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Trinity College, Hartford Connecticut

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TRINITY COLLEGE

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BIOLOGY

1.

INVESTIGATING THE SEGMENTATION CLOCK OF *TRIBOLIUM CASTANEUM* THROUGH CLONING POSSIBLE ENHANCER REGIONS OF THE *CAUDAL* GENE

Daniel Bauloye ‘20
Faculty Sponsors: Terri A. Williams, Lisa M. Nagy Ph.D, Department of Molecular and Cellular Biology, University of Arizona

Arthropods are the most speciose phylum on earth. All arthropods have a segmented body plan. Most arthropods form their segments sequentially. We have only recently learned that there is a network of genes that oscillate for the formation of each segment, known as the segmentation clock. However, we know very little about how the segmentation clock is regulated. Here, we investigate how the segmentation clock is regulated in *Tribolium castaneum* by trying to map the enhancer region of the *caudal (cad)* gene known to express in the posterior. *cad* promotes the expression of genes, such as *even-skipped (eve)*, that are part of the segmentation clock (El Sherif et al. 2014). Since *Tribolium* has a fully sequenced genome, we designed primers for three differently sized regions upstream of the *cad* and *eve* gene, (2, 5 and 8 kb) and plan to attach these possible enhancers to a reporter construct. I amplified the 5kb cad piece from genomic DNA using PCR and primers that I designed to isolate that region. We now plan to clone the region into the reporter construct, so we can inject it into *Tribolium* pupae to create a transgenic line expressing the reporter construct in their DNA. Then we will compare the reporter expression with those of the other two enhancer fragments and wild type *cad* expression. After finding the enhancer region of cad, we plan to find other elements that regulate the segmentation clock, such as transcription factors that bind to the *cad* enhancer.

2.

USING THE ENHANCER REGIONS OF CAUDAL AND EVEN-SKIPPED TO UNDERSTAND HOW SEGMENTATION IS REGULATED IN TRIBOLIUM CASTANEUM

Latanya Coke ‘19
Faculty Sponsor: Terri A. Williams

Segmentation in arthropods has been chiefly modeled based on the well-defined segmentation patterns found in *Drosophila*. In *Drosophila*, segment formation occurs all at once in the blastoderm where morphogen gradients spanning the AP axis provide patterning inputs. However, in most other arthropods, segments are formed sequentially from a posterior growth zone. Similar to vertebrates, sequential segmentation has recently been shown to use a segmentation clock. The vertebrate segmentation clock is a molecular oscillator that regulates periodic somite formation (Gibb 2010). The red flour beetle, *Tribolium castaneum*, segmentation clock is coordinated by traveling waves of expression generated by a pair-rule gene oscillator. In this study, we aimed to identify and describe regulatory controls of the *Tribolium* clock. From preliminary studies we know that the caudal and even-skipped genes are two key genes regulators in the *Tribolium* clock. To understand how the segmentation clock is regulated, we

identified and isolated 2kb upstream of the caudal enhancer region. We have cloned and sequenced this fragment as part of a series of 2kb-8kb reporter constructs that will be used to identify the cis-regulatory region driving wildtype expression.

3.

PREDATOR SELECT FOR HIGHER LEVELS OF BRAIN CELL PROLIFERATION IN TRINIDADIAN KILLIFISH, *RIVULUS HARTII*

Joshua Corbo ‘19, Margarita Vergara ‘19
Faculty Sponsor: Kent Dunlap

Killifish, *Rivulus hartii*, from the freshwater streams of Trinidad are a remarkable organism for understanding how the brain is influenced by both internal and environmental factors. The activity and morphology of the brain is highly responsive to changes in the environment. Brain cell proliferation is type a brain process that is sparsely studied, especially in the context of its environmental influences. Because of extensive ecological studies in the region, Trinidadian killifish are used to determine how predation directly effects brain cell proliferation and size of the brain. In the wild population of *Rivulus*, waterfalls in the streams block predator movements upstream, thereby creating two populations of killifish – i.e., *Rivulus* living with predator (HP) and *Rivulus*-only (RO) populations. Fish were caught in HP and RO locations from three replica streams at a total of six populations. In the common garden study, the F1 population of killifish from the same RO and HP streams were reared in captivity under the same living conditions. Immunocytochemistry for proliferating cell nuclear antigen (PCNA) was performed on the dissected brains from both wild and common garden killifish to quantify the amount of cell proliferation in the forebrain and midbrain. In the wild, killifish from HP streams had significantly more cell proliferation throughout the brain indicating that predator presence appears to enhance cell proliferation. In captivity, fish originally from HP streams also had increased proliferation, showing that the population differences in the wild are likely due to evolved genetic differences among populations. There was significantly more cell proliferation in the brains of wild caught killifish when compared to the captive killifish, which is explained by simply being in a more complex environment. This combined study suggests that predation has caused brain activity in RO and HP killifish to differ genetically, since the results from the common garden experiment were consistent with the original findings from the wild killifish study.

4.

