RhoC knockout cell lines using CRIPSR-Cas9 in a set of inflammatory and noninflammatory breast cancer cell lines. RNA-seq analysis of these show that SUM149 RhoC knockout cells produce the largest amount of differentially regulated genes when compared to wild-type cells. These differentially regulated genes include many of the key genes involved in NAA associated pathways. Additional molecular studies are ongoing to determine the specific role of NAA in the adapted metabolic pathways of inflammatory breast cancer.

Poster 9

Presenter: Kevin Nguyen

Advisor: Ayyalusamy Ramamoorthy (Biophysics)

The Investigation of Random versus Alternating Copolymers in the Formation of Lipid Nanodiscs

Polymer lipid nanodiscs have played an important role in the study of integral membrane proteins without the need for detergents. Styrene maleic acid and its derivatives have been shown to dissolve lipids to form nanodiscs in solution; however, some of the basic mechanisms of nanodiscs formation have yet to be fully investigated. Firstly, the solubilization process is due to amphiphilic polymers and whether one needs a fully alternative or a random alternative polymer is still a mystery. Secondly, what is the stability of the nanodiscs formed with these two polymers. To answer these questions, we propose a synthesis of both types of polymers by the functionalization of polymaleic anhydride (PMA) through two mechanisms. We hypothesize that an anhydride opening of PMA with an alkyl amine will produce a perfect alternating functionalized amphiphilic polymer while an amide coupling would yield a random alternating PMA functionalized polymer. Nanodisc formation will be tested by analyzing samples with dynamic light scattering (DLS), transmission electron microscopy (TEM), size exclusion chromatography (SEC), static light scattering (SLS), and nuclear magnetic resonance. The stability will be tested using NMR and differential scanning calorimetry (DSC). This research will better our understanding of the advantages and limits of amphiphilic polymers and determine the best nanodisc for membrane protein extraction.

Poster 10

Presenter: Racquel Harrison

Advisor: Seok Ki Choi (Nanotechnology for Medicine and Biological Sciences)

Catalytic Dendrimers as the Therapeutic Scavenger of Organophosphates

In my UROP research project for the semester, we worked with paraoxon (or POX) which is an organophosphate oxon. The chemical is often used in insecticides and other fertilizers, however, it is destructive to the body's nervous system because it damages an enzyme in the body called acetylcholinesterase (AChE). Acetylcholine (ACh) is an organic chemical that is released by other nerve

cells to send signals to other nerve cells. AChE removes ACh from synopse after it creates the required stimulation on the next nerve cell. If it gets inhibited, ACh is not removed after the stimulation and multiple stimulations are made, resulting in muscle contractions and paralysis.

Our goal in the project is to find a dendrimer, which is a synthetic polymer with a branching, tree like structure, and use that dendrimer to latch onto the paraoxon to deactivate the chemical from doing any more harm to the nervous system once it is already absorbed in the skin. We work with different conjugates of dendrimers to see which dendrimer is the most effective. One experiment that we do is we calculate the percent enzyme activity where we see the reactivation of the acetylcholinesterase. The better the reactivation, the more effective the dendrimer. We check this activity by using plate readers. Ultimately, we want to see good reactivation of the AChE enzyme as a result of the effectiveness of the dendrimer latching onto the POX to prevent potential nerve damage.

Poster 11

Presenter: Emily Fu

Advisor: Lonnie Shea (Biomedical Engineering)

Evaluation of Synapse Sparing and Formation after Spinal Cord Injury with Lentiviral Therapy

