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**FIFTEENTH ANNUAL  
SUMMER RESEARCH SYMPOSIUM  
TRINITY COLLEGE**

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# **BIOLOGY**

**1.**

## **THE ROLE OF THE CAUDAL GENE IN THE SEGMENTATION CLOCK OF *TRIBOLIUM CASTANEUM***

Archana Adhikari '22

Faculty Sponsors: Terri A. Williams, Lisa A. Nagy & Ben Goldman, University of Arizona

Segmentation is the basis of body plan for many highly diverse taxa, including annelids, arthropods and vertebrates. The well-studied vertebrates use a segmentation clock, a feedback loop of certain genes, which oscillates to add segments during embryogenesis. Although inferred to exist in most arthropods, *Tribolium castaneum* is the only arthropod proven to have a oscillation clock like vertebrates while forming segments. But unlike vertebrates, the period of oscillations of the segmentation clock varies: the clock runs slow during early segmentation while it runs fast in late embryo segmentation. The oscillations of segmentation clock in *Tribolium castaneum* use a feedback circuit involving three genes: even-skipped, odd, and runt. We know the caudal gene activates the even-skipped gene of the segmentation clock, and modulates the clock circuit. So, we are looking for any activators and repressors that regulate the caudal gene. From computational analysis, we came up with five potential regions in caudal gene that might play role in regulating segmentation clock. We are creating transgenic beetle lines with reporters for each potential regulatory region, and will assay their role during embryogenesis.

I am working on a region in intron 1, a non-coding region of caudal gene. First, we are building a reporter construct, inject them in the pearl eye mutant beetles, and then create the transgenic beetles. After forming transgenic colonies of beetles, we would examine embryos for expression of mCherry reporter in order to find out when is caudal activated and how caudal are regulated in different time during development. The red fluorescent protein, mCherry, in our reporter construct reports us about caudal activation in the region of our interest and another green fluorescent protein, eGFP, present in our construct is expressed in eyes of the beetle and tells us whether the beetle is transgenic.

I am in the process of creating a plasmid that contains region of our interest and will be used to make a transgenic line. After completing this, we will be analyzing regulation of segmentation clock in transgenic *Tribolium castaneum* and the role caudal gene plays in the varying oscillations of the segmentation clock.

**2.**

## **TESTING FOR RELATIONSHIPS BETWEEN INDIVIDUAL PREY BEHAVIOR AND GROWTH RATE ACROSS DIFFERENT LEVELS OF RISK**

Daniel S. Bauloye '20

Faculty Sponsors: Benjamin J. Toscano, Hassen Allegue

Conspecific individuals often exhibit consistent differences in behavior. For example, some prey individuals may be bolder than others, maintaining high activity in the presence of a predator. To explore the fitness consequences of individual boldness, we tested for relationships between

boldness and the growth rate of *Helisoma trivolvis* snails under different levels of predation risk. We applied the behavioral reaction norm (BRN) framework to decompose individual-level snail responses to risk into personality (elevation) and plasticity (slope) components. We hypothesized that snails which are less behaviorally responsive to predation risk (i.e. non-significant or negative slope) will grow faster under high predation risk due to greater feeding activity relative to more responsive snails. We found that mean snail growth rate (i.e. averaged across individuals) did not change in the presence of predation risk. Nevertheless, this finding does not preclude individual-level relationships between behavior and growth. Thus, our next step is to perform a random (i.e. mixed model) regression to extract individual elevation (personality) and slope (plasticity) components of boldness behavior. We will then test for relationships between these components of individual behavior and growth rate within the different predation risk treatments.

### 3.

#### **BIOCURATING AT CLINGEN: GENE CURATION**

Hannah McCurry '20

Faculty Sponsor: Heidi Rehm, The Clinical Genome Resource, Broad Institute, Cambridge, MA

ClinGen, or The Clinical Genome Resource, is a company based at the Broad Institute of MIT and Harvard in Cambridge, MA that aims to create an open database cataloguing the clinical associations between genetic variations and certain diseases. This goal is being achieved through a method called biocurating, which can be performed on either the variant level (variant curation) or the gene level (gene curation). Variant curation involves applying a number of codes based on a thorough literature search and use of computational devices to determine its chance of being benign or pathogenic. Gene curation involves a thorough literature search, which compiles previously published information of the gene-disease association into one succinct curation, which is then categorized as one of the following: definitive, strong, moderate, limited, or no known gene-disease association. This poster details the specifics of gene curation and provides two example curations performed this past summer (2019) at ClinGen. The curations belong to the skeletal dysplasia group of gene-disease associations, which is the newest working group at ClinGen. The gene-disease associations used as examples in this poster are Hypochondroplasia and *FGFR3*, and Pycnodysostosis and *CTSK*. Both of these gene curations reached the definitive marker for the strength of the gene-disease association. ClinGen aims to build “a central resource that defines the clinical relevance of genes and variants for use in precision medicine and research” through upholding open science and making publicly available resources about the genetic backgrounds of certain diseases (ClinGen website).

### 4.

#### **DETERMINING THE ROLE OF CDT1 UNDER METAL STRESS IN ARABIDOPSIS**

Chloe Michalopoulos '22

Faculty Sponsor: Susan M. Bush

Cadmium is naturally available in the surface level of soil around the world and is also increased by human activity. Cadmium is toxic, so plants have mechanisms to deal with this stressor. *Cadmium tolerance 1 (CDT1)* is a gene that is found in many plants including the model plant

Arabidopsis. Does this gene help in cadmium tolerance in Arabidopsis? A homolog of *CDTI* in rice has been found to bind Al in the cell wall; mutant plants lacking *CDTI* are hypersensitive to aluminum presence (Xia et al., 2013). However, the function of *CDTI* in Arabidopsis has not yet been studied. Two insertional mutants in the *CDTI* promoter were isolated; to find the function of this gene, wildtype and mutant Arabidopsis seedlings were placed under abiotic stress to study their response. *cdt1* mutants responded similarly to the wildtype seedlings under varying pH and under aluminum stress. One of the *cdt1* mutants (*cdt1-2*) responded like wildtype to 25 $\mu$ M CdCl<sub>2</sub> while the other (*cdt1-3*) was hypersensitive. Gene expression analysis of *cdt1-2* revealed over-expression of *CDTI* under cadmium stress. Future gene analysis will help scientists better understand the role of the *CDTI* gene in environmental response.

## 5.

### **TOMATO VARIETIES RESPOND DIFFERENTLY TO ALUMINUM TOXICITY**

Collin Modelski '20

Faculty Sponsor: Susan M. Bush

Aluminum found naturally in the environment becomes toxic to crops at low pH levels. This aluminum toxicity can lead to stunted growth, shorter roots, and decreased fruit size. Tomatoes (*Solanum lycopersicum*) uses aluminum tolerance genes such as *ALMT12*, *ALMT9* and *MATE* in order to release the metabolites malate and oxalate, which help the plant to combat the presence of aluminum. They bind to the aluminum before it has the chance to bind to the cell wall and cause damage. The focus in our study was to determine how different varieties of tomato respond to aluminum toxicity. Four varieties were grown for one week in a hydroponic system in the presence or absence of Al. After being grown in the presence of Aluminum, root length decreased as the concentration of aluminum increased. Furthermore, the amount of malate exudate increased with increasing concentration of aluminum. Preliminary qPCR data looking at genes shows up-regulation of *ALMT12*. This increased expression could help plants that are growing in toxic environments survive under Al-toxic conditions.

## 6.

### **SPECIALIZATIONS FOR YOLK PROCESSING IN REPTILES**

Charlie Reimers '20, Farahana Appiah '21, Madeline Barnes '20, Luisa Lestz '19

Faculty Sponsors: Daniel G. Blackburn, Yunming Hu

My summer research involved using the scanning electron microscopy (SEM), which has produced images of yolk samples from *Alligator mississippiensis* that provide an insight into the methods by which these reptiles process yolk and distribute essential nutrients to the developing embryo. Various developmental stages of yolk tissue were used to understand the changes in yolk cellularization throughout embryonic progression. In early stages, the yolk is in the form of free yolk spheres. Nutrient rich endodermal cells, which aid in the digestion of yolk, are not in abundance during these stages. For the development at mid-stages, yolk spheres are digested into smaller droplets through the process of phagocytosis by the proliferating of endodermal cells. The formation of "spaghetti strands" is indicative of late stage eggs, where yolk-filled endodermal cells form around a network of blood vessels. The structure of these strands allows for the efficient

transport of nutrients from the yolk to the embryo. Similar patterns of yolk transport and uptake were found in previous studies in our lab on several snake species, the lizard species *Sceloporus undulatus*, the turtle species *Chelydra serpentina*, and *Trachemys scripta*. The SEM imaging of *Alligator mississippiensis* is still in the preliminary stages and we will focus on these specimens in the upcoming semester to further our understanding of yolk patterns and development in reptiles.

## 7.

### **TOLL RECEPTORS' INVOLVEMENT IN CELLULAR MOVEMENTS DURING EARLY AND LATE SEGMENTATION OF *TRIBOLIUM CASTANEUM***

Kathryn Russell '22

Faculty Sponsors: Alice Vossbrinck, Terri A. Williams, Benjamin Goldman, University of Arizona, Lisa Nagy, University of Arizona

Cell movements are known to play a significant role in elongation of the embryo during segmentation in the red flour beetle *Tribolium castaneum*. While little is known about how cells move during elongation in *Tribolium*, the process is better understood in the model organism, *Drosophila*, the fruit fly. In *Drosophila*, Toll receptors have a demonstrated role in convergent extension, a method of elongation of the germband by which rows of cells merge together in a process known as intercalation. In *Drosophila*, Toll receptors are a link between pair-rule genes which are expressed in discrete stripes and the actual effector molecules causing the cell movements. A recent study demonstrated the involvement of Toll receptors, specifically Toll 10 and Toll 7, in *T. castaneum* elongation. However, the intercalary behavior of cells in *T. castaneum* is less orderly than in *Drosophila*, which may reflect a difference in underlying mechanisms. It is known that there are differential amounts of cell movement in early *versus* late *T. castaneum* segmentation, but it is not clear how cell movements are affected by the differential expression of Toll 10 and Toll 7 during these times. An analysis of RNA seq data revealed that Toll 6 is expressed in increasing amounts between 13 and 19 hours into development, which may indicate that it has a larger role in cell movements than previously thought. To gain a better understanding of these three Toll receptor's roles in the intercalation and elongation of *Tribolium* germbands, sections of each gene were cloned. These cloned Toll fragments were used to make double-stranded RNA which will be co-injected with membrane staining fluorescent dye into *Tribolium* embryos in order to knock down the function of the Toll genes. These embryos will then be viewed under a fluorescent microscope and compared with phalloidin stained wild type embryos to look at the effect of knocking down the genes on cell movements and rearrangements. This comparison will provide insight into the roles of Toll receptors 6, 7 and 10 in *T. castaneum* in convergent extension.

## 8.

### **GENE SILENCING: THE SEARCH FOR CELL BEHAVIORS THAT DRIVE BEETLE ELONGATION**

Jeffrey P. Sagun '21

Faculty Sponsors: Terri A. Williams, Lisa M. Nagy, University of Arizona, Benjamin Goldman-Huertas, University of Arizona

Some of the most diverse taxa on earth are segmented. For an embryo to develop from a fertilized egg into an adult, the body axis must elongate. Elongation is required to extend the body axis for the development of a segmented adult body plan. Segmentation and elongation have been actively studied in the red flour beetle *Tribolium castaneum*, but little is known about the cell behaviors and effector molecules that lengthen the embryo. *T. castaneum* is an interesting insect to study because its cell behaviors are dynamic and variable, deviating from the model system *Drosophila*. It is known that primary pair-rule genes, such as *even-skipped* and *odd-skipped*, function as transcriptional repressors and activators to regulate segment patterning, as well as controlling embryo elongation, in the red flour beetle. Silencing these pair-rule genes can halt the processes of segmentation and elongation. Here we use RNA interference (RNAi) to produce *T. castaneum* embryo phenotypes in response to pair-rule gene knockdowns. By injecting double-stranded RNA (dsRNA) into the embryos, we were successful in observing a truncated knockdown phenotype by *Tc-odd*<sup>RNAi</sup>. In future work, we will reproduce the RNAi phenotypes at four time points during embryogenesis and collect the knockdowns from each timepoint for RNAseq analysis of *Tc-eve*<sup>RNAi</sup> and *Tc-odd*<sup>RNAi</sup> knockdown embryos. We will then use comparative transcriptome analysis to identify candidate effector molecules that drive elongation. Lastly, we will select and directly test, *via* knockdown, candidate effector molecules that were identified by comparative transcriptome analysis. These data will help us understand the mechanistic basis for the differences in elongation among taxa.

## 9.

### **LIVE IMAGING & FATE MAPPING: CHARACTERIZING THE DIFFERENCE OF CELL MOVEMENTS IN EARLY VS. LATE SEGMENTATION IN *TRIBOLIUM CASTANEUM***

Joli A. Smith '22, Tara M. Coalter, Hector D. Garcia

Faculty Sponsors: Terri A. Williams, Alice M. Vossbrinck, Lisa Nagy, University of Arizona

Our investigation of *Tribolium castaneum* development is essential to our understanding of evolutionary connections to other Arthropods and even vertebrates. The end goal of this experiment was to generate a comprehensive fate map of the blastoderm and determine the stability of gene expression patterns during the early transition of gastrulation. Cell lineage and fate map analysis provide the foundation for understanding development in any system and have been used extensively in vertebrates. There were three standard questions that came from fate-mapping: How exactly does the embryo grow?, Where do anterior and posterior cells end up as the embryo elongates?, and How is it that almost all the segments arise from the posterior of the embryo? Also, when we correlate gene expression with fate, do cells in the blastoderm stage continue expressing certain genes throughout development? And do these cells change their gene expression? By using confocal microscopy, we will be able to generate a comprehensive fate map of the blastoderm and

determine the true pattern of gene expression during the early transition of gastrulation. Cell lineage tracing and fate mapping analysis have been used extensively in vertebrates and will provide a foundation for understanding development in any system. In order to photoconvert and trace the movements of a group of cells as an embryo develops, we will be using nls-td-EOS; nls stands for nuclear localization signal and EOS is a green fluorescent protein which photoconverts to red when exposed to an ultraviolet laser.