SPECIALIZATIONS FOR YOLK PROCESSING IN TURTLE SPECIES *CHELYDRA SERPENTINA AND GRAPTEMY SCRIPTA*

Luisa Lestz ‘19, Farahana Appiah ‘21, Madeline Barnes ‘20
Faculty Sponsors: Daniel G. Blackburn, Yunming Hu

With the use of the scanning EM (SEM), we have been able to visualize the yolk processing pattern in *Chelydra serpentina* and *Graptemys scripta*, and specifically how the yolk sac becomes populated by cells and blood vessels. In the early development, we noticed free yolk spheres in the sac and a few endodermal cells. Later stage eggs were characterized by the

proliferation of cells and phagocytosis of large yolk spheres which are then broken down by the cell. Finally, we see the invasion of blood vessels into the yolk sac, forming strands that are spaghetti-like. The endodermal cells form a thin layer around these capillaries and permit nutrients from the yolk to be efficiently transported to the developing embryos. A similar yolk processing pattern has been observed in two snake species, one lizard species and the turtle *Trachemys scripta*. Future studies will look at chicken tissues under SEM, since no study has ever provided an anatomical description of yolk processing in birds. Additionally, we will observe alligator tissues in order to understand whether this trait carries into this branch of the phylogenetic tree.

5.

ALUMINUM TOLERANCE IN TOMATOES: ORGANIC ACID SECRETION

Kelly Lucas ‘20
Faculty Sponsor: Susan M. Bush

Aluminum (Al) toxicity in plant yield crops is a topic of concern for agriculturists and farmers around the globe. Since aluminum is present in more than 30% of arable lands that produce thrives in, research on the behavior of harvest species under such aluminum stress is important in preventing crop loss. To prevent aluminum destruction one mechanism that plants utilize to restrict degeneration is chelation. By definition, chelation is the formation of bonds between ions and metal ions. In this scenario, a negatively charged organic acid bind with the single central atom from an Al^{3+} cation. Such organic acids that are typically released by plants in an aluminum tolerance response mechanism include malic acid, citric acid, fumaric acid, succinic acid, and oxalic acid. The main objective of this project is to determine the types of organic acids that *Solanum lycopersicum*, a domesticated species of tomato, releases from its roots under the stress of aluminum. In attempt to explore both the concentration and identity of these organic acids, high performance liquid chromatography was used. In addition, multiple genes of interest involved in the transport of these organic acids were analyzed. More specifically, *Solyc08g082950*, an aluminum activated malate transporter gene, was taken into consideration. Future directions for this research include further analysis of the *Solyc08g082950* gene, usage of a malate acid assay, investigation of aluminum activated tolerance mechanisms in other crops such as wheat, and exploration of these mechanisms in a variety of heirloom tomatoes.

6.

THE EFFECT ON THE NOTCH SIGNALING PATHWAY BY DIFFERENT LENGTHS OF AMINO ACID SEQUENCES IN THE SERRATE JUXTAMEMBRANE REGION

Duuluu Naranbat ‘19, Zimo Huang ‘21
Faculty Sponsor: Robert J. Fleming

The Notch signaling pathway is a highly conserved cell-to-cell signaling system that is present in eukaryotic animals. This pathway plays a crucial role during mutliple developmental stages of organisms. The Serrate molecule (ligand) is found to have the capability to activate the receptor Notch. To activate the Notch receptor, a 65 amino acid segment in the Juxtamembrane (JM) region of the Serrate protein is required. Removal or replacement of this 65 amino acid segment

with similar JM segments of other transmembrane proteins such as the vertebrate Serrate homolog (called Jagged) may restore partial Notch activation ability. However, it remains unclear how this JM segment mediates Notch activation ability. It is hypothesized that the length of the segment plays a significant role in the activation level of the Notch signaling pathway. Two DNA constructs of differing lengths were made to be translated into Drosophila to determine the activation level of the receptor Notch in response to the altered ligand forms.

7.

DETERMINING THE ROLE OF CDT MUTATION IN AL TOLERANCE IN ARABIDOPSIS

Vanessa Ross '21
Faculty Sponsor: Susan M. Bush

With increasing research on climate change, it is being predicted that changes in the chemistry of crops and soils may occur. Research has begun to focus on molecules naturally occurring in soils that have the potential to cause even more crop damage and loss in the face of these changes. Aluminum, the most abundant metal in the earth's crust by concentration, in its cation form (Al^{3+}) is highly toxic to plants, especially in acidic soils. In order to explore one of the mechanisms by which plants defend themselves against this soil toxicity, we explored Arabidopsis plants containing mutations in the *CDT1* gene, previously shown in rice to play a role in aluminum tolerance. DNA from wildtype Arabidopsis (Col) and three different CDT1 mutant lines (*cdt1-1, cdt1-2* and *cdt1-3*) was isolated for genotyping, which was completed using PCR and gel electrophoresis. Seeds harvested were from plants genotyped as either homozygous or heterozygous for each respective *cdt1* mutation. Col, *cdt1-1*, *cdt1-2* and *cdt1-3* seeds were germinated on ½ MS agar plates of pH 5.7 for 7 days at room temperature; in addition, seeds from *als1-3*, an Arabidopsis line with a mutation in the aluminum-induced *ALS1* gene, were plated under the same conditions as a positive control. Half of the seedlings were transferred onto gellan gum plates containing 0.0 mM $AlCl_3$, while the other half were transferred onto gellan gum plates containing 0.5 mM $AlCl_3$; all plates were of pH ~4.2. Results show after 7 days of growth, varying genotype between Col, *cdt1-1* and *als1-3* had no significant effect on root length ($p = 0.5536$), while treatment level of aluminum had a significant effect on growth ($p = 1.967E-5$). This may suggest that CDT1 does not play a strong role in aluminum tolerance in Arabidopsis. Future directions will include RNA extraction and qPCR to look at the difference in expression levels of *CDT1* in roots with and without aluminum.

8.