There are approximately 17,700 new cases of Spinal Cord Injury (SCI) every year in the United States. Currently, there are no existing therapeutics to reverse damage done to a spinal cord. A polymer scaffold ("bridge") has been developed to aid in regeneration. After a mouse hemi-section on the C5 vertebrae, this scaffold is used to fill the gap left after tissue excision, allowing for tissue growth and the direction of axon growth. Genetically engineered viruses, lentiviral anti-inflammatory interleukin 10 (IL-10) and brain-derived neurotrophic factor (BDNF), will be delivered on the bridge to aid in regeneration. Neuromuscular junctions are chemical synapses formed by the interaction of motor neurons and muscle fibers. After a SCI, muscle tissues become denervated, due to a loss of nerve supply. Shoulder and forearm flexor muscles tissues are targeted in this project because C5 is the main overlap between the two muscles. This allows us to compare innervation between them and evaluate the progression of neuron to muscle contact. IL10 treatment results in the sparing of muscle tissues from denervation at 2 weeks post-SCI. Histology also shows that growth cones are sprouting toward denervated NMJs and motor neuron axons are growing across the SCI. At later timepoints, we hypothesize that regeneration will continuously be improved due to IL10 and BDNF expression. This study shows that these bridges provide an adequate environment for regeneration, and that the delivery of viral vectors allows for the targeting of multiple processes using a single delivery system.

Poster 12

Presenter: Jacqueline Welday

Advisor: Henry L. Paulson (Neurology)

Regulation of c9orf72 FTD/ALS Pathology by Ubiquilin-2

Ubiquilin-2 (UBQLN2) is a protein quality-control protein involved in the ubiquitin proteasome system (UPS) and autophagy. In addition to its ability to regulate toxic proteins in the brain, UBQLN2 has been directly associated with neurodegenerative disease due to mutations that cause frontotemporal dementia (FTD)/amyotrophic lateral sclerosis (ALS). ALS is characterized most commonly by the presence of

TDP-43 inclusions and abnormal translocation to the cytoplasm. Additionally, in a subset of hereditary cases, unregulated translation of RNA on chromosome 9 open reading frame-72 (C9ORF72) leads to aggregates of dipeptide repeats (DPRs). To investigate the potential role of UBQLN2 in regulating levels of disease proteins associated with FTD and ALS, we used human embryonic kidney (HEK-293) cells transfected with DPRs or different forms of TDP-43 and either overexpressed or knocked down UBQLN2. We found a significant decrease in the levels of both soluble and insoluble TDP-43 when UBQLN2 was overexpressed was observed. To evaluate the role of UBQLN2 in regulating disease pathology in vivo, mouse models were generated using adeno-associated virus (AAV) injection of the hexanucleotide repeats in wildtype, UBQLN2 transgenic and UBQLN2 knockout mice. Levels of DPRs and TDP-43 were measured when UBQLN2 was overexpressed or knocked down. Our data suggest that UBQLN2 is an important modulator of aggregation-prone proteins in neurodegenerative disease and indicate the importance of further investigating this connection. Future studies will expand our pilot study to further analyze the effect of UBQLN2 on toxicity in a C9ORF72 mouse model.

Poster 13

Presenter: Johari Summerville

Advisor: Patricia Garcia (Information)

How the University of Michigan Effectively Contributes to African American STEM Retention Rates

There is a gap in science, technology, engineering, and mathematics (STEM) retention and graduation rates of white and black students in Predominantly White Institutions (PWIs). Black students are less likely to succeed in STEM fields due to the lack of representation and lower self-efficacy (McGee, 2016). In order to improve this problem, there needs to be changes made to the way science is taught in schools to encourage more culturally sustaining pedagogy. Incorporating more culturally sustaining STEM coursework helps to maintain minority students interest by providing them with a personal connection to their coursework (Paris, 2012). As a result of the lack of culturally sustaining pedagogy STEM coursework has become inaccessible to underrepresented minority (URM) students. However, there is an increase in employers who aim to increase the diversity of perspectives in STEM fields. Which is why it is important that universities play an active role in contributing to the success of their African American students. The purpose of my research is to analyze the effectiveness of on campus resources for African American STEM students at meeting financial need, providing mentorship, and improving student STEM self-efficacy. I will also be looking at what resources on campus play an important role in providing assistance but aren't targeted solely at URM students. The questions I will be studying are: What STEM programs offered at the University of Michigan are targeted at minorities? What scholarships are offered to URM STEM majors? What other resources are available to students? What mentorship opportunities are available?