## 10.

### **PRELIMINARY ANNOTATION AND ANALYSIS OF THE *ARCTOSTAPHYLOS GLAUCA* GENOME**

Sarah Wilson '20

Faculty Sponsor: Dr. Amy Litt, University of California Riverside

The genus *Arctostaphylos* (Ericaceae), commonly referred to as manzanitas, are a group of shrubs and small trees, with a high endemic diversity in California. Though they are ecologically significant and have received much attention from California botanists, the boundaries among manzanita species and subspecies remain unclear. As part of a larger investigation using next-generation sequencing data to evaluate species diversity of manzanitas, we are assembling a manzanita genome sequence, for a distinct and widespread diploid species *Arctostaphylos glauca*. We used Oxford nanopore sequencing and short-read Illumina sequence data to produce an assembly of high contiguity with a low sequencing error rate. This is the first genome assembly for the genus *Arctostaphylos* and subfamily *Arbutoideae*. Here we perform a number of analyses on the genome assembly including masking repetitive elements and annotating likely gene function. We also compare our constructed genome assembly of *A. glauca* to other chromosome-level assemblies within the family Ericaceae and order Ericales. Specifically, we summarize transposable element information and predict gene function using a GO Analysis and a GO Enrichment Analysis. Sixteen different transposable element families were identified, making up 10% of the preliminary genome. Viral GO Terms were enriched in comparison to *Vaccinium corymbosum*. Analyses of this assembly may shed light on genetic and evolutionary forces in the evolution of the genus and subfamily. This genome assembly helps us to improve detection of genetic differences and relationships among manzanita species and enable future research.

## 11.

### **DEFINING PARAMETERS OF POTENTIAL ERRORS IN UNSUCCESSFUL LIGATION**

Junyao Yuan '21, Zimo Huang '21

Faculty Sponsor: Robert J. Fleming

The Notch signaling system is a conserved cell communication pathway that plays significant roles in the development of most of vertebrates. To further our investigation of essential amino acid regions located in the juxtamembrane region of Serrate, we needed to generate DNA constructs that alter the coding region of this gene. Two separate DNA constructs were attempted and both projects required successful DNA ligation processes to piece together different segments of DNA into a single coding construct. DNA ligation has become an albatross for the Fleming lab as we have not been able to reliably achieve success at ligation for the past two years. We undertook an extensive series of control experiments in an attempt to identify the problematic step or steps that

have prevented this technique from working reliably. We will describe these procedures and the results of these controls herein.

## 12.

### **REVEALING INDIVIDUAL-LEVEL PREY RESPONSES TO PREDATION RISK**

Zach Yung '22, Marta Drausnik '22

Faculty Sponsors: Ben Toscano, Hassen Allegue

Prey often modify their behavior to reduce the chances of being eaten. For example, some prey species will take longer to emerge from a refuge in the presence of predation risk. Previous work characterized population-level responses to risk, but individual-level responses could provide new insight into the fitness consequences of individual behavior. Our study system consisted of 100 snails (*Helisoma trivolvis*) and crayfish (*Faxonius limosus*) collected from the South Brook Park River (Hartford, CT). Each snail was assayed across four levels of predation risk in order to measure its behavioral reaction norm. We found that, at the population-level, mean emergence time from the shell (i.e. refuge) increased with risk. Yet, at the individual-level, snails differed in the elevation and slope of their emergence time responses. Our future work will explore the drivers and ecological consequences of these complimentary aspects of individual-level behavioral variation.

## **CHEMISTRY**

## 13.

### **IN VITRO MEASUREMENT OF PROTEIN KINASE B ACTIVITY ON PEPTIDE SUBSTRATE REPORTERS**

Sababa Anber '20

Faculty Sponsor: Michelle L. Kovarik

Protein kinase B (PKB or Akt) is an essential enzyme that regulates metabolism, survival and apoptosis in many cell types. The activity of PKB in intact cells and cell lysates can be measured using fluorescently-labeled peptide substrate reporters, such as Crosstide, AP-I and VI-B, coupled with high efficiency capillary separations. The goal of this experiment was to study the rate of PKB enzyme activity in vitro, using the three peptide-substrate reporters and purified human PKB. Seven concentrations of each peptide (2 - 50  $\mu\text{M}$ ) were incubated with PKB, ATP and co-factors, and the reactions were stopped at various times between 0 to 30 min. The reaction mixtures were then assayed by micellar electrokinetic chromatography. The percent area of phosphorylated and non-phosphorylated peaks generated from the instrument indicated the enzyme activity. As expected for Michaelis-Menten kinetics, we observed that rate of phosphorylation increased with substrate concentration until it reached its maximum velocity ( $V_{\text{max}}$ ). For the Crosstide peptide, triplicate experiments yielded values of  $V_{\text{max}}$  and  $K_M$  of  $3.1 \pm 0.3 \times 10^{-11}$  mol/min and  $11 \pm 2$   $\mu\text{M}$ . For the AP-I peptide, triplicate experiments yielded values of  $V_{\text{max}}$  and  $K_M$  of  $2.3 \pm 0.2 \times 10^{-11}$  mol/min and  $13 \pm 4$   $\mu\text{M}$ . Preliminary experiments with VI-B suggest  $V_{\text{max}}$  value of  $8 \times 10^{-12}$  mol/min and  $K_M$  value of 21  $\mu\text{M}$ . Future work will include producing triplicate results for VI-B as well as repeating the experiment using purified PKB from *Dictyostelium discoideum* cells. These

results will allow us to make quantitative comparisons of PKB substrate preferences between species.

#### **14.**

### **SEX DIFFERENCES IN NEUROCHEMICAL RESPONSES TO COCAINE AND A KETOGENIC DIET IN RATS**

Ahmad Chughtai '20

Faculty Sponsor: William H. Church

Past research has shown that the dopamine system is linked to the rewarding effects of drugs and has demonstrated the presence of sex differences in behavioral and neurochemical responses to drugs of abuse such as cocaine. This study focused on investigating sex differences in the ketogenic diet mediated neurochemical response to cocaine. Changes in the chemical dynamics of dopaminergic reward pathways were measured in male and female rats following chronic cocaine administration and used to compare animals given a ketogenic diet with animals given a control diet. The brain regions that were analyzed in this study included the cortex, nucleus accumbens, striatum, and midbrain. HPLC with electrochemical detection was used to quantitate NE, DA, DOPAC, HVA, 5HT, and 5HIAA in these areas. Results indicated that there was a sex-specific effect of the ketogenic diet in dopaminergic activity following acute cocaine challenge.

#### **15.**

### **INVESTIGATING THE BINDING SITE OF OSTEOCALCIN ON BOVINE TYPE 1 COLLAGEN**

Audrey Ettinger '20

Faculty Sponsor: Richard Prigodich

Osteocalcin is a protein found in bone that binds to collagen fibers and is anchored tightly in gap regions by calcium ions found in crystalline hydroxyapatite. In the crystal structure of osteocalcin, alpha-helices with many acidic residues are what bind to this hydroxyapatite, and the structurally undefined N-terminus binds to collagen. Previous research in the Prigodich Lab discovered the role of the N-terminus binding to collagen, but the binding site on collagen is still unknown. Three analytical methods were used to study the structure of osteocalcin and its binding properties to type 1 collagen. The N-terminus of osteocalcin was analyzed using Circular Dichroism, which can be used to study the secondary structure of proteins. CD indicated less disorder as the length of the N-terminus increased. The N-terminus of osteocalcin was combined with atelocollagen and telocollagen separately and analyzed with UV-Vis spectrometry in order to calculate disassociation constants and observe the importance of telopeptides for binding. Ultimately, loss of telopeptides decreases binding 10-fold between osteocalcin and type I collagen. <sup>1</sup>H NMR (1D & 2D) was used in order to assign and identify osteocalcin peaks for reference in later STD-NMR experiments.

#### **16.**

## **MICROCHIPS WITH SUPPORTED PHOSPHOLIPID BILAYER AS A TOOL TO ANALYZE THE CHEMICAL STATE OF INDIVIDUAL *Dictyostelium discoideum* CELLS**

Jonathan Fan '22

Faculty Sponsor: Michelle L. Kovarik

This work utilizes microfluidics, the use of channels with the dimension of less than 100  $\mu\text{m}$ , to analyze the chemical state of individual *Dictyostelium discoideum* cells. Several different tools, such as peptide substrate reporters, and small molecules like carboxyfluorescein and dichlorofluorescein, are used to measure the chemical state of individual cells. The peptide substrate reporter VI-B is a fluorescently labeled peptide that is designed to measure the activity of protein kinase B. Dichlorofluorescein (DCF) and carboxyfluorescein (CF) are used to measure reactive oxygen species. The goal of the project is to find an optimal condition to separate these molecules using electrophoresis in cell lysates after the molecules are loaded into the cell. In order to achieve this goal, a supported bilayer membranes (SBM) coating is needed on the microfluidics devices to prevent cells from adhering to the inside of the microfluidics channel and facilitates separation. The SBMs can either be neutral, positively charged, or negatively charged, and the direction and the magnitude of electroosmotic mobility can be tailored in a predictable manner by controlling the lipid composition of the SBMs. The combination of 50% 1-palmitoyl-2-oleoyl-*sn*-glycero-3-ethylphosphocholine (positively charged) and 50% phosphatidylcholine (zwitterionic) molar ratio lipids enabled both the unmodified VI-B and the p-VI-B to migrate toward the detector in anodic electroosmotic flow. The combination of 30% L- $\alpha$ -phosphatidyl-DL-glycerol (negatively charged) and 70% phosphatidylcholine (zwitterionic) molar ratio lipids enabled the unmodified VI-B, the p-VI-B, DCF, and CF to migrate toward the detector in cathodic electroosmotic flow. This condition enables us to investigate both the PKB pathway and oxidative stress simultaneously. Future work includes completing an experiment to investigate the effect of SBM coatings on cell adhesion to the microchannel. In the long term, the optimized separation conditions in this work will be used to do single-cell analysis of *Dictyostelium discoideum*.

### **17.**

#### **MEASUREMENT OF MTOR ACTIVITY USING A CUSTOM-MADE PEPTIDE SUBSTRATE REPORTER**

Daniel Feldman '21, Grigorii Kalminskii, Sameir Madden '19

Faculty Sponsors: Hebe M. Guardiola-Diaz, Michelle L. Kovarik

mTOR, known as the mechanistic target of rapamycin, is a serine/threonine kinase that forms two complexes, mTORC 1 and mTORC 2. These complexes are involved in regulating anabolic processes, such as cellular growth and proliferation, and conserved catabolic processes, such as autophagy. The goal of this project is to measure the activity of mTOR using a custom peptide substrate reporter. A peptide substrate reporter is a fluorescently labeled peptide sequence, 3-20 amino acids in length, that can be acted upon a certain enzyme of interest. The reporter sequence, 6FAM-WYYAGSPHN, was formulated using a proteomic data set indicating conserved amino acid residues near the phosphorylation sites of native mTOR substrates. We optimized the capillary electrophoresis buffer to separate fluorescent fragments of the unmodified reporter to distinguish the phosphorylated peak from the fluorescent fragment peaks. The ability to resolve all fluorescent

fragments of the reporter is important for *in vivo* experiments, where peptidases could cleave the reporter into its fluorescent fragments. MALDI-TOF MS was used to confirm the fragmentation pattern of the custom-made peptide substrate reporter produced by pronase E. Additionally, two mutant HEK 293 cell lines were lysed to study *in vivo* mTOR activity, one over-expressing the wild-type mTOR kinase domain and the other expressing constitutively active mTOR. *Dictyostelium discoideum* cells were also lysed to detect *in vivo* TOR activity. We tested a variety of lysis conditions used in different studies that were hypothesized to keep mTOR complexes intact and functional for kinase experiments. Current results show that the peptide reporter experienced greatest degradation with the constitutively active mTOR HEK 293 cell type. The addition of rapamycin to any cell type created less degradation of the peptide reporter. In addition, MALDI-TOF MS confirmed the presence of the intact reporter as well as a few other fluorescent and nonfluorescent fragments. Future research will be getting the custom-made peptide substrate reporter phosphorylated by mTOR in HEK 293 and *Dictyostelium discoideum* cell lysates. Also, a series of Michaelis–Menten kinetics experiments will be conducted with the reporter and the active 1362-end kinase domain of the mTOR enzyme.

## 18.

### **SOLID PHASE PEPTIDE SYNTHESIS FOR MAKING LARGER $\beta$ -SHEET PEPTIDES**

Anna Maria Imwalle '20

Faculty Sponsor: Timothy P. Curran

The Curran lab focuses on developing a model system for studying  $\beta$ -sheets using organometallic chemistry in order to study their behavior. One long term goal of this research is to study the effects of amyloid proteins, which are any misfolded proteins that are mostly  $\beta$ -sheets (i.e. Amyloid B – the protein involved in the progression of Parkinson's Disease).'