SOCIAL BUFFERING OF THE NEUROGENIC RESPONSE TO TAIL AMPUTATION IN WEAKLY ELECTRIC FISH, *APTERONOTUS LEPTORHYNCHUS*

Margarita Vergara '19, Joshua Corbo '19
Faculty Sponsor: Kent Dunlap

Social interaction affects the brain and behavior of many animal species, including humans. Social interaction also promotes the production of new neurons (neurogenesis) and enhances cutaneous wound healing, but the positive effects of social interaction on the neurogenic

response to body injury have remained virtually unexamined. Previous studies showed that experimental tail amputation decreased forebrain brain cell proliferation in weakly electric fish (*Apteronotus leptorhynchus*) in a fashion that resembled the effect of predator-induced tail injury in free-living electric fish (*Brachyhypopomus occidentalis*). Here, we investigated the relationship between social interaction, simulated predator injury, and neurogenesis in *A. leptorhynchus* by asking two questions: 1) Can the presence of conspecifics mitigate the negative effect of tail amputation on brain cell proliferation? 2) Does the timing of social interaction relative to injury influence this social buffering of neurogenesis? In our first experiment, focal fish were either isolated (n= 7) or paired (n= 6) for 4 d to stimulate brain cell proliferation prior to injury. We then amputated the tails of all focal fish followed by short-term recovery (1 day). We measured cell proliferation (PCNA + density) in the forebrain and midbrain. Fish living with a social partner following tail amputation had more forebrain cell proliferation than those living in isolation, indicating that social interaction buffers the neurogenic response to amputation. In our second experiment, we examined the effect of social interaction during only the post-amputation phase. We initially isolated all focal fish for 4 d before being exposed to three different social contexts: a) tail amputation and social pairing (n= 10), b) tail amputation and isolation (n= 7), and c) social pairing only (n= 7). Since social buffering tends to act slower than the decrease in brain cell proliferation following tail amputation, we allowed fish to have a longer recovery period (7 days). Paired amputated fish had forebrain cell proliferation rates between those of isolated amputated fish and paired intact fish, suggesting that post-amputation social interaction by itself can also mitigate the negative consequences of amputation. In both experiments, the neurogenic response to social buffering was specific to the forebrain and did not occur in the midbrain.

9.

INVESTIGATING ALUMINUM TOLERANCE IN ARABIDOPSIS AND TOMATO USING MORIN AND CALLOSE STAINING

Sarah Wilson ‘20

Faculty Sponsor: Susan M. Bush

Genetic differences exist between wild and domesticated tomato species. Prior work has identified allelic differences between *S. pennellii*, a drought-tolerant species, and *S. lycopersicum* in the gene *Aluminum Sensitive1 (ALS1*). The protein ALS1 moves phytotoxic aluminum into the vacuole for sequestration in the apexes of roots. To study the effect of ALS1 on aluminum-related phenotypes, Arabidopsis plants with wildtype and loss-of-function mutant versions of the ALS1 gene were studied. Using fluorescence microscopy, differences in aluminum uptake and aluminum wounding response between the roots of plants carrying different alleles of ALS1 were found. Morin, an aluminum binding dye, was used to determine the differences in aluminum sequestration between the different ALS1 variants. Plants lacking ALS1 have reduced aluminum binding in their roots. Callose production, plugs created to close holes in the cell wall, was utilized to determine the amount of wounding response different variants displayed. We observed increased change in callose staining in plants lacking the *ALS1* protein. Future studies are planned to explore the impact of different functional alleles of ALS1 from tomato species in the Arabidopsis model system.

CHEMISTRY

10.
SYNTHESIS AND CHARACTERIZATION OF AN OPTICAL STIFFNESS SENSOR
HuaYue Ai ‘21
Faculty Sponsor: Lindsey Hanson

Metal nanoparticles have unique optical properties due to their interaction with visible light, and these optical properties are tunable by changing their size, shape or surroundings. These properties, along with the small size, make nanoparticles good candidates for sensors that can detect a change in the stiffness of their surroundings and report it as an optical signal. In this work, we investigated gold nanorods (AuNRs) as candidates for optical stiffness sensors. AuNRs were synthesized using CTAB and NaOL as capping ligands and were then surrounded by a shell of soft, thermoresponsive pNIPAm (poly (N-isopropylacrylamide)) based hydrogel. In order to change the stiffness, different cross-linking ratios (5:1, 10:1, and 20:1) were used during polymerization of the hydrogel. The size of the hydrogel and location of the AuNRs were tested by negative staining TEM. Upon heating the beads, a shift of the AuNR plasmon peak was observed due to the increase in refractive index of the collapsed hydrogel. The data was collected and analyzed using MATLAB. Future research will focus on synthesis of matrix substrates (composed of polyacrylamide hydrogel and AuNR surrounded by pNIPAm based gel) and development of a mathematical model, which will infer the stiffness of surroundings from the amount of shift in the spectrum.

11.
***IN VITRO* MEASUREMENT OF PROTEIN KINASE B ACTIVITY ON PEPTIDE SUBSTRATE REPORTERS**
Sababa Anber ‘20
Faculty Sponsor: Michelle L. Kovarik

Protein kinase B (PKB) is an enzyme involved in regulation of metabolism, cell survival and apoptosis in many cell types. The activity of this enzyme in intact cells and cell lysates can be measured using fluorescently-labeled peptide substrate reporters. However, it is necessary to understand the kinetics of the reaction to interpret the resulting data. The purpose of this experiment was to investigate the rate of enzyme activity *in vitro*, using three different peptide substrate reporters (VI-B, Crosstide and AP-I) with purified PKB from human and *Dictyostelium discoideum* cells. Seven concentrations (2 - 50 µM) of the three peptides were prepared, and the human enzyme and substrate were allowed to react for 0 to 45 min. Enzyme activity was measured by the rate at which the substrate was phosphorylated using capillary electrophoresis with laser-induced fluorescence. As expected based on Michaelis-Menten kinetics, preliminary results revealed that with increased peptide substrate concentration, the phosphorylation rate increased until it reached a maximum velocity, $V_{\max\ (\text{Crosstide})} = 6 \times 10^{-12}$ mol/min, $V_{\max\ (\text{AP-I})} = 3 \times 10^{-12}$ mol/min, $V_{\max\ (\text{VI-B})} = 8 \times 10^{-13}$ mol/min. The K_M value, which corresponds to the substrate concentration at half $V_{\max}$, was ~10 µM for Crosstide, ~30 µM for AP-I and ~20 µM for VI-B.