Poster 14

Presenter: Janice Kwan

Advisor: Katherine Bauer (Nutritional Sciences)

Non-maternal Caregivers' Roles in Child Feeding among Low-income Families

Research on child feeding practices has traditionally focused on the role of the mother. However, we are increasingly learning that other caregivers, such as fathers and other family members, may also play a large role in feeding children. Parent-child relationships and parenting styles have been linked to health outcomes such as obesity and may have an important impact on the child's nutrition. Our research hopes to expand this topic to understand the role of other caregivers involved during feeding and how the conversations between caregivers influence child feeding practices. Using semi-structured interviews, we asked mothers of 9-12-year-old children in low-income families about other caretakers who help with feeding their child to learn more about household dynamics around feeding. The mothers were asked if any other caregivers are involved in feeding their child, what conversations regarding feeding are about, and if the mother and other caregiver agree or disagree on feeding practices. Within these conversations, we coded for themes such as disagreements over healthy and unhealthy foods, discussions about the child's weight, and child food preferences.

Poster 15

Presenter: Melissa Berlin (Sociology)

Would you Rather: be at Home or in a Home? A Comparison of Old Age Social Connectedness

The old age social life can be characterized by three major transitions. Social networks shrink and intensify. The need for social support increases and the availability of social support decreases. Age-related limitations, especially related to transportation mobility, make it difficult to access the social network. Social connectedness, the quantity and quality of social relations, is at risk in old age. Aging related changes put older adults at an increased risk of perceived isolation, the subjective discrepancy between one's actual and desired quantity and quality of social relations. Many advocate for seniors who face challenges to living independently to receive care at home, where they can maintain their sense of independence. Others argue in favor of assisted living facilities as a catch-all solution to meeting care needs and providing social opportunities. This study explores the following questions: how do older adults experience social connectedness and perceived isolation? How does this experience vary between older adults living alone in private homes and older adults living in assisted living facilities? I conducted 16 qualitative interviews with middle-old and old-old women who lived alone in a private home or in an assisted living facility. The themes that emerged in these interviews revealed differences in three main aspects of social connectedness between the two groups; interactions, relationships and belonging. The experience of social connectedness was largely characterized by intentionality for community-dwelling respondents and by availability for assisted living respondents. I did not find a notable degree of perceived isolation in either group.

Poster 16

Presenter: Michael Riehs

Advisor: Charles McCrory (Chemistry)

Investigation of Iron and Chromium Doped Cobalt Oxide Nanoparticles for Electrochemical Alcohol Oxidation

The oxidation of alcohols into their corresponding carbonyl compounds is an essential component for many large scale industrial processes. In recent years, the conversion of biomass in particular has drawn great attention for producing useful chemical compounds that can be used towards new fuel sources and

polymers. Presently, the catalysts used for these conversions are typically expensive and not environmentally friendly. Use of electrochemistry can open the way to cheaper and greener selective alcohol oxidation. This work investigates the use of mixed metal oxide catalysts for the electrochemical oxidation of alcohols based in part on known mixed metal oxygen evolution catalysts. The particles under question are cobalt oxides with varying amounts of either iron or chromium doped in. Electroanalytical tests determine the activity and product selectivity of each catalyst from a series of tests in solutions of sodium hydroxide and benzyl alcohol. From these comparative studies, we hypothesize that both a combination of dopant identity and concentration will play a crucial role in product selectivity. The information gained from the electroanalytical studies will be used for the rational design of more selective and active catalysts in the future.