In order to efficiently and quickly synthesize peptides for these studies, solid phase peptide synthesis (SPPS) will be used as a synthesis method. As of now, the effectiveness of the Merrifield method is being studied by synthesizing a short peptide strand and analyzing the reaction yield and product purity. So far a high yield and excellent purity for the target peptide have been obtained.

Beyond solid phase peptide synthesis, this summer, using solution phase synthesis we have created a ferrocene sandwich complex with two diazoglycines, each having a C-terminal t-butyl ester. This was formed by first creating the diazoglycine derivative and then combining it with a dialkyne. This compound was purified by column chromatography and the pure product was separated in good yield.

## 19.

## **USING THE SODIUM BISULFITE PROTOCOL TO EXTRACT ALDEHYDES FROM MIXTURES WITH KETONES**

Amodini Katoch '22

Faculty Sponsor: Cheyenne S. Brindle

Purification is very important in chemistry in order to be able to further experiment with one's desired compound. In previous experiments it has been shown that the sodium bisulfite protocol is effective in removing aldehyde contaminants and different carbonyl compounds from a given mixture. In this experiment we examined the protocol's ability to remove aldehyde contaminants when mixed in a solution with ketones. It is useful to be able to remove aldehyde contaminants in a mixture of ketones because it would mean that one would be able to accurately and efficiently purify a solution that has two very structurally similar compounds. This process can also be applied to an industrial process called the Wacker-Tsuji Oxidation which creates both ketones and aldehydes as a mixture of products. By using the sodium bisulfite protocol we can purify both the ketone and aldehyde by separating them from one another. By using decreasing volumes of sodium bisulfite solution and using different aldehyde and ketones we were able to identify the optimal volume of sodium bisulfite that produces the greatest separation selectivity between aldehydes and ketones. Finally, the sodium bisulfite protocol was applied to a test Wacker Oxidation of styrene which creates a 10:1 mixture of aldehyde and ketone products. We found that the aldehyde was selectively removed, however, re-isolation was problematic. In the future we will look at less volatile styrene derivatives in order to improve re-isolation.

### **20.**

## **DETECTION OF URIC ACID METABOLITES AS POTENTIAL BIOMARKER FOR PARKINSON'S DISEASE**

Kevin C. Lyskawa '22

Faculty Sponsor: William H. Church

Early detection of the neurodegeneration associated with Parkinson's Disease (PD) could benefit the development of effective therapies. Previously, plasma from PINK-1 knockout rats (an animal model of PD) showed an increase in products resulting from uric acid (UA) neutralization of reactive oxygen species (ROS). Using LC-MS with multiple reaction monitoring, similar analysis was carried out on homogenate from various brain nuclei of the same animals. Elevated levels of allantoin were found in dopaminergic (DAergic) terminal regions of the PINK 1 knock-out rats when compared to wild type, while no increase was observed in the midbrain (DAergic cell body region). The increase of allantoin in the terminal regions suggests an increase in superoxide (an ROS) production which may reflect changes in terminal field metabolism associated with synaptic activity. Data from both plasma and brain analysis suggests that compounds resulting from the neutralization of ROSs by uric acid could serve as novel biomarkers associated with active neurodegeneration.

### **21.**

## **SELECTIVE DETECTION OF SUPEROXIDE ANION: SYNTHESIS OF A FLUORESCENT PROBE**

Olesya Martynova '20

Faculty Sponsors: Michelle L. Kovarik, Cheyenne S. Brindle

Superoxide anion has been linked to various pathological diseases, such as malignant tumors and coronary disease. Detection of the superoxide radical in living cells in real time via fluorescence spectroscopy can become the first step in prevention of these illnesses. However, superoxide is not fluorescent, so an indicator probe must be synthesized in order to react with the radical to make it detectable. Current work toward the synthesis of the fluorescent probe DBZTC (2-chloro-1,3-dibenzothiazolinedicyclohex-ene) is being optimized to allow for an efficient route to this molecular probe. The optimization involves improving the purity of the intermediates and enhancing the yield. The first step of the synthesis is the production of (E)-2-chloro-3-(hydroxymethylene)cyclohexene-1-carboxaldehyde using a version of the Vilsmeier–Haack reaction. The structure and purity of this intermediate has been analyzed with <sup>1</sup>H NMR and GCMS. The second step of the synthesis involving the formation of an N,S-acetal to form the complete superoxide probe structure have been completed and will be tested via elemental analysis. The purity of the final structure is under investigation. Future work includes testing the fluorescent properties of the probe and its effectiveness in detection of superoxide radicals.

22.

## **SPECIFICITY OF PEPTIDE SUBSTRATE REPORTERS FOR PROTEIN KINASE B FROM *Dictyostelium discoideum***

Misha Mehra '21

Faculty Sponsor: Michelle L. Kovarik

Cell signaling pathways are complex networks that involve many different molecules, feedback loops, and redundancies. These complexities are difficult to disentangle, but high efficiency capillary separations are a useful tool in meeting this challenge. We are using micellar electrokinetic chromatography (MEKC) to investigate the specificity of three peptide substrate reporters (VI-B, AP-I or Crosstide) and conclude which is most specific for protein kinase B (PKB) in the social amoeba, *Dictyostelium discoideum*. When *D. discoideum* cells are starved, they produce cAMP, which results in aggregation of the amoebae via the PI3K-PKB signaling pathway. The activity of PKB can be measured using peptide substrate reporters, which are fluorescently-labeled 8-15 amino acid sequences. We hypothesized that the addition of cAMP would increase phosphorylation of reporters specific to PKB and the addition of LY294002, a PI3K inhibitor, would reduce phosphorylation of reporters specific to PKB. Optimized MEKC conditions were used to separate the unmodified peptide substrate reporters from enzymatic products, including the phosphorylated reporters. The VI-B peptide was separated in 15 mM borate and 100 mM SDS at pH 11.4, while AP-I and Crosstide separations used 100 mM borate, 100 mM SDS at pH 7.7. As expected the (+cAMP –LY294002) treatment had highest phosphorylation. Crosstide and AP-I had higher percent phosphorylation than VI-B and all three peptides show similar inhibition by LY294002. To further assess specificity, we are comparing phosphorylation of the reporters at two points in social development. PKB has two isoforms – PKBA (expressed early in social development) and PKBR-1 (expressed later in social development). PKBA is PI3K-dependent,

while PKBR-1 is not, making PKBA more susceptible to LY294002 than PKBR-1. The preliminary 6 h data obtained shows lower percent change when compared to the 1 h data, which is consistent with the fact that the PKBR-1 isoform is not susceptible to the addition of the LY294002 drug. Further work is being done to compare the two social development times.

### 23.

#### **PROBING INTRAMOLECULAR HYDROGEN BONDING OF PEPTIDES ATTACHED TO A RIGID ORGANOMETALLIC RING SYSTEM**

Jeanvier Soungwah '21

Faculty Sponsor: Timothy P. Curran

Research in the Curran lab led to the discovery of a rigid, bimetallic ring system in which two alkynes are coordinated to tungsten and held next to each other at a distance of approximately 3.3 Angstroms. This is the distance between two peptides in a beta-sheet. Work is ongoing to see if peptides attached to this rigid, bimetallic ring system will adopt beta-sheet conformations. Derivatives of the ring system in which peptides are attached via a methylenecarboxyl linker (CH<sub>2</sub>CO) have shown great promise, but the pattern of hydrogen bonding seen experimentally suggests that hydrogen bonds at the ends of the peptides are not held tightly. To explore this further, a shortened non-peptide ester derivative was prepared and examined. Details about how this derivative was made and how it behaves will be presented.

### 24.

#### **OPTIMIZING THE REMOVAL OF ALDEHYDES FROM MIXTURES USING SODIUM BISULFITE**

Hanna Vescovi '21

Faculty Sponsor: Cheyenne S. Brindle

Sodium bisulfite reacts with aldehydes to create a charged adduct, allowing the aldehyde to be removed from mixtures by liquid-liquid extraction. Previously we noted that the effectiveness of sodium bisulfite at removing aldehyde contaminants from mixtures decreased when a change in the source of the bisulfite occurred. The previous source of bisulfite was over 20 years old, thus we focused our efforts on potential differences related to aging processes. In order to restore optimal activity and pinpoint the source of difference, a variety of parameters were optimized for their ability to remove aldehyde contaminants. Optimization focused on examination of temperature, pH, buffers, water, and oxidation by-products. The results showed that the removal rate was improved by inclusion of citric acid buffers and low-water content methanol as the initial miscible solvent. Removal rates were improved to 97% under these conditions. While high, these rates do not reach the levels previously observed with our vintage bisulfite. While continuing to examine factors that may differentiate batches of bisulfite, we are also using our improved conditions to investigate the isolation of aldehydes from complex mixtures, such as plant extracts.

### 25.

## **DOSE-DEPENDENT EFFECTS OF 2,3,7,8-TETRACHLORODIBENZO-*P*-DIOXIN (TCDD) ON ACETYL-COA METABOLISM**

Nicholas A. Zacharewski '23

Faculty Sponsors: Dr. Kelly A. Fader, Dr. Rance Nault, Russell Fling, Michigan State University

Acetyl-CoA is a two-carbon metabolite that plays a central role in carbohydrate, lipid, and protein metabolism. Its primary function is to deliver an acetyl group into the Krebs cycle leading to further oxidation and production of adenosine triphosphate (ATP). 2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin (TCDD), a persistent environmental contaminant, has been shown to cause the development and progression of steatosis to steatohepatitis in mice resembling human non-alcoholic fatty liver disease (NAFLD). TCDD activates the aryl hydrocarbon receptor (AHR), a transcription factor responsible for regulating gene expression. TCDD has been reported to cause central carbon metabolism reprogramming in mice, however the effects on acetyl-CoA metabolism have not been fully investigated. In this study, C57BL/6 male mice were orally gavaged every 4 days for 28 days with sesame oil vehicle control or 0.01, 0.03, 0.1, 0.3, 1, 3, 10, and 30  $\mu\text{g}/\text{kg}$  TCDD. Hepatic acetyl-CoA levels and gene expression were examined using untargeted liquid chromatography tandem mass spectrometry and RNA-Seq analysis, respectively. At 3, 10, and 30  $\mu\text{g}/\text{kg}$  TCDD, hepatic acetyl-CoA levels decreased 1.9-, 28.5-, and 6.4-fold, respectively. TCDD also repressed *Acacb* (2.3-fold), *Acly* (4.29-fold), and *Acss2* (8.8-fold) at 30 $\mu\text{g}/\text{kg}$ . Decreased protein levels of ACAC $\alpha/\beta$ , ACLY and ACSS2 were confirmed using the WES ProteinSimple System, suggesting sources (e.g. citrate and acetate) and utilization (e.g. fatty acid biosynthesis) of acetyl-CoA were repressed. Further studies will examine the significance of acetyl-CoA depletion in the progression of steatosis to steatohepatitis.

## **ENGINEERING**

26.

### **MODELING THE VEHICLE-TO-VEHICLE WIRELESS PROPAGATION CHANNEL**

Marios Bourtzonis '22

Faculty Sponsor: Lin Cheng

Wireless propagation channels are a largely untapped field of engineering that can innovate and improve modern-day society. Especially when it comes to vehicle-to-vehicle propagation channels, there is still a lot of research to be done to accurately model and predict the behavior and characteristics of these channels. Because on-field data collection is rigorous and requires extensive time, equipment, and resources, simulated data can be used to reproduce real-world environments. Simulated environments intend to precisely imitate real-world scenarios in urban, suburban, and rural areas. Using parameters provided by the simulated environment, we can use different models to predict the physical characteristics of communication channels, such as different power delay profiles and Doppler power spectra. Comparing these results to real-world measurements will assist in validating the models and deeming them effective to describe the physical nature of wireless propagation channels, opening the doors to a variety of potential applications to scientists. Power delay profiles plot the power received on a multi-path channel as a function of time delay, while Doppler power spectra characterize the relationship between a

frequency spectrum and the corresponding amplitude. Physical models from scientific literature were implemented to output the delay profiles and Doppler spectra given a communication pair and parameters, with the intention to be compared to real-world data to evaluate the accuracy of the models. If the model can be verified, it will allow scientists to continue making breakthroughs and improving their understanding of wireless propagation channels, which can assist with traffic control, road accident prevention, and various other on-road applications that will benefit society.

**27.**

### **TELELOCOMOTION – REMOTELY OPERATED LEGGED ROBOTS**

Digesh Chitrakar '22, Rahul Mitra '21, Hassan Rashid '22, Isabella Yung '22

Faculty Sponsor: Kevin Huang

Teleoperated systems enable active human control of robotic proxies and are particularly amenable to dangerous or inaccessible environments unsuitable for autonomy. Examples include emergency response, underwater manipulation, robot assisted minimally invasive surgery and handling of high-value delicate structures. However, teleoperation architectures have been predominantly employed in manipulation tasks, and are thus only useful when the robot is within reach of the task. This work introduces the idea of extending teleoperation to enable online human remote control of legged robots, or telelocomotion, to traverse challenging terrain. Traversing rough or unpredictable terrain remains a challenge for autonomous legged locomotion, as demonstrated by robots commonly falling in high-profile robotics contests. Collapse can result in high mission costs, damages, loss of time and can ultimately render the critical task incomplete with unrecoverable failure. Telelocomotion can reduce this risk of mission failure by leveraging the high-level understanding and adaptability of human operators to command in real-time the gaits of legged robots. Inspired by the established benefits of haptic feedback in teleoperation, a haptic telelocomotion interface was developed. An extensive within-user study was then conducted to assess the proof-of-concept telelocomotion interface. The study compared basic keyboard and joystick interfaces with the haptic interface for control of a simulated hexapedal robot. Results are promising to the use of haptic feedback for telelocomotion, particularly for more complex traversal tasks such as stairs.