However recent results revealed that at higher concentrations, the velocity curve decreases. This could be due to substrate inhibition, in which the substrate itself acts as an inhibitor and impedes the activity of its enzyme. Future work on this project will determine whether substrate inhibition is affecting the velocity curve by looking at whether the results are reproducible and will compare the V_{max} and K_M values of (Crosstide, AP-I, VI-B) using the amoeba version of the enzyme.

12.
ANALYZING THE EFFECTS OF COCAINE AND A KETOGENIC DIET ON BRAIN NEUROTRANSMITTER CONTENT 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 further, 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 with respect to cocaine addiction and measuring how the ketogenic diet impacts the neurochemistry of behavioral reinforcement. 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 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 dopamine activity, as measured by the DOPAC/DA ratio in each brain area, was altered by administration of chronic cocaine and the ketogenic diet in female rats. These findings suggest that female animals subjected to chronic cocaine while on the ketogenic diet have an enhanced response to an acute cocaine challenge.

13.
EXAMINING REACTIVE OXYGEN SPECIES AS BYPRODUCTS OF ENDOGENOUS STRESSORS IN *D. DISCOIDEUM*
Jason S. Deck ‘21
Faculty Sponsor: Michelle L. Kovarik

Reactive oxygen species (ROS) are produced as byproducts of aerobic respiration, in which oxygen is used to convert glucose to ATP. At higher glucose concentrations, more respiration, and therefore more ROS, would be expected, which is not ideal since ROS may damage to cells if allowed to accumulate. If cells are subjected to a stressor, such as increased glucose levels, then the ROS they produce, and their level of oxidative stress, should increase. To test this hypothesis, we suspended K-AX3 *D. discoideum* cells at densities of 200,000 cells/mL with glucose concentrations ranging from 1× to 3× glucose (18-55 g/mL). We measured the cell density in each flask and resuspended cells in fresh media daily. We found that the doubling time of 1× cells increased from 8.3 h to 9.9 h over a period of 92 h, 2× from 9.8 h to 11.7 h, and 3× from 9.1 h to 17.6 h. A blood glucose meter was used to measure the change in glucose concentration during cell growth. The concentration of glucose went from 0.011 mg/L to .0092

mg/L over 24 h. This indicated that the cells consumed enough glucose in the media to change its concentration by 0.01 mg/L; however, the change is negligible compared to the total glucose concentrations. To examine ROS concentrations in the cells, we measured 1× and 3× cells via an indicator dye, called DCFH2-DA. The indicator is oxidized by ROS to produce a fluorescent product that was measured by fluorescence microscopy. In one experiment, we found that 1× cells demonstrated a more varied response (1100 ± 900 rfu), while 3× cells were more homogeneous (580 ± 60 rfu) after incubating for 4 hours. Cells incubated with 1× glucose were also brighter, which suggested higher ROS levels. This was not what we expected based on our hypothesis since we expected that higher glucose concentrations would illicit higher levels of ROS. Since we did not find this was the case, we plan to use a metabolic indicator, called XTT, to identify if superoxide was produced, rather than the other ROS that interacts with DCFH2-DA.

14.

EXPLORING WAYS TO MAKE FMOC-DERIVATIVES OF 4-AMINO-2-BUTYNOIC ACID

Uyen Doan ‘21
Faculty Sponsor: Timothy Curran

Solution phase synthesis, the current method for the synthesis of small peptides, is extremely time-consuming to synthesize larger peptides, because each step requires isolation and purification of the product. Hence, it is better to attach the peptide to the solid support to synthesize larger polypeptide. For the solid phases peptide synthesis (SPPS) of 4-amino-2-butynoic acid, a commonly used protecting group is 9-flourenylmethoxycarbonyl (Fmoc). In this research project, the goal is to explore different ways of making Fmoc-derivatives of 4-amino-2-butynoic acid so it can be used in SPPS. Results from mass spectroscopy and ^{1}H NMR tests showed that the Fmoc-amino acid was successfully obtained. Details regarding the synthesis, purification, and characterization of the protected Fmoc derivatives will be presented.

15.