Poster 17

Presenters: Anisha Moorthy, Clara Steeby, and Tori Turpin
Advisor: John Jonides and Tessa Abagis (Psychology)

Perceptual Load and Attention

Visual search tasks require attention to target information and away from distracting information. Perceptual load theory describes attention as a limited capacity resource. Attention is first directed towards information relevant to the task at hand and then directed towards distractors. Tasks with higher perceptual loads leave less attention to be directed towards distractors while tasks with low perceptual loads leave more attention for distractors. Studies have supported this theory in visual search tasks involving target letters X and N with a varied perceptual load. In such tasks, we have found evidence that some participants develop a strategy to search for only one of the letters, turning the discrimination task into a single item search task. The current study aims to explore perceptual load theory by using nearly identical arrows as stimuli to reduce effects of single item search. Preliminary analysis of data has shown that there are significant differences in accuracy and response latency between high and low perceptual load trials suggesting that increasing perceptual load decreases the saliency of the distractor arrow.

Poster 18

Presenter: Zhiquan Sun
Advisor: Benjamin Safdi (Physics)

Indirect Detection of Axion Dark Matter with Radio Signals from Neutron Stars

Axions are one of the best-motivated dark matter particle candidates and are able to solve the strong CP problem. In the presence of magnetic fields, axions can resonantly convert to observable photons, making the strong magnetic field within neutron star magnetospheres a natural channel for axion indirect detection. By solving the axion-photon mixing equations and modeling neutron star populations, we calculate the expected radio signal flux due to conversion from several astrophysical targets. Focusing on the Galactic Center of the Milky Way, the globular cluster M54 in the Sagittarius dwarf galaxy, and the Andromeda galaxy, we show that narrow-band radio observations with telescopes such as the Green Bank Telescope and the future Square Kilometer Array will be able to probe the axion parameter space over roughly two orders of magnitude in mass, starting at a fraction of a μeV.

Poster 19

Presenter: Steel Cardoza

Advisor: Eleni Gourgou (Mechanical Engineering)

Advancing behavioral arenas for small model organisms by 3D printing nematode growth medium

C. elegans tiny nematode is a model organism broadly used in neurobiology studies. Recently, exciting results regarding C. elegans spatial learning ability were obtained, using simple T-shaped mazes. We seek to transition from practically 2D- to 3D-behavioral arenas to explore complex 3-dimensional behavior. This interdisciplinary project spans thermal dynamics and additive manufacturing, combining principles from materials science, mechanical engineering and neurobiology. To build our arenas, a standard fused deposition modeling 3D printer is modified. The customized printing head combines a linear actuator, heating cartridge, heat sink, syringe, and heated nozzle, for temperature control and consistent ink viscosity. C. elegans are cultured on nematode growth medium (NGM), a thermoreversible transparent hydrogel (2% agar, plus nutrients). To minimize environmental change stress, assays need to be made of NGM as well. NGM properties are quantified by rheology experiments. The linear actuator is driven by custom computer code that reads interpreted 3D printer code and is controlled via Arduino. Printing head housing parts are custom-made from variety of materials (aluminum, plastic, wood, glass) to maximize performance. The substrate includes a modified Peltier device with an integrated glass dish, which contains the cooled plotting medium (glycerin). Its density is matched to the printing ink and cooled to promote accelerated solidification and support. As a proof of principle, we have shown NGM can be printed in the plotting medium by manual extrusion. As a next step, we will fine tune the printer-computer coordination and finally test C. elegans behavior.

Poster 20

Presenter: Mary Jane Risch

Advisor: Stephen Kemp (Plastic Surgery)

20 mm Autografts Supplemented with Autologous Adipose Tissue Enhances Functional Recovery Following Nerve Injury

Introduction: Injuries to peripheral nerves vary widely in their severity, and clinical outcomes are frequently disappointing. Adipose-derived stem cells (ASCs) have been previously shown to enhance peripheral nerve regeneration. However, ASC processing leads to both clinical and regulatory burdens. Unpurified fat is whole adipose tissue that is harvested without subsequent ASC isolation. In addition, harvesting of unpurified adipose tissue is currently approved by the FDA and a common surgical practice. The purpose of the present study was to investigate the effect of autologous, adipose tissue on nerve regeneration through 20 mm long autografts in the rat.