**28.**

### **VISIBLE LIGHT COMMUNICATION FOR VEHICLE TO VEHICLE APPLICATIONS**

Andrew Clark '21

Faculty Sponsor: Lin Cheng

Visible light communication (VLC) utilizes light rays, usually from an LED, as a means to transmit a signal to a photodetector receiver. By using a vehicle headlamp as the transmitter to a photodetector mounted on the back of another car it is therefore possible to create a vehicle to vehicle (V2V) network. This provides many benefits including increased security, increased bandwidth, low power consumption and easy implementation. For this system to become a reality, however, many simulations must be generated in order to predict how the system will perform. While simple in theory, the actual model requires a certain level of complexity due to the intricacy of vehicle headlights.

29.

### **DEVELOPMENT OF VIRTUAL REALITY APPARATUSES THROUGH MODIFICATION OF EXISTING PSYCHOLOGY SOFTWARE**

Logan W. Drescher '21

Faculty Sponsors: Michael Grubb, Kevin Huang

The topic of ocular suppression has been extensively covered in the field of neuroscience. In those studies, the effects of suppression have been investigated using complicated setups meant to hold the user's head in place. However, such configurations are both expensive and unwieldy, and as such could use a technological replacement. By replacing the traditionally restrictive harness with a minimalistic virtual reality (VR) headset, much of the complication of the physical setup can be minimized. However, software for the headset has to be designed such that it is easy for any neuroscientist to pick up and use. Towards that goal, development has started on updating the codebase of PsychoPy, a Python library and GUI to make psychology experiments with standard computer equipment. Development of the edited software has started; however, it has not been completed yet. Due to a series of dependency problems and semantic errors, the code is too unstable for human testing. However, the code can run in a limited fashion and qualitative evidence reveals that ocular suppression occurs in virtual reality. Should the software be stabilized and testing reveal similar results to previous studies on suppression, a new type of research will start to emerge from neuroscience. Different phenomena may be revisited under the lens of virtual reality, with the hopes that new information may be gleaned.

30.

### **ENERGETICS AND DECAY OF ISOTROPIC TURBULENCE FROM AN OSCILLATING GRID**

Kieran Neath '22, Ahmed Eldmerdash '20, Ike Njoroge

Faculty Sponsor: Clayton Byers, National Aeronautics and Space Administration (NASA)

Subjecting stagnant liquids to the movement of an oscillating grid produces nearly isotropic, homogeneous turbulence. When isolated from outside motion, energetics and decay of said isotropic turbulence can be investigated by resolving velocity components of particles constituting the system. Modelling these particular decays provides a step forward in solving De Karman and Howarth's differential equation.

$$\frac{\partial F}{\partial t} = \frac{1}{r^4} \frac{\partial}{\partial r} \left[ r^4 \left( K + 2\nu \frac{\partial F}{\partial r} \right) \right]$$

(de Karman & Howarth, 1938)

In this equation,  $F$  is a correlation of the velocity at two points in the flow field and  $K$  is a correlation of the square of velocity at one point with the velocity at another. Using this mathematical expression enables turbulence in a decaying isotropic field to be statistically described. One can consider the term on the left as the rate of change of kinetic energy in the fluid (which always decreases), while the last term on the right represents the dissipation of energy due to viscous fluid forces.

This research is conducted using oscillating grids to create homogeneous isotropic turbulence within water in a stationary tempered glass tank. Grids are fabricated using metal and are driven by a reciprocating motor able to vary torque and frequency. The velocity of the fluid is estimated by populating the flow with small particles that travel with the motion of the fluid. The velocities of particles are analyzed using two-dimensional particle image velocimetry in which a high speed camera records movement of silver particles placed within the water on which laser light will be reflected. This process is carried out during turbulence decay - which takes place when the grid stops oscillating and the kinetic energy of the fluid decreases due to viscous dissipation. Results of this research will be used to form a deeper understanding of how turbulence decays and create more accurate mathematical models for it. Changing characteristics of particular grid sizing, including fractal elements in grid design and adding a second opposing grid will be variables that will be including in development of this research. Modelling and being able to describe the nature of turbulent flows can be applied to aerospace industry advancements and validations of computer simulations.

### **31.**

#### **MOSFET CHANNEL ENGINEERING AND SCALING STUDY USING COMSOL® MULTIPHYSICS SIMULATION SOFTWARE**

Divas Subedi '22

Faculty Sponsor: Deborah A. Fixel

With the scaling of semiconductor devices into the nanometer regime, short channel effects are an ever-present issue. Among these effects are threshold voltage variation with the channel length, reduced output resistance, punch-through, and hot-electron degradation. COMSOL Multiphysics is used to study the effect of constant-field scaling on a FIBMOS (focused-ion-beam metal-oxide-semiconductor) device compared to the conventional MOSFET (metal-oxide-semiconductor field-effect transistor). The transistors are constructed using silicon doped with different doping concentrations. A narrow P+ region with higher doping concentration than the substrate is implanted next to the source region to emulate an asymmetric device structure that is made using the Focused-Ion-Beam technique. The effects on mobility of the carriers due to lattice vibrations, ionized impurity ions, carrier concentrations, surface effects, and presence of large electric fields have been addressed by incorporating Mobility Models into the simulator. Recombination of the carriers has been considered by implementing the Shockley-Read-Hall Recombination Model. Building on the previous work done by Shen et al., simulations are conducted on a conventional MOSFET as well as a FIBMOS transistor for 122.5-nm, 175-nm, 245-nm, and 350-nm channel-length devices. An investigation is conducted on threshold voltage stability upon channel length variation, output resistance, electrical field inside the channel, and sub-threshold conduction to see if the FIBMOS demonstrates the characteristics of an ideal transistor compared to the conventional MOSFET. The simulations show that the FIBMOS device demonstrates greater threshold voltage stability upon channel length variation, improved output resistance, greater resistance to the punch-through effect, and reduced hot electron degradation.

### **32.**

## **SIMULATING AN ACCURATE VEHICLE PROPAGATION NETWORK ON CALIFORNIA HIGHWAYS USING PEMS AND GEMV<sup>2</sup>**

Erkin Verbeek '21

Faculty Sponsor: Lin Cheng

An accurate vehicle network simulation is essential for efficient future developments of Vehicular Ad-hoc Networks. Vehicle-to-vehicle (V2V) propagation characteristics vary greatly from small scale to large scale as well as over time. A physically measured propagation network of the required scale would be an incredibly expensive and arduous process, therefore an accurate simulated approach is necessary.

Using measured public highway traffic data from across California supplied by PeMS, combined with roadway definitions from the Open Street Map project, allow us to realistically simulate a highway for different time and spatial variances. We port those simulations into a MATLAB-based propagation model called GEMV2 to produce the propagation network, and then we analyze the resulting metrics.

### **33.**

## **LASER ABSORPTION MEASUREMENTS OF CARBON MONOXIDE DURING DIMETHYL METHYLPHOSPHONATE (DMMP) PYROLYSIS AND OXIDATION IN A SHOCK TUBE**

Hannah Zukowski '21

Faculty Sponsors: John D. Mertens, Dr. Eric Petersen, Texas A&M University, Sulaiman Alturaifi, Texas A&M University

The purpose of studying the chemical weapon, Sarin ( $C_4H_{10}FO_2P$ ), is to understand how to destroy it through combustion. By studying the combustion of molecules with similar chemical composition to Sarin, knowledge of the combustion chemistry of Sarin can be improved. Molecules similar to Sarin (surrogates) include dimethyl-methylphosphonate (DMMP), diethyl-methylphosphonate (DEMP), and triethylphosphate (TEP). Therefore, the purpose of this study was to run pyrolysis and oxidation DMMP experiments with a shock tube, measure CO production, OH\* and PO<sub>2</sub>\* emission, and compare these results with the predictions of the current kinetics models. Through studying the products of combustion of DMMP at various temperatures, kinetics models can be improved to aid in further understanding of the chemical combustion of Sarin.

# **ENVIRONMENTAL SCIENCE**

34.

## **DISINFECTION BYPRODUCT FORMATION MECHANISMS IN DRINKING WATER TREATMENT**

Sophia Georgiou '22

Faculty Sponsor: Arianne A. Bazilio

During conventional drinking water treatment, granular filtration is used to clean the water and disinfectant chemicals are also used for catalytic oxidation of dissolved manganese (Mn(II)) adsorbed to manganese oxides. One of the disinfectant chemicals used is free chlorine. Although this helps to kill pathogens, the organic matter in the water may react with chlorine to form halogenated disinfection byproduct (DBPs). Previous research suggested that the rate of formation of the brominated DBPs decreases during Mn(II) removal but more research was required to test this hypothesis. In order to test the effects of Mn(II) removal by catalytic oxidation on the concentration of the DBPs, a simulation of the events was prepared using manganese oxide particles to test the reaction. The final concentrations of the bromine, chlorine, and the DBPs would then be measured. The results would then be compared to control groups. The specific DBPs that to be measured were trihalomethanes (THMs) and halo acetic acids (HAAs). In order to measure these a gas chromatograph was supposed to be used; however, the machine did not produce proper separate peaks and therefore the final concentrations could not be measured accurately. Brominated DBPs are more genotoxic and carcinogenic than their chlorinated counterparts and therefore it was important to note the bromate and bromide concentrations in these reactions. In looking at the bromate concentration, the ion chromatograph (IC) was used. This machine also presented problems with separation of peaks due to it containing an improper column. When the suitable column was used, the required separation was achieved but the summer research program was ending. Research will continue in the future because of the health and safety concerns that these halogenated brominated byproducts present

35.

## **ANALYZING ALUMINUM, IRON AND PHOSPHORUS CONCENTRATIONS IN THE LAKE AUBURN, ME WATER COLUMN TO DETERMINE THE ROLE PLAYED BY INTERNAL P LOADING**

George Kapanadze '20

Faculty Sponsor: Arianne A. Bazilio

The objective of the research was to build on prior work focused on metals in Lake Auburn sediment to provide an explanation for the decreased water quality observed at the site in 2011 and 2012. As the lake has historically been a pristine water source serving over 60,000 residents, this decline was important as it led to both fish kill and algal blooms. Aluminum, iron and phosphorus concentrations were determined to deduce whether internal P loading in Lake Auburn, ME was the primary cause of elevated phosphorus concentrations. Water samples were obtained at six different sites along the lake at varying depths and stored in Nalgene bottles. Multiple sampling events took place over the course of the summer but due to time constraints not all samples were

analyzed. Method detection limits were found for each metal to determine the lowest concentrations that could be reliably measured using Inductively Coupled Plasma Mass Spectrometry. The measured concentrations from one sampling event did not show any variation in aluminum and iron concentrations as values were consistent throughout the sampling sites. Phosphorus concentrations were only elevated at the effluent site which is expected due to the addition of corrosion control before distribution to reduce the amount of lead dissolving into water from pipes. As the project was not fully completed, conclusions about the importance of internal P loading to decreased water quality in Lake Auburn cannot be drawn. Further research should be conducted to identify the role that internal P loading has on phosphorus concentrations as well as the relationship with lake stratification.

### **36.**

#### **PRODUCTS (PPCPs) IN WATER**

Blen Mengesha '21

Faculty Sponsor: Arianne A. Bazilio

The level of Pharmaceuticals and personal care products (PPCPs), which include antibiotics, hormones, synthetics, etc., have raised significantly leading a threat to the aquatic ecosystem and human health. PPCPs can be released into the aquatic environment from wastewater treatment plants (WWTPs) which were not built to remove these compounds from human waste. Ibuprofen, naproxen, ketoprofen, diclofenac, and bezafibrate are commonly found in effluent WWTPs. Studies have shown that PPCPs in water sheds are increasing, raising concern about adverse effects on the aquatic ecosystem and human health. There is a limited amount of research on the amounts of PPCPs in ecosystems, but PPCPs are ranked as highly toxic to aquatic organisms. The study involves replicating and improving existed methods that have been used to measure PPCPs in water. The result indicates a working method was successfully established. After optimizing the liquid chromatography mass spectrometer (LC-MS) operational parameters, good chromatography separation and detector signals were observed. Future research on PPCPs in watersheds includes adding more analytes and evaluating the separation, conducting solid-phase extraction, and measuring these compounds in the water samples from study streams.

### **37.**

#### **ELEVATION DEPENDENCE OF THE MAGNETIC PROPERTIES OF SOILS IN THE WHITE MOUNTAINS NATIONAL FOREST, NEW HAMPSHIRE**

Kayleigh Moses '22

Faculty Sponsor: Christoph Geiss

Soils provide valuable insight into Earth's climatic history. Most previous studies have focused on how properties of wind-blown dust (loess) correlate with rainfall patterns. The motivation for this study is that little knowledge is available regarding the properties of soils in correlation with elevation on mountains. This investigation studies vertical soil transects in the White Mountains National Forest in New Hampshire, USA. Since temperature (and precipitation) are expected to change with elevation, this study determines whether soil magnetic properties reflect these

changes. Three magnetic parameters were measured: Magnetic Susceptibility ( $\chi$ ), Anhysteretic Remanent Magnetization (ARM), and Isothermal Remanent Magnetization (IRM). Magnetic susceptibility accounts for the abundance of all magnetic particles, while ARM focuses on small magnetic grains and IRM focuses on large magnetic grains. The ratio of ARM/IRM was used as a proxy for soil development. The compilation of data from East-Facing slopes on Mount Lafayette, and Mount Moosilauke displayed significant decreases in ARM/IRM with elevation, confirming the strong influence of temperature and growing season length on soil development and magnetic enhancement.