RAPID CHANGES IN THE RED SEA CARBONATE SYSTEM DUE TO DUST

Maxwell H. Furigay ‘19
Aleck Zhaohui Wang and Eyal Wurgaft, Woods Hole Oceanographic Institute, Woods Hole, MA

Total alkalinity (TA) and dissolved inorganic carbon (DIC) are two important metrics in ocean chemistry, with wide-ranging environmental implications for aquatic ecosystems as well as the geochemistry of the planet in a macroscopic scale. Previous work has shown that dust that contains calcite (a naturally-occurring form of calcium carbonate) causes heterogeneous precipitation of calcium carbonate to occur, causing TA and DIC to decrease in a 2:1 ratio. Oftentimes, especially in windy, dessert climates, dust ends up blowing into oceans, which may have significant impacts on the local ocean chemistry. In this study, dust collected from the Red Sea region is suspended in water from the Red Sea, and DIC and TA changes over time are tracked. We find that dust causes significant TA and DIC decreases of up to six percent in the short term (under 200 hours), depending on the concentration of dust used and the time that the

dust is suspended in the water. However, the ratio of TA:DIC reduction due to dust appears to be 1:1, rather than 2:1. Additional work suggests that there is a species in the dust that is a source of alkalinity, possibly masked by the larger effect of calcium carbonate precipitation. Further work will explore alternate mechanisms for DIC/TA change in seawater and attempt to quantify the different mechanisms by which these changes occur.

16.
SYNTHESIS AND CHARACTERIZATION OF MONODISPERSE AU NANOPARTICLES

Anika Harkins '21
Faculty Sponsor: Lindsey Hanson

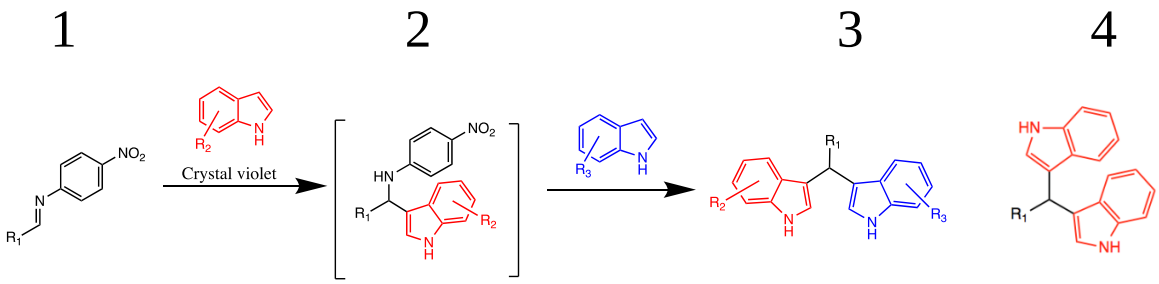
Due to their small size, noble metal nanoparticles have unique optical properties caused by surface plasmon resonance that respond to deformations in shape due to pressure. When silver nanoparticles are compressed, studies have shown that they exhibit pseudoelastic behaviour that allows the particles to regain their original shape after being deformed. It is important to study whether gold nanoparticles exhibit the same pseudoelastic behaviour in order to better characterize the mechanical properties of gold nanoparticles and their response to deformations due to which can be detected by the optical plasmon of the gold nanoparticles. Moderately sized nanoparticles of various sizes were synthesized for future compression in the Diamond Anvil Cell (DAC) to test pseudoelastic tendency based on size. These particles were then characterized by TEM imaging and spectroscopy to determine monodispersity and average size. Based on TEM imaging, several samples were determined to not be monodisperse enough for use in the DAC. The particles that appeared to be monodisperse from the images were analyzed with ImageJ to determine the average size distribution of the particles. After ImageJ, two batches of particles of different sizes were determined to be sufficiently monodisperse with a standard deviation of about 20% of the mean and were subsequently cleaned and concentrated for use in the DAC. The next steps are to deform the particles in the DAC and measure the surface-diffusion driven return to equilibrium state of the particles.

17.
TRITYL-CATION CATALYZED SYNTHESIS OF NON-SYMMETRIC BISINDOLYLMETHANES

Vanessa Jones '19
Faculty Sponsor: Cheyenne Brindle

The use of multiple single addition reactions to produce a single large product is an important technique for building molecular complexity. We large products called bisindolylmethanes[3] from the sequential addition of two different indoles to an imine, using triarylmethyl cation catalysis. This requires the synthesis of imines[1] from aldehydes. The imines are produced by adding different types of aldehydes to paranitroaniline. The solids produced from this reaction were then recrystallized to purify. Nuclear magnetic resonance was used to confirm the purity of the resulting imines. These imines can then be used to

create single addition products. The conditions of these reactions must be optimized to produce the highest percentage of single addition product[2]. Both temperature and concentration of solvent are altered. Various temperatures and concentrations were altered a reaction with the imine derived from piperonal. However, this reaction overall was found to select for double addition product[4]. Future work will include altering the reaction conditions for other imines in order to optimize for the single addition product. Once these conditions are optimized they can be used to conduct a one-pot two-step synthesis for bisindolylmethanes.



18.
SPECIFICITY OF PEPTIDE SUBSTRATE REPORTORS FOR PROTEIN KINASE B FROM *DICTYOSTELIUM DISCOIDEUM*
Misha A. Mehra ‘21
Faculty Sponsor: Michelle L. Kovarik

Dictyostelium discoideum has a relatively short social cycle, which makes it an ideal species for timely viewing of each of its life stages. Nutrient deprivation marks the beginning of the *Dictyostelium* social cycle. Starvation of the amoebae leads to secretion of cAMP, which attracts other amoebae to move towards the signal. Protein kinase B (PKB) is an enzyme found in *Dictyostelium* that is activated in response to the release of cAMP and signals information about social development within the cell. The aim of the experiment was to investigate the specificity of three peptide substrate reporters (VI-B, AP-I or Crosstide) and conclude which is most specific for the enzyme PKB from *Dictyostelium*. Each of the peptides was developed in human cells and has not previously been applied outside of mammalian systems. Cells were treated with combinations of cAMP and the PI3K inhibitor LY294002. Capillary electrophoresis coupled with laser-induced fluorescence detection was used to obtain the percent phosphorylation in each of the peptide substrate reporters. As expected it was found that the percent phosphorylation was highest for the (+) cAMP (-) LY294002 treatment, and Crosstide and AP-I had higher phosphorylation than VI-B. Further work will be done to compare the two isoforms of PKB in *Dictyostelium*. PKBA is an isoform of PKB that is active early in development and is susceptible to LY294002, but the isoform PKBR-1 expressed later in development is not. We will therefore compare time points at 1 h and 6 h of social development.