Materials & Methods: F344 rats were used in this study and were randomly assigned to one of four experimental groups: (1) naïve control ; (2) 20 mm autograft; (3) 20 mm autograft + unpurified adipose tissue, and; (4) 20 mm autograft + purified fat. All animals were tested at baseline, and were then followed serially for 12 weeks. Outcome measures included sensorimotor and sensory pain assessments. Terminal outcome muscle measures examined EMG and muscle force parameters.

Results: Animals in the autograft + unpurified fat group and autograft + purified fat group displayed enhanced peripheral nerve regeneration compared to the autograft only group. These animals displayed

increased muscle force parameters at study endpoint, and displayed faster recovery of sensorimotor function. Histomorphometrical assessment showed significant differences between autograft and both autograft + fat groups.

Conclusions: Autologous unpurified and purified adipose tissue enhanced peripheral nerve regeneration through 20 mm autografts. Harvesting of unpurified fat circumvents current FDA regulatory burdens and has the potential to change current clinical management of traumatic
peripheral nerve injuries.

Poster 21

Presenter: Desi Dikova

Advisor: Stephen Maldonado (Chemistry)

Electrodeposition of Catalytic CoO_x on Macroporous GaP Photoanodes for Stable Solar Water Oxidation

Macroporous gallium phosphide (GaP) is a promising photoanode for photoelectrochemical water-splitting. An anodic etching process is necessary to create these porous structures; unfortunately, this process also introduces defect sites prone to degradation in basic operating conditions, limiting the lifetime of the photoelectrode. This work aims to enhance the stability of macroporous GaP photoanodes through the electrodeposition of cobalt oxide (CoO_x), a dual-functional protective layer and catalyst for solar water oxidation. The performance and stability of these devices is assessed by their external quantum efficiency (EQE) and transient photocurrents. Macroporous GaP photoelectrodes coated in CoO_x yield higher steady-state photocurrent than uncoated or planar electrodes. In total, this work will demonstrate electrodeposition as an effective method for catalyzing and protecting photoelectrode surfaces.

Poster 22

Presenter: Sari Grossman

Advisor: David Sherman (Chemistry and Life Science)

Mutagenesis of Key Histidine Residues of Bacterial Cytochrome P450 for Mechanistic Insights on the Epoxidation Step within an Iterative C–H Functionalization Pathway

Tirandamycin is a potent antibiotic against vancomycin-resistant Enterococcus faecalis and the native substrate of TamI, a versatile bacterial cytochrome P450 monooxygenase that can perform several consecutive oxidations on the tirandamycin core scaffold. The extent of the oxidative tailoring of the bicycle moiety is key to bioactivity. The first step in the oxidative cascade is the hydroxylation of tirandamycin C to yield tirandamycin E, which is subsequently oxidized by TamL, a flavin adenine dinucleotide-dependent oxidase, to produce an allylic ketone of tirandamycin D. Next, TamI performs an enantioselective epoxidation followed by a primary hydroxylation yielding tirandamycin A and B, respectively. Through computational studies, a suspected unproductive hydrogen bonding interaction was discovered between histidine 99, histidine 102, and the allylic ketone of tirandamycin D. We hypothesized that the efficiency of the epoxidation step from tirandamycin D to tirandamycin A can be improved by eliminating this interaction through mutagenesis studies. Here, we overexpress and purify double and single mutants of the target histidine residues and conduct biotransformation reactions with tirandamycin D. We compare product conversion to wildtype TamI through time-of-flight (ToF) mass

spectrometry analysis to elucidate the effects of substituting the active site environment of the P450 on the epoxidation of tirandamycin D. The characterization of this interaction can shed light on the structural basis and kinetic parameters for the epoxidation reaction. Thus, providing insight on how to perform iterative enzymatic C–H functionalization reactions for the possible generation of novel antibiotics through further protein engineering.