**38.**

### **DISCOVERING AND UNDERSTANDING THE CAUSES OF INCREASED PYRRHOTITE DAMAGE IN CONCRETE**

Jordan Stephan '22

Faculty Sponsors: Jonathan Gourley, Christoph Geiss

Homeowners in northeastern Connecticut are facing problems of cracking in concrete found in their basements due to the mineral pyrrhotite, an iron sulfide that starts to break down to form larger sulfate minerals. We identify pyrrhotite by using a magnetic susceptibility test combined with a total sulfur analysis (CNS). To understand under what conditions pyrrhotite breaks down, two of the factors of deterioration were examined. Two factors could be submersion in water and increased levels of oxygenation. By leaving samples submersed in water with high levels of oxygenation for periods of one to eight weeks, the effects of water and oxygenation on pyrrhotite concentration were examined. After submersion, the samples were dried and tested for sulfur concentration using the CNS analyzer. T-tests of the results showed that submersion and increased oxygenation did have a significant impact on the rate of deterioration of pyrrhotite. When samples from each week of the submersed concrete were compared to each other, the sulfur concentrations for the submersed samples showed a steady decrease in percent sulfur over time. The study showed that percent sulfur (and therefore the amount of pyrrhotite) changed significantly from week 0 to week 7 during testing ( $p < .0001$ ,  $df=10$ ). Although this test showed that water and oxygen are both causes of increased deterioration of pyrrhotite, other options could still be considered as factors that could lead to deterioration. Understanding how even more deterioration occurs could help find threshold levels of pyrrhotite before damage occurs.

**39.**

### **USING GROUND PENETRATING RADAR TO MAP SUBSURFACE GLACIAL DELTA DEPOSITS**

Chuck Sweeney '20

Faculty Sponsor: El Hachemi Bouali

Ground penetrating radar is a device used to image sub-surface features, whether they are geological or anthropogenic. The antennas on the GPR unit emit radar waves into the ground which bounce off reflectors (ex: soil composition change, large rocks, metal pipe, water saturation/water, etc.) and are received by the antenna to produce an image. For this experiment we selected River Highlands State Park in Cromwell, Connecticut as the site conditions are optimal

for using GPR. In addition, it has been documented that there are glacial delta deposits in the area. For the experiment, 100 MHz antennas were used to map these subsurface delta deposits to determine flow direction of the glacial outwash. Upon analyzing the results, it was discovered that River Highlands State Park is on top of a collapsed glacial delta morphosequence, that shows opposite flow direction on the GPR imaging. This discovery adds to Connecticut's glacial history and provides an application for GPR use.

#### **40.**

### **LONG-TERM EVALUATION OF A RIVER TURTLE COMMUNITY INFLUENCED BY HARVEST, HABITAT DEGRADATION, AND CLIMATE CHANGE**

Eleanor Tate '21, Myles Little '21

Faculty Sponsors: Amber Pitt, Joseph Tavano

In an effort to identify long term-changes in a river turtle community, we reexamined a 4.6 km section of the North Fork of the White River, Ozark County, Missouri that was previously studied in 1969, 1980, 2005, 2006 and 2007. We analyzed the 2019 data in comparison to the previous 2007 research to determine the habitat alterations, community composition, and population analysis of the Northern Map Turtle (*Graptemys geographica*). In previous studies during 1969 and 1980, *G. geographica* faced declining populations, than in 2005, 2006, and 2007 the population began to increase. Our 2019 results continue to indicate an increase in the *G. geographica* population. Our data, from 2019 indicates a more diverse community composition than previous data. The turtle population faced increased amounts of threat after a high intensity flood. Threats to the population included loss of nesting zones and basking habitat, water quality degradation and warmer water temperature due to decreased tree coverage over the banks, and increased human recreational use of the river.

#### **41.**

### **USING X-RAY DIFFRACTION TO FINGERPRINT CONNECTICUT ROCK AGGREGATE IN CONCRETE**

Stephen Tyler '21

Faculty sponsor: Jonathan Gourley

The use of pyrrhotite-containing concrete has become an issue in northeastern Connecticut as it was unknowingly used in the constructing concrete of hundreds, if not thousands, of basements and foundations dating back to the 1980s. The aggregate used in this concrete can be traced back to a quarry called Becker's quarry in Willington, Connecticut. This quarry mined a certain schist which contains elevated amounts of sillimanite, garnet, and pyrrhotite. Pyrrhotite is an iron-sulfide mineral that is highly reactive and may act as a donor for sulfate ions in the formation of secondary minerals. When aggregate containing pyrrhotite is used in concrete, these secondary minerals cause the expansion and thus cracking of concrete, which compromises its structural integrity. The minerals present in concrete can usually be identified by comparing diffracted X-rays in a sample of pulverized concrete to the expected diffraction angles of various minerals. After careful studying and analysis, concrete samples from Becker's quarry can be identified by observing certain diffracted peaks of sillimanite, garnet, and pyrrhotite. This method is not always 100%

reliable due to the sheer number of minerals and resulting X-ray peaks in concrete, which often overwhelm the lesser sillimanite, garnet, and pyrrhotite peaks. Since these 3 indicators are accessory minerals that are usually only found in trace amounts, the peaks they produce are small and may sometimes go unseen as they are consumed by the much larger peaks of more prominent concrete minerals such as quartz, graphite, calcite, and biotite. Two reliable tests to determine whether concrete is susceptible to internal sulfate attack have already been well developed, however the goal of this research is to gain the ability to use X-ray diffraction as an additional, reliable means of diagnosis and recognition.

## **MATHEMATICS**

**42.**

### **TAKING A “CLUSTERED” LOOK AT EU IMMIGRATION**

Hanae Bouazza '20

Faculty Sponsor: Ryan Pellico

This research presents an exploratory data analysis of immigration data from member nations of the European Union (EU). Using MATLAB, we performed hierarchical and k-means cluster analysis, as well as regression analysis on some of the survey data. The analysis is based on a special Eurobarometer survey published by The European Commission on April 2018 that aims to examine the “Integration of immigrants in the European Union”. The survey records a wide range of demographic data about immigrants as well as questions about “feelings towards immigrants” for citizens in each EU member nation. In Fall 2018, I conducted an Econometrics group project using a cross-sectional segment of the same data set. We concluded that residents' attitudes and feelings towards immigrants influenced significantly immigrants' choice of the country they would settle in inside the EU. This result motivated this summer research.

This research was conducted in two parts. First, we studied how countries with similar feelings towards immigrants are clustered and can be grouped based on their geographic position, political orientation, and/or economic growth both cross-sectional and over time. Then, we used the residents' attitudes as well as GDP per capita and population density to develop a random walk model that would use various parts of the survey data to determine the probability of a “random walker” immigrant in the EU would choose one country over another depending on his/her starting point. With a hope to continue developing the random walk model, I am currently undertaking a senior thesis in mathematics in Stochastic Partial Differential Equations and their applications to economics.

**43.**

### **THE SPECTRUM AND VIBRATION MODES OF HANOI GRAPHS**

Thu Bui '21

Faculty Sponsor: Ryan Pellico

The Hanoi graphs have been studied extensively for how they encode the space of all possible configurations and legal moves in the standard Towers of Hanoi puzzle on 3 pegs with  $n$  discs. In this project, we study the sequence of Hanoi graphs as discrete geometric objects, which approximate the Sierpinski gasket, a self-similar fractal. In particular, we use techniques from

linear algebra implemented in MATLAB to determine the eigenvalues and eigenvectors of the graph Laplacian, an  $n$  by  $n$  square matrix which encodes the adjacency structure of the graph. The collection of eigenvalues is known as the spectrum of the graph, while the collection of eigenvectors is known as the vibration modes of the graph.

We started by numerically computing the sequence of eigenvalues and eigenfunctions of the graphs with  $n$  less than 8 in MATLAB. After that, we looked for patterns in the behavior of the eigenvalues and observed two special gaps in the spectrum. Moreover, we spent time on finding how the eigenvalues at level  $n$  can be obtained from the ones at level  $n-1$ . Besides eigenvalues, we also used MATLAB to graph the eigenfunctions (vibration modes) in three-dimensions to look for patterns and symmetries in the eigenfunctions at different levels. We have completely characterized the relationship between the eigenvalues and eigenfunctions of level  $n$  and  $n+1$  for  $n=1$  and  $n=2$  and have some partial results for general  $n$ . In the future, we are working on the general recursive relationship between  $n$  and  $n+1$ , and proving the persistence of the spectral gaps as  $n$  approaches infinity.

**44.**

#### **THE ELECTRIC GUITAR: ANALYSIS OF HARMONIC FEEDBACK**

Benjamin Liske '20

Faculty Sponsor: Lauren Lazarus

Given its prominent appearance in Western popular culture, the electric guitar is a remarkably technical instrument. As its popularity rose, artists such as Jimi Hendrix and Pete Townshend began to use harmonic feedback in their music – learning to control this phenomenon became an essential aspect of the art of guitar playing. In this study, our objective was to determine which environmental and technical factors influence the spectral nature of this feedback; in other words, the balance of frequencies of the sound waves that build in these interactions. Our approach to this study was through the analysis of our own experimental recordings; from this, we used a numerical technique known as the Fourier transform in order to accurately determine the various amplitudes and phase shifts of the component waves of the electric signals. In our findings, the location of the guitar body's electromagnetic pickups, the devices which transmit electrical information to the amplifier, appeared to play a most crucial role in our harmonic content.

## **NEUROSCIENCE**

**45.**

#### **EFFECTS OF A KETOGENIC DIET ON PAIN TOLERANCE AND TACTILE SENSITIVITY ACROSS THE ESTROUS CYCLE IN FEMALE RATS**

Kimber Boekell '20

Faculty Sponsor: David N. Ruskin

A ketogenic diet is a restricted carbohydrate, adequate protein, very high fat diet that induces a metabolic state of ketosis, in which the body uses ketones rather than glucose as a primary fuel source. Prior research has shown the ketogenic diet to be effective in reducing inflammation and the diet has been used as a metabolic therapy for reducing seizures in individuals with epilepsy.

The proposed antiepileptic mechanisms of the ketogenic diet include the activation of potassium channels, adenosine A<sub>1</sub> receptors, and GABA receptors. Previous experiments have suggested that the antiepileptic mechanisms of the ketogenic diet may reduce tactile sensitivity and nociception in male rats, however these effects have not been tested in female rats. The goal of this experiment was to test the effects of a ketogenic diet on tactile sensitivity and thermal nociception in female rats, and to determine whether current phase in the estrous cycle affects tactile sensitivity and nociception or the effects of a ketogenic diet on these factors. Adult female Sprague-Dawley and Long-Evans rats were fed a standard control diet for 4 weeks of testing and were then switched to a strict ketogenic diet and allowed three weeks to establish ketosis before testing was repeated for another 4 weeks. Tactile sensitivity was measured using the plantar von Frey test and nociception was quantified by measuring latency to hind paw withdraw from a hot plate. Current stage in the estrous cycle was determined by vaginal lavage on each day of testing. The results did not show a significant effect of the ketogenic diet on tactile sensitivity in either the Sprague-Dawley or Long-Evans females. There was no significant effect on thermal nociception in the Sprague-Dawley females, but Long-Evans females showed significantly lower thermal pain tolerance at 50 degrees C when on the ketogenic diet. Current phase of the estrous cycle did not have a significant effect on either measure. Further investigation using a larger sample size is necessary to determine whether a ketogenic diet significantly impacts sensitivity and nociception in female rats.

#### **46.**

#### **EVALUATING COGNITIVE, LOCOMOTOR AND SENSORY TENDENCIES OF C57BL/6J ADENOSINE KINASE KNOCKOUT HETEROZYGOTE MICE**

Suzanne Carpe '22, Allison Wells '22

Faculty Sponsor: David N. Ruskin

Increasing adenosine by reducing adenosine metabolism through the manipulation of adenosine kinase (ADK) levels could potentially improve symptoms of neurological disorders as it has been shown to do in epileptic seizures, hence the growing interest of researching such mechanism and its effects. This can be determined through the common laboratory model C57BL/6J mice: recent transgenic work has produced ADK knockout heterozygote mice. These mice exhibit approximately half of the normal level of ADK when compared to the standard homozygous wild-type mice, which translates in an increase in adenosine levels. This study aimed to further characterize adenosine's role in cognitive, locomotor, and sensory performance by subjecting C57BL/6J ADK wild-type and heterozygote mice through a variety of tests in those three areas and comparing the results. Experiments included 3-chamber sociability, open field, forced swim, Y-maze, formalin injection and plantar von Frey tests to measure sociability, anxiety, depressive-like behaviors, locomotor activity, and inflammation and nociceptive pain responses, respectively. The obtained results led to the preliminary conclusions that an increase in adenosine leads to low sociability and a tendency for decreased pain responsiveness. Moreover, it was possible to note that locomotor activity seems to be inversely proportional to adenosine levels. There was no significant effect in other tests. Future studies will aim to increase the sample size to corroborate the established trends and obtain more statistically significant results.

47.