19.

DEVELOPMENT OF A LIQUID CHROMATOGRAPHY/MASS SPECTROSCOPY METHOD FOR BIOMARKER DETECTION IN PARKINSON'S DISEASE

Eugene Miller '21
Faculty Sponsor: William H. Church

There is currently no cure and no satisfactory treatment for Parkinson's Disease (PD). This lack of effective therapeutic treatment is due to the fact that the motor symptoms of PD do not present themselves until 80% of the dopamine cells in the substantia nigra are dead. The identification of a biomarker for the onset of neurodegeneration would greatly improve the potential outcomes of current and future treatments. Uric acid reacts with reactive oxidative species (superoxide, nitric oxide, and peroxynitrite) and the products of these reactions (allantoin, 6-aminouracil, triuret, respectively) could serve as biomarkers for degeneration prior to individuals becoming symptomatic. A liquid chromatography/mass spectrometry method of analysis was designed to quantitate these four analytes in serum samples. The separation, quantitation, and qualification of these compounds were investigated during the summer. Calibration curves were generated for all four compounds. Allantoin and 6-aminouracil were qualified within serum samples. Initial evaluation of the project suggests that this method will contribute to the diagnostic strategies currently available for Parkinson's Disease. Additional research into the validity of these compounds as biomarkers will be conducted.

20.

SYNTHESIS, CHARACTERIZATION AND DETERMINATION OF AN EXHIBITION OF BETA-SHEET CONFORMATION

Thanh Nguyen '19
Faculty Sponsor: Timothy Curran

This research involves synthesis and characterization of a dialkynylferrocene with amino acid esters appended to the two alkynes, the synthesis and characterization of the complex of this dialkyne with tungsten **1**, and the conformational analysis of **1**. It has been proposed that intramolecular hydrogen bonds will form between the two peptide chains in **1**, and that this hydrogen bonding will resemble that seen in beta-sheets. The use of an organometallic moiety to generate model beta-sheet systems would allow for experiments (like redox reactions) on these systems that are only possible with metal ions. The general strategy of this research is to synthesize the dialkynylferrocene, complex it to tungsten, and then purify and examine the target molecule. Synthetic methods in both organic and inorganic chemistry will be used. To determine the conformation of the tungsten complex methods such as NMR spectroscopy, X-ray crystallography and DFT calculations will be employed. This poster will present the work accomplished so far on this project, which is funded by a grant from the National Science Foundation.

21.

REFORMING ALDEHYDES FROM A BISULFITE ADDUCT WHILE PRESERVING STEREOCEMISTRY

William Patterson IDP ‘23
Faculty Sponsor: Cheyenne Brindle

Last summer Professor Brindle and her research group came up with a facile liquid-liquid extraction using bisulfite to separate aldehydes and ketones from other organic molecules. The aim of this research was to find a method of reforming the aldehyde while preserving the stereochemistry of the molecule. While testing the procedure created by Professor Brindle and her research group, we discovered that fresh bottles of stock bisulfite were not completely removing aldehydes from other organic molecules, as they had done in the past. To determine the source of this discrepancy, we tested the bisulfite protocol at different pH levels, temperatures, and concentrations. I also tested potential by-products of oxidation of the bisulfite ion as additives to see if these had an effect on the protocol. The best protocol was found to be simply increasing the amount of bisulfite solution used in the protocol. We successfully synthesized two alpha chiral aldehydes from commercially available materials to asses racemization during the bisulfite reversion reactions. We tested known reversion conditions including iron salts, and formaldehyde on simple commercially available aldehydes, but did not get any aldehyde ack when trying to reform it from the bisulfite adduct. In the future, we hope to be able to modify the extraction in a way that will allow the reverse reaction to proceed and give us our original stereochemistry of the aldehyde.

22.

SYNTHESIS AND CHARACTERIZATION OF PEPTIDES ATTACHED TO A RIGID BIMETALLIC RING SYSTEM USING METHYLENE LINKERS

Michael Phillip ‘19
Faculty Sponsor: Timothy Curran, DePhillips Fellowship

The main objective of this research is to investigate the possibility of creating a model β-sheet by using an organometallic framework composed of a constrained bimetallic ring system which consists of a ferrocene dialkyne coordinated to $W(dmtc)_2$. The alkynes are held in the syn orientation and are 3.5 Angstroms apart which is close to the distance between two peptides in a β-sheet. This leads to the possibility of investigating whether the attachment of peptides to the alkynes would allow intramolecular hydrogen bonding to occur between the peptides thereby forming a model β-sheet. The peptide derivatives were synthesized by attaching alanine (in the first experiment) and glycine (in the second experiment) to methylene linkers and then connecting these compounds to ferrocene diacid chloride. The final step in this synthesis involved coordinating both ferrocene dialkynyl peptides to $W(CO)_3(dmtc)_2$. The products obtained in each experiment were purified using various extraction methods and flash chromatography. Each product obtained was characterized by using ESI-MS, HPLC, ^{1}H NMR

and DMSO titration. The detailed synthesis and characterization of procedures will be further discussed in the poster. The conformations of the products obtained were modeled using density functional (DFT) calculations. The data showed that the amide protons on the peptides were able to engage in intramolecular hydrogen bonding while maintaining the rigidity of the bimetallic ring system.