Poster 23

Presenter: Kiran Ajani

Advisor: Priti Shah (Psychology)

Generalizability of Null Effects in Medical Studies

Research on innovative medical treatments is a significant part of the healthcare field. As much as possible, these studies attempt to generalize their conclusions to wider populations, so that patients from all backgrounds can benefit. However, some research cannot be generalized, for a variety of reasons. This study examines whether individuals are able to understand in what contexts this occurs – namely through study design issues – and come to a conclusion about the treatments identified in those studies using decision trees. 88 introductory psychology students were divided into control and experimental groups. The participants were each given three worksheets to determine their critiques of the studies provided, and the experimental group participants were additionally instructed to draw decision trees to aid them in their decision making. The results indicated that, although the change in ratings of the studies was significantly lower in the experimental group than in the control group, decision trees did not ultimately impact participants' perceptions of the studies. Further, the number and quality of their critiques and decision tree factors did not significantly change from the first to last worksheet. The findings of this study suggest that, even if decision trees may not be useful in aiding the general population's understanding of medical studies, scientific literacy within patients and the public at large must be emphasized more so that they are able to critically analyze relevant research. These results may be useful in both academic and clinical settings.

Poster 24

Presenter: Monica Olszewski

Advisor: Julie Biteen (Chemistry)

Identifying Byproducts of Resistance Starch Breakdown by Ruminococcus bromii and Bacteroides thetaiotaomicron

Ruminococcus bromii (R. bromii) and Bacteroides thetaiotaomicron (B. theta) are human gut bacterium that help supplement human metabolism and immunity by catabolizing host-indigestible glycans. R. bromii benefits other bacterial community members through cross-feeding events, a process in which one or more species can grow by utilizing the products of another species; B. theta grows by using the byproducts of resistant starch and dietary fiber digestion by R. bromii. While others have shown that this microbial community has billions of bacteria and a plethora of complex interactions, including cross-feeding, much less is known about the details or mechanisms of these interactions. Here we propose using high performance liquid chromatography (HPLC) to identify the types of various byproducts of R. bromii and B. theta resistant starch breakdown. We develop a baseline for sugar, vitamin, mineral, and starch

solutions to identify the byproducts in spent rum media produced by R. bromii to identify what byproducts B. theta utilizes in cross-feeding.

Poster 25

Presenter: Jordan McKaig

Advisor: Robert Woods (Biology and Internal Medicine)

Evolution of Antibiotic Sensitivity in Daptomycin-Resistant VRE

The threat of antibiotic resistant bacteria is one of the most prominent contemporary public health concerns, especially in a hospital setting where frequent use of strong antibiotics is critical to patient care. When antibiotic pressure is high, resistance can be observed arising in the hospital population; however, less is known about how levels of resistance change after an antibiotic is no longer present in the environment. Acquisition of mutations that confer resistance to a drug are often associated with fitness costs. Over time, bacteria may evolve compensatory adaptations that allow for resistance to a drug but have detrimental effects on growth. This project investigates the reversion to daptomycin sensitivity in two groups of vancomycin-resistant Enterococcus faecium (VRE). One group of isolates evolved daptomycin resistance within a single patient over the course of infection (de novo). The other group of isolates was already resistant at the time of infection (transmitted). The control group is six initially sensitive isolates from the de novo cases. We hypothesized that daptomycin resistance is lost more slowly in transmitted cases because they are more likely to carry compensatory mutations decreasing the cost of resistance. Triplicate populations of 6 isolates from each group were allowed to evolve in the absence of antibiotic for approximately 300 generations. Resistance was quantified through plate count methods and broth microdilution minimum inhibitory concentration testing. Results of this study will provide valuable insight into how antibiotic resistance evolves, informing future resistance management strategies.