**THE ROLE OF EMPATHY, CLINICAL TRIALS, AND EYE GAZE IN CONTAGIOUS YAWNING AND ITCHING**

Carin Colebaugh '20

Faculty Sponsor: Molly Helt

Social contagion is brought about by the tendency of individuals to converge behaviorally and emotionally with those around them. Mimicking the behaviors of others allows individuals to build bonds, and when these behaviors convey emotional signals, it is considered a primitive form of empathy. Previous research has shown that both individuals with Autism Spectrum Disorder (ASD) and individuals with high levels of psychopathic traits are less susceptible to contagious yawning, a yawn induced by seeing or hearing another's yawn, than their typical peers. The current study utilized eye tracking to capture the visual attention of the participants while viewing video clips of others yawning to explore the relationship between contagious yawning and eye gaze in both populations. The current study also showed participants video clips of people scratching to induce contagious itching. While contagious itching still involves paying attention to the bodily signals and taking them on as your own and may rely on neural regions overlapping those employed in contagious yawning, it does not rely on signals transmitted from the face. Results showed that low levels of psychopathic and ASD traits, overall empathy, and eye contact with the target resulted in more contagious yawning. Contagious itching was shown when the participant was rated, as a subscale of the Adult Sensory Processing Disorder Checklist, to have high "Sensory Based Reactivity," as well as low levels of psychopathic traits. Contagious yawning was less frequent in those with high ASD and high psychopathic traits compared to those low in both. Contagious itching was highest amongst those with high ASD traits and lowest amongst those with high psychopathic traits. Diminished susceptibility to contagious yawning observed in ASD and psychopathy occurs through different mechanisms. In ASD, empathy deficits may be secondary result of inattention to the eyes. In psychopathy, empathy deficits may occur due to a lack of ability to physically embody the person being observed.

48.

**THE EFFECT OF LIGHT AND MELATONIN ON RHYTHMIC DAILY ACTIVITY OF THE CHINESE MUD SNAIL, *CIPANGOPALUDINA CHINENSIS***

Andre Curtis '20

Faculty Sponsor: Charles C. Swart

Circadian rhythms are physical, mental, and behavioral changes that follow a daily cycle. They respond primarily to light and darkness in an organism's environment. Melatonin is a natural hormone made by the body's pineal gland and is intrinsically involved in the regulation of the sleep cycle and other mood relate neuro-mechanics. Recent studies have demonstrated that, among the myriad of other factors related to neurodegeneration, sleep dysfunction may be an early indicator of predisposition of Alzheimer's disease (AD). While it is widely held that melatonin is a pertinent supplement to help those that are experiencing sleep issues, it is yet to be fully explored as to the far-reaching side effects of this medication. Due to the reduced complexity of their nervous systems compared to vertebrates, invertebrates have long served as invaluable models for understanding neurobiological and neuropsychological systems. We concluded that melatonin was

increasing the overt behavioral activities of fresh water snails, hence disrupting their circadian rhythm. There was also evidence from this experiment that suggest possible implications for the reproductive cycle of the fresh water snails.

**49.**

**THE LONG TERM BEHAVIORAL EFFECTS CAUSED BY GESTATIONAL EXPOSURE TO THE KETOGENIC DIET**

Kiera Flynn '21, Meg Huston '20

Faculty Sponsors: Luis A. Martinez, David N. Ruskin

The ketogenic diet (KD) is a high fat, low carbohydrate, and adequate protein diet that has potential therapeutic potential for neuropsychiatric disorder. While little is known on the effect of gestational exposure to KD, previous studies have shown that the diet improves sociability and anxiety/depressive-like behaviors in healthy mice. Studies have also shown that postnatal exposure to KD has improved sociability in a mouse model of autism. We want to test if gestational exposure to the ketogenic diet will alter the brain oxytocin system, which will lead to improved sociability and affect in a mouse model of autism. To test this we have inject pregnant CD-1 mice with VPA or poly I:C to induce autism like behavior in the offspring. At 10 weeks of age, offspring will then undergo a series of behavioral testing that will evaluate social behavior and anxiety/depressive like behaviors

**50.**

**EFFECTS OF A KETOGENIC DIET ON COCAINE-INDUCED REWARD**

Meg Huston '20, Kiera Flynn '21

Faculty Sponsor: Luis A. Martinez

Substance abuse is a major public health issue for which little to no effective treatment has been determined. Some addictive substances, including cocaine, have been associated with an increase in dopamine signaling that is associated with the reward properties the drug elicits. Ketogenic diets (KDs) have been previously used to treat a range of neurological disorders, most notably epilepsy. Adenosine signaling has been recognized as a possible mechanism that underlies the effects seen in epilepsy and KDs have been thought to be therapeutic due to the fact that KDs increase the adenosine signaling. Increases in adenosine signaling have been seen to reduce dopamine signaling in the reward centers in the brain. It was previously observed that rats on a KD had reduced cocaine-induced locomotor responses. This study will continue to investigate the effects of a KD on drug addiction by exploring the effects of a KD on cocaine-induced reward. At five weeks of age, male and female Sprague-Dawley rats were either placed on a control diet (CD) or a KD. The rats were maintained on the diet for three weeks prior to testing and throughout the remainder of the experiment. Behavioral testing consisted of a pretest day followed by six conditioning days and a posttest day. From the pretest, side preference was determined for each animal. On conditioning days 1, 3, and 5 rats were given i.p. injections of either cocaine (10 mg/kg) or saline and placed in their initially non preferred chamber. On conditioning days 2, 4, and 6 rats were given i.p. injections of saline and placed in their initially preferred chamber. CD animals that were injected with cocaine exhibited a strong preference for the initially non-preferred side whereas KD

animals who were injected with cocaine did not exhibit that effect, thus suggesting that a KD reduces cocaine-induced reward and could be implemented as a potential therapy for drug addiction.

## **51.**

### **TRINITY RETURN-TO-LEARN POST-CONCUSSION PROTOCOL ASSESSMENT**

Anna Hackett '20

Faculty Sponsor: Sarah A. Raskin

Return-to-learn after concussion protocols have received less attention than return-to-play protocols. Return-to-learn protocols are step by step guidelines for students and teachers to help ease concussed students back into their academic work in primary and secondary schools. We know of no established protocols for college students. At Trinity, faculty are given information on common effects of concussion, and suggested academic accommodations. This study aims to assess the entire return-to-learn protocol currently in place at Trinity College, with a specific focus on how well known the program is to students and how helpful they have found it, in an attempt to ascertain what aspects of the protocol work well and what could be improved. Faculty will be surveyed to gain their input on how the protocol has worked and how cumbersome it is for them; and coaches will be surveyed to assess if they have any role in helping their athletes return to the classroom as well as the playing field. In addition, cognitive tests will be given to students who have had a previous concussion while in college to determine if particular cognitive deficits associated with concussion (attention, memory, executive functioning) correlate with greater difficulty in successful return to classes.

## **52.**

### **DEVELOPMENT OF AN INTRAHIPPOCAMPAL KINDLING MODEL OF EPILEPSY**

Carter Jones '19, Roxana Alvarez '20, Elias Kagabo '20, Nancy Saad '22

Faculty Sponsors: J. Harry Blaise, David N. Ruskin, Susan A. Masino

Epilepsy is a debilitating condition associated with overexcitation and ineffective inhibition of neuronal pathways in the brain. This condition causes a diverse set of symptoms, most prominently of which are seizures. While some antiepileptic drug (AED) regimes have proven to be effective in treating this condition, there are many cases where the drugs do not suffice. The ketogenic diet (KD) has been used for decades as an effective anticonvulsant. Its powerful and natural processes result in some patients becoming seizure-free. Some patients have even remained seizure-free after returning to a normal diet. The kindling model is often used to better understand epilepsy and the progression of seizures. Through repetitive electrical or chemical stimulations, kindling lowers the threshold required to induce epileptic behavior. The goal of this research study is to determine whether a KD can prolong the development of major seizures in an electrically kindled rat model. Male Sprague Dawley rats between 280 and 300 grams were used in this study. A stereotaxic surgery was performed to implant electrodes into the hippocampus and cortical regions. These brain regions were electrically stimulated according to an electrophysiological timeline until specific epileptic setpoints were obtained. Only one KD rat was successfully taken through the entirety of the kindling procedure due to technical difficulties involving the rat

electrode cap falling off. To further explore this epileptic model and KD effects, more rats and a modified method of implanting the electrode cap must be used.

### 53.

#### **THE EFFECT OF COPPER AND GLYPHOSATE CONTAMINATION ON BODY MASS AND ACETYLCHOLINESTERASE ACTIVITY OF *EISENIA FEOTIDA***

Sierra Little-Gill '22

Faculty Sponsor: Charles C. Swart

*Eisenia fetida* is a species of earthworm found throughout New England. Previous research suggests that copper used in pesticides on fruit trees is an acutely toxic compound to *Eisenia fetida* at concentrations higher than 600 mg Cu/kg soil (Meregalli, 2017; Zhou, Wang, Li, Sun, Yu & Zhou, 2013). Glyphosate is the active ingredient in pesticides such as Roundup™ and has been shown to affect the mass of *Eisenia fetida* (Correia & Moreira, 2010). When glyphosate and copper are mixed, glyphosate appears to reduce the bioavailability and toxicity of copper to earthworms. In addition, the activity of Acetylcholinesterase has been shown to increase in the presence of copper but remains at a control level when the worms are exposed to both copper and glyphosate (Zhou et al. 2012). The current study did not demonstrate a correlation between the treatment given and a change in mass or acetylcholinesterase activity. The worms were exposed to either glyphosate (500 mg/kg or 1000 mg/kg), copper (100 mg/kg or 150 mg/kg) or a mixture of the two for 21 days in the chronic experiment. The earthworms were exposed to higher concentrations of glyphosate (1500 mg/kg or 2000 mg/kg) and copper (150 mg/kg and 200 mg/kg) for 72 hours during the acute exposure experiment. Mass of the worms was measured before and after exposure to the chemicals and the acetylcholinesterase assay was conducted after the earthworms were exposed to the chemicals. There was no correlation between the type of treatment and the initial and final mass of *fetida* for any of the treatments. There was no correlation between the type of treatment and the acetylcholinesterase activity in any of the treatments. The lack of statistical significance could be due to a small sample size or a mite and mold infestation in the soil used for the experiments.

### 54.

#### **PSYCHOMETRIC PROPERTIES OF THE MEMORY FOR INTENTIONS SCREENING TEST (MIST)—SHORT FORM**

Kathryn Marsden '21, Dorothy Anika '22, Michelle Mordasiewicz '22

Faculty Sponsor: Sarah A. Raskin

Prospective memory (PM) is the ability to form and complete intentions after a delay period (Einstein & McDaniel, 1990). The Memory for Intention Screening Test (MIST) is used as a clinical measure of PM. The MIST is comprised of both time and event-based tasks. The MIST takes approximately 30 minutes to administer, however in clinical practice this was found to be lengthy. PM involves encoding an intention, storing the intention while performing other tasks, initiating the intention after a period has passed, and executing the intention. The goal of this study was to modify the length of the original MIST, so that it would take less time to complete. Certain tasks were removed from the original MIST, to create the short MIST. These revisions allow the

MIST-S to be administered in 18 minutes as opposed to 30 minutes. MIST-S also uses background screening questionnaires as the ongoing task, thereby allowing for that time to be used as part of the evaluation. These tasks are no less engaging and appear to work sufficiently. The correlation between scores from the two independent rates was high ICC= .90,  $p \leq .001$ , indicating good inter-rater reliability. Given the high validity of original MIST, and that the items from the MIST-S are identical, it is assumed that items are valid. The correlation between the MIST-S and the CAPM was not significant, but this is also true of the full MIST. Not surprisingly, age did show significant effects with lower scores seen in older age group. Overall, the MIST-S performs the same objective as the original MIST with an improved ease of administration. It has demonstrated good reliability and validity, suggesting that the MIST-S may be a good brief alternative to the MIST embedded in neuropsychological batteries. Further research is needed to determine sensitivity to other disorders

**55.**

**COMPARING INTRINSIC VS. EXTRINSIC DRIVERS OF INDIVIDUAL BEHAVIOR: STATE-DEPENDENCE OF SNAIL (*HELISOMA TRIVOLVIS*) PERSONALITY**

Peyton Orloff '22

Faculty Sponsors: Charles Swart, Benjamin J. Toscano

Animal personality describes behavioral differences among conspecific individuals that persist over time. Though personality is taxonomically widespread, it remains unclear why personality exists within natural populations. One hypothesis suggests that personality is driven by individual differences in the state of individuals (e.g. body mass or growth rate). To test this hypothesis, we explored links between exploration and boldness behavior of individual snails and snail body mass and growth rate. Each of these behaviors was measured across two contexts: exploration was measured in a familiar and novel environment, while boldness was measured in the absence and presence of predation risk. We found that snails were generally unresponsive to these different contexts, with slight if any changes in behavior. Instead, individual differences in behavior were predicted by snails' growth rate: snails whose body mass increased the most over the course of the experiment were much more cautious and slow to start moving regardless of environmental context. In the future, we will investigate the effect of individual brain variation (another intrinsic factor) on snail behavior.