23.

CONSTRUCTION OF A MS LIBRARY OF BINDER MATERIALS USING DART-TOF-MS

Claire Pritchard ‘20
Faculty Sponsor: Henry DePhillips

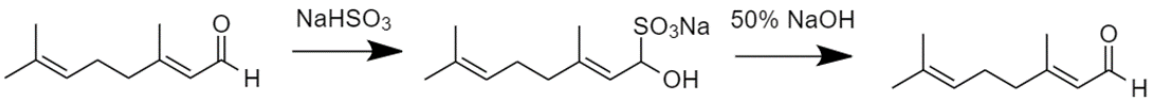
The identification of binder materials used in easel paintings is important for restoration and conservation of easel paintings but paint samples are microscopic, which can be an issue when using certain kinds of mass spectrometry. Direct Analysis in Real Time-Time of Flight-Mass Spectrometry (DART-TOF-MS) is distinct from other methods of mass spectrometry in that it does not require any sample preparation so that samples can be studied directly without any preparation that may lower the concentration of components to below detection limits. DART-TOF mass spectra for 11 commonly used binders were collected and a mass spectral library of m/z values was constructed to use as a reference for identification of binder materials in a paint sample.

24.

OPTIMIZING MASS RECOVERY OF NATURAL PRODUCTS FOLLOWING LIQUID-LIQUID EXTRACTION ON ESSENTIAL OILS WITH KNOWN ALDEHYDES

Hanna Vescovi ‘21
Faculty Sponsor: Cheyenne Brindle

Studying natural products is essential for the creation of new pharmaceuticals. Natural products are useful compounds to study when beginning to create new drugs because natural products can have bioactive properties. For instance, citral, an aldehyde that comes from lemongrass and citrus fruits, has antimicrobial properties. For natural products to be studied, they must first be isolated from the material that contains the natural compounds. One easy method used for separating natural products is liquid-liquid extraction. Performing a liquid-liquid extraction on lemongrass essential oil can be used to isolate the natural product citral. A protocol in which a liquid-liquid extraction is executed by adding a minimum volume of water to the aqueous layer, polar immiscible solvent to dissolve organic materials of the essential oil, specific volume of miscible solvent relative to the volume of water added, and minimum volume of sodium bisulfite to react with the aldehyde and produce a charged adduct, yields the highest percent mass recovery of citral from lemongrass essential oil. For future studies, it would be useful to develop a protocol that can be used to isolate natural products from entire organisms, rather than from materials that are already very pure, such as essential oils.



ENGINEERING

25.
BIOMECHANICS OF THE STANDING VERTICAL JUMP
Elias Kagabo ‘20
Faculty Sponsor: Joseph L. Palladino

The Vertical jump test is one of the most important assessments of the lower body power often used to evaluate the athleticism in many different sports like basketball, football, and volleyball. In this project, I worked with a force sensor (Force Plate) to study ground reaction forces involved in human movement. The objective of the study was to demonstrate how calculating impulse can predict the height that a person jumps and determine how accurate the force plate is. Performing a standing vertical jump on the force plate gives a plot of ground reaction force as a function of time. By integrating this curve, we calculated the impulse delivered to the ground by the jumper. Using the impulse-momentum theorem and kinematic relations, we were able to calculate how high the person jumped. The results were then confirmed by measuring the actual height reached using a camera. https://www.whatsmyvertical.com/how-to-measure-vertical/

26.
BIPEDAL TELELOCOMOTION AND ACTIVE VIBRATION CONTACT SENSOR - WORK IN PROGRESS
Mahmoud Khalil ‘20, Logan Drescher ‘21, Kirk Boyd ‘21
Faculty Sponsor: Kevin Huang

Remotely operating robotic devices marries the many benefits of machines with the operational level control and adaptive nature of human beings, thus extending human controlled manipulation to spaces otherwise inaccessible, e.g. underwater operations, nuclear waste cleanup, munitions remediation etc. Indeed, once robots are within operating distance of the task, teleoperation has proven to be a successful corobot architecture. Therein lies the problem. Oftentimes real-world scenarios are not easily accessible by wheeled robots, such as stairs and coarse rubble. Legged locomotion offers a flexible and viable means for traversing unpredictable terrain, yet autonomy in this field lacks the robustness required for real deployment. This works aims to explore human controlled robotic locomotion. Initial designs incorporate a low-cost, servo-driven humanoid robot for the remote device, and two haptic input devices at the operator workstation for control of each lower limb. Contact forces from the remote site are to be reflected back to the user via these haptic devices. It is hypothesized that semi-autonomous balancing in tandem with human controlled limb placement can improve locomotion agility and

efficiency, particularly with difficult terrain. In order to accurately and transparently reflect remote contact forces to the local operator, sensing of the remote environment is key. A lightweight time of flight depth sensor accurately obtains 3D surface geometries of the environment, while a prototype high-sensitivity sensor for limb contact detection is developed in-house. This novel device utilizes an active mechanical vibration signal which is in turn measured via sensors. Such a simple architecture will be used to characterize contact vs. non-contact states, determined simply by change in measured signal pitch. These technologies combined can help ensure efficient and safe teleoperation to address dangerous tasks in lieu of human responders.

27.