Poster 26

Presenter: Megan Burns

Advisor: Megan Burns (Psychology)

Exploring Cues of Social Class and Decision-making

Historically, classic decision-making theories have demonstrated the universality of their paradigms through abstraction from context. Yet, context necessarily influences the decision-making process. The study of social class has recently become a topic of interest in social psychology, and I theorized that predicted trends in decision-making might not hold up along social class lines. I replicated classic paradigms in decision-making literature (e.g. Kahneman and Tversky's prospect theory, base rate neglect, Shafir's choosing/rejecting hypothesis) to demonstrate that the expected findings held among my own sample. I then modified particular paradigms to account for social class. I hypothesized that contextual cues of social class would produce opposite or varied effects compared to those predicted by theory. For example, Kahneman and Tversky's nondiagnostic base rate neglect problem is dependent on information being universally nondiagnostic. But are social class cues understood ubiquitously? I predicted that cues as simple as the ability to travel cross-country to attend a wedding may indicate class to those unaccustomed to that sort of luxury.

Poster 27

Presenter: Camille Phaneuf (Cognitive Science)

The Need for TLC (Tender Loving Cellphone)

Research in Cyberpsychology suggests that cellphone usage has pervaded daily life in the United States, and the lives of university undergraduates in particular, since the advent of widespread accessibility to smartphones. The existing literature points to an increasing human dependence on personal cellphones, but it has yet to be concluded whether or not cellphone dependence can be classified as an addiction. The current study uses multiple methods to inform knowledge in this area, combining a controlled experiment with quasi-naturalistic observation, a self-report survey, and a focus group discussion. The survey includes measures of Fear of Missing Out (FoMO), ring anxiety, phantom calls or messages, cell phone use dependence, and self-reported usage. The research questions include: a) whether or not addictive behavior related to cell phone use is apparent, b) whether or not temporary lack of access to one's cell phone is psychologically aversive in a social setting, c) the influence that presence vs. absence of cell phones has on spontaneous social interactions, and d) whether survey measures related to cell phone use and dependency predict cell phone related behaviors.

Poster 28

Presenter: Anna Argento

Advisor: Pedro Lowenstein and Maria Castro (Neurosurgery and Biophysics)

Role of the Extracellular Matrix in High-Grade Glioma Self-Organization

Glioblastomas (GBM) are the most common adult brain tumors, characterized by rapid invasion into normal brain and high therapeutic resistance. Despite extensive research on GBM invasion, growth patterns remain unclear. Our data demonstrate that GBM tumors exhibit self- organized multicellular structures, termed "oncostreams," that may influence tumor invasion and malignancy. MATLAB analysis of human and mouse GBM characterize oncostreams as large groups of uniformly-oriented fusiform cells distributed throughout the tumor. We created correlation maps of relative cell positions and orientations and fit them to a statistical mechanics model of flocking birds. Genetically-engineered glioma mouse models show a negative correlation between oncostream density and animal survival, suggesting that oncostreams contribute to tumor malignancy. Laser microdissection (LMD) of oncostreams followed by RNA-Seq and bioinformatics analyses indicate that particular extracellular matrix (ECM) components are over-expressed within streams. This implicates the ECM as a key regulator of oncostream organization. Comparison between wild-type IDH1 (SB NPA) and mutant IDH1 (SB NPAI) tumor models confirm that collagen expression levels positively correlate with oncostream density and tumor aggression. Furthermore, collagen degradation on organotypic tumor slices induces a decrease in oncostream density. To study the biomechanics of oncostreams, we developed a novel in-vitro model of oncostreams by co-culturing ECM-secreting fibroblasts and NPA glioma cells. Confocal imaging and MATLAB shape analysis confirm that oncostream cells in-vitro have higher aspect ratios and decreased roundness, in accordance with in-vivo stream structures. Manipulation of the underlying ECM may prove to disrupt oncostream formation and development, representing a key target for anti-glioma therapies.