**56.**

**ASD TRAITS ARE ASSOCIATED WITH HIGHER AROUSAL TO NEGATIVE EMOTIONS OF OTHERS AND PSYCHOPATHIC TRAITS ARE ASSOCIATED WITH LOWER AROUSAL TO NEGATIVE EMOTIONS OF OTHERS**

Rachel Scheub '20, Sierra Little-Gill '22

Faculty Sponsor: Molly Helt

Individuals with Autism Spectrum Disorder (ASD) typically show less emotional contagion to others (e.g., Bacon et al., 1998; Helt et al., 2019; Scambler et al., 2007), and in general, experience less social resonance with others. The present study explores differences in arousal levels while viewing positive, neutral, and negative emotional stimuli across three groups: those high in autistic

traits, those high in psychopathic traits, and those low in both. Fifty six college students were given the AQ (autism quotient), IRI (interpersonal reactivity index) and the PPI (psychopathy personality inventory), measuring clinical autism traits, empathy, and psychopathic traits in the adult population. The participants' faces were recorded while skin conductance response (SCR) was measured and their behaviors were coded for contagion. A median split on each measure was performed to create the three groups. The groups were differentiated by their SCR to negative stimuli, with the high AQ group showing increased arousal to negative stimuli and the high PPI group showing low arousal to negative stimuli, compared to the low AQ/PPI group. These results suggest that in participants with greater clinical autism traits, there is a heightened response to "avoid signals" such as negatively valenced stimuli. Empathy was significantly correlated with contagious behaviors, as well as increased SCR to positive stimuli, and inversely correlated with increased SCR to negative stimuli. For a neurotypical individual, there may be more social value in controlling arousal to negative stimuli (rather than co-expressing negative arousal) in order to respond with helping behavior, and this mechanism may be dampened in those with ASD. On the other hand, participants with greater psychopathic traits demonstrate a dampened response to negative stimuli. This aligns with our hypothesis that psychopathic traits would be correlated with decreased arousal when viewing the distress of others.

## 57.

### **THE ARRANGEMENT OF MUSCLE FIBERS IN COLUMELLAR AND FOOT MUSCLES OF THE CHINESE MYSTERY SNAIL, *CIPANGOPALUDINA CHINENSIS***

Meg Smith '21

Faculty Sponsor: Charles C. Swart

Gastropods, including the Chinese mystery snail, withdraw into their shells to avoid predation and desiccation. Behaviors that allow an animal to escape predation, such as withdrawal, are highly important and under strong evolutionary control. An understanding of the structures which execute the withdrawal behavior is an important part of the study of the behavior as a whole. The columellar muscle attaches the body of the mollusc to its shell and is responsible for its ability to withdraw in and out of its shell. The foot muscle is responsible for locomotion. The arrangement of muscle fibers in the columellar and foot muscles of snails have yet to be described in detail. Here, electron microscopy and fluorescence microscopy were used to obtain images of the muscle fibers in *Cipangopaludina chinensis* columellar and foot muscles, as well as the mantle and the muscular branch that attaches to the shell. These images provide a preliminary insight to the patterns and arrangements of muscle fibers in these structures. It was found that the columellar muscle seemed to be a three-dimensional woven mesh of fibers, the foot consisted of wave-like bands of muscle, and both the mantle and the attachment were groups of fibers that ran longitudinally through the structures. These images and initial descriptions provide a good initial understanding of the patterns and arrangements of gastropod muscle fibers and outlines for future investigations into the anatomy of this snail and how it functions in the withdrawal behavior.

58.

**EFFECT OF A KETOGENIC DIET ON ACUTE INFLAMMATORY PAIN INDUCED BY COMPLETE FREUND'S ADJUVANT (CFA) IN MALE MICE**

Isabella C. Sturdevant '20

Faculty Sponsors: David N. Ruskin, Susan A. Masino

Pain is one of the most common illnesses in the world as over 1.5 million people suffer from chronic pain. Around 20% of U.S. adults suffer from chronic pain and 8% have high-impact chronic pain limiting major life activities and lowering one's quality of life. Many types of pain disorders are due to chronic inflammation which can be difficult to treat and manage. While acute inflammation is a normal and healthy response to remove pathogens from body tissue, chronic inflammation can cause further damage. The ketogenic diet (KD) is a high fat, low carbohydrate, moderate protein diet and is suggested to increase ketone bodies and ATP levels, reduce neuronal excitation, increase adenosine levels, and have possible analgesic and anti-inflammatory effects. The effect of adenosine activation is suggested to decrease excitability in the brain and reduce inflammation through adenosine A<sub>1</sub> receptors (A<sub>1</sub>Rs). This study analyzed the effects of the KD on lowering acute inflammatory pain in male mice. A<sub>1</sub> receptor knockout (KO) mice were put on a control diet (CD) while C57BI/6 wild-type (WT) mice were put on either a control or ketogenic diet regime for three weeks prior to experimentation. Behavioral analysis was obtained through measuring tactile sensitivity, using an electronic plantar von Frey before and after the right hind paw was injected with heat-killed tuberculosis bacteria known as Complete Freund's Adjuvant (CFA), causing persistent inflammation. Results implied a trend towards a significant difference between strains as the WT mice had a lower pain sensitivity than the KO mice. Data suggests that a KD may alleviate pain, however a larger sample size is needed for significance. Future research will continue to increase the sample size as well as incorporate data from the marble burying test to determine the effects of the KD on pain and normal compulsive behaviors.

## **PHYSICS**

59.

**COINCIDE – DIGITAL DATA ACQUISITION OF MULTI-PARTICLE EVENTS**

Stephen J. DeMonico '17, Aashwin Basnet '19, Alex Bellas '20

Faculty Sponsor: David Branning

Many nuclear, particle, and optical physics experiments require the detection of multiple particles arriving simultaneously. Measurements of this nature have been used to verify the physical consequences of quantum mechanics and to justify the deviation from classical reasoning in the context of quantum phenomena. While there are devices capable of making such measurements, the cost can be prohibitive to small educational labs, such as one might find at Trinity. The device being researched will exploit inexpensive technology to create a digital version of the previously analog process, which will significantly reduce the obstacles associated with affordability and distribution of the equipment.

# **PROGRAM IN INNOVATION AND EDUCATION**

**60.**

## **MODELBRICKS: A NOVEL APPROACH TO COMPUTATIONAL MODELING**

John S. Albanese '21

Faculty Sponsors: Michael L. Blinov; Ann E. Cowan

Complex molecular networks can often be constructed from simpler modules called bricks. The adaptive behavior of living cells can be represented by a combination of functional motifs that reproduce different patterns of cell response to a signal, including simple linear and sigmoidal responses as well as far more complex behaviors like toggle switches and oscillators. The topology of these modules can be captured in graphical form and represented as wiring diagrams in Systems Biology Graphical Notation (SBGN). To understand why these models work as they do, precise mathematical descriptions of molecular circuitry are needed, and the models can be efficiently and thoroughly described in a different type of multiplex brick, called a ModelBrick. Multiplex bricks represent a rich source of information that could be leveraged to simplify model building and understanding by the community at-large. A computable ModelBrick is essentially a small, thoroughly annotated model derived from a multiplex brick that is minted a DOI for a permanent reference. Element annotations include stable identifiers such as PubMed IDs and references from Gene Ontology, Systems Biology Ontology, Reactome and BioCyc as well as from other public databases such as UniProt, and CheBi. ModelBricks are interoperable with the Systems Biology Markup Language (SBML) model composition standard. The ModelBricks database continues to expand and serves as an open source for these small, comprehensive biological models. The project is a part of the Virtual Cell modeling and simulation framework, originating at UCONN Health Center.

**61.**

## **DIFFERENTIAL SUSCEPTABILITY TO COLON ULCERATION IN A/J AND B6 MPGES-1 KNOCKOUT MICE**

Natalie Bruno '20

Faculty Sponsors: Dr. Masako Nakanishi

The most effective medicinal therapy that suppresses inflammation, ongoing pain and fever has been non-steroidal anti-inflammatory drugs (NSAIDs). NSAIDs have also been shown to suppress colorectal cancer by reducing the production of prostaglandin E<sub>2</sub> (PGE<sub>2</sub>). When using NSAIDs long term are often associated with toxicities, including gastrointestinal injury. The susceptibility to this gastrointestinal injury is variable among members of the general population. This may suggest that there are underlying genetic and/or environmental factors that influence this susceptibility to gastrointestinal injury.

During the study to examine the roles of PGE<sub>2</sub> in inflammation and cancer, we found that when the microsomal prostaglandin E synthase-1 (mPGES-1) gene, the final enzyme that generates PGE<sub>2</sub>, was deleted in the A/J mouse strain, it caused spontaneous ulceration in their colons. However, when the mPGES-1 gene was deleted in the C57BL/6 (B6) mouse strain, it did not result in the ulceration. This difference in colonic ulceration induced by the mPGES-1 gene deletion

suggests that these mice may be a useful model to study the varying susceptibility to NSAIDs in the human population. In this study we begin preliminary investigation into the differences between these strains of mice. We conduct these tests using immunohistochemistry (IHC) identify MUC2 levels, analyze the intestinal microbiome, examine intestinal permeability using FITC Dextran and culture colon organoids. These results provide new insights into the understanding of the influence that different genetics and environmental factors have on susceptibility to colon ulceration.

## 62.

### **SMART PHONE ENHANCEMENT OF EFFECTIVE DISCHARGE (SPEED) HOME PILOT STUDY: QUANTITATIVE FINDINGS**

Martha Peregoy '21

Faculty Sponsors: Marlon Terrones<sup>2</sup>, Morgan Lagueux<sup>3</sup>, Tifa Talovic<sup>3</sup>, Sandra Carpenter, BS<sup>4</sup>, Willie Frazier III, MPH<sup>5</sup>, Marta Neubauer, MD<sup>4,5</sup>, Juan Espinoza, MD<sup>6</sup>, Glenn Flores, MD.<sup>4,5</sup>  
(<sup>2</sup>Central Connecticut State University, <sup>3</sup>Sport & Medical Sciences Academy, <sup>4</sup>UConn School of Medicine, <sup>5</sup>Connecticut Children's Medical Center, <sup>6</sup>Children's Hospital Los Angeles)

Over 9,000 children are discharged from US hospitals every day, requiring coordination of multiple systems and stakeholders. There is little standardization of the process, however, which results in inter- and intra-institutional variation, inconsistencies, medical errors, poor documentation, poor communications, and families that leave the hospital unprepared. Digital-health interventions have been successfully implemented in different aspects of healthcare; however, interventions evaluating the use of technology for pediatric discharges are lacking, and there are no published studies on the use of smart phones to enhance the pediatric discharge process. The aim was to conduct a pilot study to determine the feasibility and acceptability of using smart phones to improve pediatric hospital discharges. A 72-question survey was administered to parents of children being discharged from two children's hospitals. Survey questions addressed parental technology-adaptation readiness and attitudes towards and perceptions of using smartphone video recordings during the discharge process and in the coordination of their child's care. The surveys were orally and anonymously administered in English and Spanish to a convenience sample of parents at Connecticut Children's and the Children's Hospital of Los Angeles. Parents received a \$5 Target gift card for survey completion. Of the 67 parents surveyed at CT Children's, 100% reported having cell phones, using their phone to access the internet, and having recorded videos on their phone. Fifty-two percent of parents agreed or completely agreed that video recording their child's discharge instructions and teach-back conversation would improve their understanding of their child's discharge instructions, and 57% of parents agreed or completely agreed that they would watch a video of their child's hospital discharge instructions after their child went home. These results suggest that smartphone video recording of discharge instructions has the potential to improve parents' understanding of their child's hospital discharge instructions.

**63.**

**MICROLOCALIZATION OF IODINE NANOPARTICLES IN MBD-MD-231 TOMATO LUCIFERASE TRIPLE NEGATIVE BREAST CANCER**

Vanessa J. Ross '21, Sharif M. Ridwan

Faculty Sponsors: James F. Hainfeld, Henry M. Smilowitz, PhD.

Gold (AuNPs) and Iodine nanoparticles (INPs) increase the specificity of radiotherapy by enhancing the local dose in tumor regions (Hainfeld et al., 2004, 2008, 2010, 2013, 2019). Previous studies show both AuNPs and INPs localize to the tumor region after intravenous injection (Smilowitz et al., 2018; Hainfeld et al., 2019) and significantly extend median survival of mice with advanced orthotopic gliomas by more than two-fold (Hainfeld et al., 2013, 2019). Recently, the Smilowitz lab in collaboration with Nanoprobes, Inc. have shown that IV injected INPs similarly significantly extend life of mice with advanced TNBC growing in their brains (Unpublished Results). This study aims to determine the microlocalization of INPs in breast tumors growing in the brains of mice in order to better understand the mechanism by which INPs increase survival. To observe localization, 231 Tomato Luciferase (TL) and 231 Brain Homing (BH) lines of triple negative breast cancer (TNBC) cells were implanted orthotopically into the brains of immunosuppressed mice, followed by iodine nanoparticle tail vein injections. Mice were euthanized either 24 or 72 hours post-INP injection using cardiac perfusion/fixation. The fixed brains were preserved in cryomatrix, cryosectioned at 7  $\mu\text{m}$  each and processed for immunohistochemical staining protocol. Confocal microscopy was conducted for visualization of INPs; ZEN imaging was used to perform a qualitative/semiquantitative analysis of the tissues. Results of analysis aim to address the differences in microlocalization of INPs in the 24 hour and 72-hour groups with respect to tumor and endothelial cells, the location of INPs on the cell surface, intracellular INPs, the relationship of INPs to nuclei and the association of INPs to the endothelium. Localization of INPs to areas essential to tumor proliferation, nuclei and vasculature, imply the possibility of greater specific damage to tumors and overall increased therapeutic efficacy.

## **PSYCHOLOGY**

**64.**

**MANTRA IN MEDITATION: THE EFFECT OF SOUND ON RELAXATION**

Philisha Abraham '20

Faculty Sponsor: Randolph Lee

The use of mantra as a tool for meditation is an ancient practice. It is a spiritually rooted discipline, thought to release various types of energy when producing sounds. The study aims to use modern technology to reexamine traditional Eastern beliefs about the body and its capabilities. It analyzes the physiological effects that sound and, more specifically the "OM" sound, have on brainwaves and skin temperature. Participants were asked to complete four meditations: a baseline, silent, guided, and "OM" meditation. Findings showed a significantly lower number of baseline peaks compared to all other conditions of silent, guided and "OM". There was a significantly lower number of active brainwave peaks, which were significantly lower than neutral peaks, which were significantly lower than calm peaks. There was a significantly higher number of calm brainwave peaks across all conditions, except for the baseline condition. There was no significant difference

in temperature for the “OM” condition compared to the silent and guided. Further research can replicate the study with participants familiar with meditation and sound.

**65.**

**HOW DO YOU BEGIN DEVELOPING A COMPUTER GAME? “THE SILK ROAD” AS A WAY OF MEASURING METACOGNITION**

Madison Kane ‘20, Edwin Aldrich ‘21, Amy Ky ‘21

Faculty Sponsor: David Reuman

The central research question underlying this project is how well offline and online measures of metacognition agree with each other, and how well these measures of metacognition predict specific task performance and general academic performance in courses. Metacognition includes skills that enable learners to understand and monitor their cognitive processes related to learning. Offline methods of assessing metacognition are collected either before or after task performance, whereas online methods assess metacognition during task performance. Previous research studies have compared questionnaires to an online video game, titled *The Oregon Trail*, with 8th grade students. However, to expand the metacognition research to 7th graders, a new video game titled “The Silk Road” is in development. This summer, the researchers wrote the code for the new game. But for the game to be written, a general outline regarding the game’s objective, player occupations, decisions and more were planned out. In addition, log files, outcome measures, and graphics were created for the game. All of these items were developed this summer for “The Silk Road” computer game to be ready for experimentation and publication in the fall of 2019.

## **SOCIAL SCIENCE AND HUMIANITIES**

**66.**

**DID GENOA TRIGGER FINANCIAL INNOVATIONS BEFORE VENICE?**

Elena Pellegrini ‘20

Faculty Sponsor: Edward Stringham

Early Renaissance’s Italy is regarded to be a pioneer in the history of modern banking. In this prolific environment, where Florence and Venice are exalted as the precursor of the Financial Revolution, the role of Genoa’s institutions often remains overshadowed. In fact, before Florence and Venice, the Republic of Genoa undertook financial innovations that precede and pave the way to modern economic mechanisms later seen in the Netherlands and England. In 12<sup>th</sup> century, Genoa had already established a public debt funded through government bonds issued on a voluntary basis, contrarily to Venice, where borrowing and tax rates were set to match government spending. Among Genoa’s most sophisticated innovations is the House of St. George, an institution that incorporated the entire public debt of the city, performing for the first time in history debt-to-equity swaps, double-entry book-keepings, sinking funds, and the role of clearing house in financial transactions. Our findings suggest that Genoa’s economic advancement is due to its decentralized and self-enforcing political system, which was weaker than that of Venice. In fact, the state was more compact and more willing to interfere with the economy in Venice, which strong republicanism was rooted in a uniquely homogeneous and unified ruling class.

**67.**

**VOTIVE POTTERY AND ANCIENT METALLURGY IN ISRAEL**

Frank Orenstein '22

Faculty Sponsor: Martha Risser

Over the course of this past summer I undertook a detailed study of pottery thought to have been of religious significance in ancient Israel, alongside the importance of ancient metallurgy in the region. I conducted my initial research at the Library of Congress, which entailed examining the diverse typologies of “incense burners”, cult stands, and model shrines. During the excavation in Akko, I worked repeatedly in the pottery lab in an effort to identify relevant pieces, as well as participating in the archeometallurgy program. Despite only one possible incense burner piece being found, past excavations at Akko have unearthed others, establishing a deep connection between the city, ancient industry, and religion.

**68.**

**BENEFITS OF PHOTOGRAMMETRY TO ARCHAEOLOGY**

Bryn Hudson '21

Faculty Sponsor: Martha Risser

This past summer, I studied the academic benefits of and gained experience in photogrammetry, the creation of digital 3D models and maps. In coordination with Dave Tatem, an Instructional Technologist, I learned how to pilot a DJI Phantom 4 Pro Plus Drone. For practice, I photographed the entire Trinity College Campus and transformed the photographs of buildings, like the Chapel, into 3D models and all of the photographs into a 3D map of campus in the Agisoft PhotoScan Program. Additionally, I researched how photogrammetry has been used to further the fields of archaeology, forensics, biology, architecture, etc. Piloting a drone, creating Agisoft models, and researching the method prepared me well for photogrammetry in Akko, Israel. Every morning, I photographed the archaeological site and aided Jane Skinner, an archaeologist from Penn State University, to edit them in Agisoft. Creating 3D maps and models enabled us to easily, quickly, and cost effectively track the excavation’s progress and present the architectural remains and cultural artefacts discovered.

**69.**

**COMMUNITY MEMBERS & HEALTH PROFESSIONALS’ RESPONSES TO RACIAL DISPARITIES IN LIFE EXPECTANCY**

Mary Tursi '20, Shayna Thomas '21

Faculty Sponsors: Abigail Fisher Williamson, Colleen Walsh, Cleveland State University, Sarah Willen, University of Connecticut

The AmeRicans’ Conceptions of Health Equity Study (ARCHES) is a two-phase research study that explores how Americans of diverse backgrounds think about whose health deserves attention and investment. This poster focuses on how average Americans and health professionals explain racial disparities in life expectancy. Structural attributions perceive the reasons for disparities as external and beyond an individual's control, whereas non-structural factors can be seen as a product

of individual choices. When Americans attribute health disparities to structural factors they may be less likely to blame individuals for their health and more likely to see them as deserving of health care. Semi-structured interviews in Greater Cleveland asked participants what they knew about the 5-year life expectancy gap between African Americans and whites. They were then asked to provide explanations for the gap as well as potential solutions.

Our analysis focuses on community members (CMs) and health professionals' (HPs) responses to the racial disparities in life expectancy (LE). After coding and analyzing the data, our analysis indicates that both HPs and CMs generally attribute the disparity to structural factors, but community members are more likely to also cite non-structural factors. Those who see disparities as structural are more likely to support policies that expand the accessibility of health care. These qualitative findings will inform the development of the project's Phase II, which is a national survey of about 3,000 Americans.

## **PUBLIC HUMANITIES COLLABORATIVE**

**70.**

### **SETTLEMENT AND HOUSING IN POST WAR HARTFORD AND FINDING AND GENERATING CONTENT FOR AN ONLINE ARCHIVE**

Esther Appiah '21, Ali Kara '20

Faculty Sponsors: Maurice Wade, West Indian Social Club, Dr. Fiona Vernal

In our presentation, we will talk about the challenges that we faced when working on an online archive and working with community partners. First of all, we start by talking about the lessons we learned when working with our community partners in documenting West Indian homeownership in Hartford. First, we will mention that when conducting oral histories, the tools you have may not be appropriate for your work however, you'll just have to make it with limited resources that you have. Second, we will talk about how different levels of expertise develop through time and through progress. Third, we will talk about how we reacted to situations when the needs of the community partners shifted and when new opportunities were available to us. Then we will talk about an application called "TEMI" that we used and learned about when conducting oral histories that helped us a lot. Then we will talk about the project that we did with Professor Wade that is about finding and generating content for Anti-Colonial Thought in Caribbean Online Archive. Again, we will start with our takeaways: first, the importance of meeting with people that have expertise, second, realizing that it is not possible to be an expert in any research field in three months so that you must allocate your time wisely. We will also show some of the online resources we used and conclude by showing the online archive that we worked on.

**71.**

**VOCES DE LA MIGRACION/VOICES OF MIGRATION: ORAL HISTORIES OF LATINX HARTFORD**

Stephanie Cerda-Ocampo '21, Brenda Piedras Iturbide '21, Josselyn Alejandra Zaldívar '20  
Faculty Sponsors: Aidalí Aponte Aviles; Christina Bleyer, Watkinson Library, Sean Donnelly, Jasmine Agosto, Harford History Center

The project Voces de la Migracion consists of the creation and preservation of oral histories centering on Latinx leaders in the Hartford Community. Trinity College and the Watkinson Library have facilitated academic accessibility to the project through Media Space Kultura. The Hartford History Center at the Hartford Public Library will continue to ensure access of the archive to the Hartford community. Voces de la Migración, in its infancy, has aimed to capture the pioneering voices of political, artistic, and economic actors within the community in the past and present day. The archive consists of oral histories captured during a 10-year time frame. Our work serves to provide the foundation for an ongoing effort to highlight the history of the Latinx community. Currently the archive has illuminating pieces regarding the formation and evolution of Latinx identities and intersections, the evolution of socioeconomic and sociopolitical representation and conditions of Latinx voices, the integral role of women in the success of Latinx people's welfare, and overall, insight into the evolution of activist work and ideology of current Latinx leaders. These themes will be highlighted in future pop-up programming through the Hartford History Center, thereby ensuring our commitment to public accessibility and community engagement and collaboration.

**72.**

**URBAN RENEWAL IN SENECA VILLAGE: USING DIGITAL NETWORK MAPPING TO EXAMINE COMMUNITY RELATIONSHIPS**

Kaytlin Ernske '20, Sophia Lopez '22  
Faculty Sponsors: Alexander Manevitz, Finn Darby-Hudgens

Despite urban renewal making an official name for itself in the 1950s and 1960s through federally funded programming, it was alive in American cities long before. In the early 1800s, Seneca Village was a predominantly African-American community with the goal of establishing black empowerment by means economic freedom through property ownership. However, in the 1840s the city of New York proclaimed that Seneca villagers must sell their properties to the city under eminent domain laws. In the place of Seneca Village, Central Park was built, and Seneca Villagers were displaced. Unfortunately, much of Seneca Village's history has gone undocumented and wiped from history because of its nature. Therefore, in our research we analyzed and transcribed legal documents such as property deed transitions and landowner assessment petitions to detect relationships between Seneca Villagers, as well as their motives for petitioning their property assessment value and requesting more financial compensation. After, we Formulated an intricate spreadsheet system using Google Sheets and then imported the extracted data on personal connections between Seneca Villagers to the visual mapping software Palladio and Cystoscope. These online network visualization tools provided us with the ability to visualize personal connections between property owners, property buyers, family members, neighbors, developers, commission members and legal teams. Additionally, these programs aided in the determining who

were the most prominent and active members in the dissolving of the community. Overall, through legal documents we were able to approach the private lives of Seneca Village's.

**73.**

**HIDDEN LITERACIES SYMPOSIUM AND WEBSITE & TRANSCRIBING AND DIGITIZING ARCHIVAL MATERIALS**

Carlson Given '20, Emma Sternberg '21

Faculty Sponsors: Christopher Hager, Hilary Wyss, Connecticut Historical Society

This summer we worked on two projects in the Public Humanities Collaborative, the Hidden Literacies Symposium and Website with Professors Hager and Wyss and digitizing and transcribing archival material at the Connecticut Historical Society. The Hidden Literacies project worked to compile the academic essays written by the ten contributors on primary documents that were examples of hidden literacy. The texts are considered hidden because they were written by children and prisoners, enslaved and indigenous people. The other project we worked on was with the Connecticut Historical Society where we assisted in digitizing and transcribing the Samson Occom Collection, specifically the Joseph Johnson Sermons written in the eighteenth-century by a Mohegan preacher. Over the course of the summer we gained the skills necessary to transcribe manuscripts, use the digital platform, Scalar, to present the works for the Hidden Literacies website, and edit podcast transcriptions of the Hidden Literacies contributors.

Our presentation will summarize the research we have completed in the past ten weeks as well as the transcription guide that we created. The transcription guide is a document for students, by students, that explains the process of transcribing manuscripts and strategies to keep in mind. These two projects have given us exposure to different types of literacy and skills that we otherwise would not have learned in the classroom.

**74.**

**GENERATING A FOOD DATABASE BETWEEN THE EU // US & CAPTURING THE EVOLUTION OF COLTSVILLE NATIONAL PARK**

Yisbell Marrero '20, Kaylen Jackson '21

Faculty Sponsors: Thomas Lefebvre, Ranger Andrew Long

Our project with Professor Lefebvre was designing and creating a Transatlantic Food Database called "Who banned it.com". We compared food regulations and norms in the EU and the US such as food additives, preservatives, antioxidants, pesticides, GMOs, meat hormones, etc. This led to us making an excel spreadsheet of what was banned in one country yet not banned in another, why (disputes over quality v safety), and the products that contain the certain ingredient. Then transferring this information to the whobannedit.com website creating the 'food database'. Given the cultural weight of food as an item in trade negotiations and disputes, this online database will allow its users to get a clear understanding of the political, cultural, and scientific logic that leads the European Union and the United States to ban specific food items.

Under the Coltsville project we contributed our research skills to gathering primary images of the factory and its founders. Moreover, directed our research to spreadsheet designed uniquely by Knightlab Timeline to support the goal of an interactive engagement for the audience.

**75.**

**LGBTQ+ LIFE IN HARTFORD: AN ORAL HISTORY PODCAST**

Manny Rodriguez '20, Hendrick Xiong-Calmes '22

Faculty Sponsor: Nicholas Marino

This project captures the life narratives of LGBTQ+ people living in Hartford, Connecticut. In working with local LGBTQ+ spaces such as the Chez Est. and the Pink Drink Club, we met with and interviewed local LGBTQ+ Hartford residents about their personal lives and experiences in the community. Using Audacity software, a digital audio editor application, we transformed the interviews into cohesive podcast episodes that told the story of each individual we met. We also created a website to showcase the podcasts, as well as provide links and information to related LGBTQ+ events, organizations, etc. All of our interviews will be archived for safe-keeping and historical purposes. This project is ongoing and will be continued with Professor Marino and others.