LOCALIZATION OF IODINE NANOPARTICLES IN TRIPLE NEGATIVE BREAST CANCER TUMORS GROWING IN THE MOUSE BRAIN

Shahnila Malik '20, Sharif Midwan, Mahak Kanjolia
Faculty Sponsors: James F. Hainfeld, Henry M. Smilowitz, Ph.D

We have studied the distribution of iodine nanoparticles (INPS) within advanced human MDA-MB-231 triple negative breast tumors growing in the brains of athymic nude mice. INPs were found to surround tumor cells and vessel-like channels within tumors and colocalize with CD31 staining. There was little difference in INP distributions when tumors were analyzed 1D or 3D after INP injections. Studies to correlate INP distribution and radiation therapy enhancement are planned.

28.

A DATA-DRIVEN APPROACH FOR GAZE TRACKING

Daniel Melesse ‘20, Evelyn Luciani ‘21, Mahmoud Khalil ‘20
Faculty Sponsors: Kevin Huang, Taikang Ning

Gaze tracking presents an intuitive interface for technology in today’s society, with its application focus in controlling electronic devices. This paper concentrates on the design and application of an automatic gaze tracking system utilizing commodity equipment. Compared to preceding low-cost methods, the proposed method is significantly simpler, lowering the barrier of entry for this type of device, and can potentially afford more accurate tracking. Through the careful placement of the infrared (IR) light-emitting-diodes (LEDs) on the monitor and coaxially to the optical axis of the camera, the pupil was illuminated and reference glints became visible on the cornea. These glints were captured by a camera capable of detecting IR light, and were used to determine the users line of sight relative to the monitor. A linear model was used to address the horizontal and vertical components of the glints in the users eye and match them to the corresponding location point on the monitor. K-means clustering was utilized to classify the separate gaze regions with promising results.

29.

A WIRELESS DIGITAL STETHOSCOPE DESIGN

Skyler Szot ‘21, Alisa Levin ‘21, Anthony Ragazzi ‘21
Faculty Sponsor: Taikang Ning

The stethoscope was first invented more than 200 years ago and, to date, the practice of auscultation still follows the same original design and is inevitably subjective to the hearing ability and experience level of an individual medical practitioner. Heart diseases are of primary concern to patients of all ages, and cardiac auscultation has been the most commonly utilized bedside diagnosis to detect heart murmurs caused by abnormal cardiovascular alternations. Our goal is to develop a smart digital stethoscope with modern electronics and computing technologies to provide accurate information to assist cardiac auscultation and significantly reduce misdiagnoses. Our solution includes designing an amplifier-filtering circuit to collect an analog signal from an electronic stethoscope, performing analog to digital conversion using an Arduino microcontroller, transmitting digital heart sound signals via Bluetooth to an Android smartphone, and developing an Android app to store and process heart sound data. This approach has the capacity to graphically display heart sounds, toggle the display of indicators like systole and diastole generated through artificial intelligence, and store and replay previously generated data. The additional smart/AI component that detects heart sounds is implemented with an in-house developed peak detection algorithm. The target app provides the framework to implement further signal analysis in the future. With this mobile implementation, physicians can now utilize an additional visual aspect to make more accurate heart murmur diagnoses. The Bluetooth mobile app will help to make accurate automatic cardiac auscultation more accessible to medical professionals, and potentially more data sharing capabilities for ease of second opinion. A research paper on this work was presented at the IEEE International Conference on Signal Processing in Beijing on August 13th, 2018.

30.

VEHICULAR AD HOC NETWORKS (VANET) BASED ON COMPLEX NETWORKS THEORY

Meizi Wu ‘20
Faculty Sponsor: Lin Cheng

Vehicle-mounted ad hoc network (VANET) is created by applying the principles of a mobile ad hoc network to the vehicle domain. Vehicle-to-vehicle and vehicle-to-roadside communications architectures will co-exist in VANET to provide road safety, navigation and other roadside services. VANET can use any wireless network technology as its foundation. Complex networks can describe the evolutionary and statistical properties of systems based on statistical physics and graph theory. VANET's infrastructure has roadside access points connected to the Internet, and the BA scale-free network model is also proposed as a network form for the new network model.

31.

CHEMKIN ANALYSIS OF DMMP COMBUSTION REACTIONS IN SHOCK TUBES

Hannah Zukowski ‘21, Rahul Mitra ‘21, Aedhan Healy ‘21
Faculty Sponsor: John D. Mertens

Computational studies using ANSYS Chemkin software were performed at Trinity College to pre-determine the experimental conditions to be used in shock tube experiments at Texas A&M

University. A shock tube is a large-scale device used to heat a gas to a controlled temperature nearly instantaneously. The purpose of the research was to further understand the combustion of sarin gas. Sarin is a highly poisonous organophosphorus compound that is used as a chemical weapon due to its extreme potency as a nerve agent. Dimethyl methylphosphonate (DMMP) was used as the sarin simulant during the experiments due to its similarity in chemical and physical properties with sarin gas. Based on the species profiles, sensitivity plots and reaction flow charts obtained from Chemkin, recommendations were made to model conditions for experimental runs at the Texas A&M laboratory. After closely studying certain product channels, a number of conclusions were reached regarding the ideal conditions for DMMP combustion.

ENVIRONMENTAL SCIENCE

32.

TREE PLANTING PLAN FOR THE CITY OF HARTFORD, CT

Giles Lemmon '21
Faculty Sponsors: Christoph Geiss, Jack Hale, Grace Yi

Hartford is a city with a large number of urban trees, and the benefits of these trees cannot be understated. Urban trees provide a multitude of vital uses and are incredibly important the wellbeing of the city as a whole. The City of Hartford has a current tree count of around 568,000, which means that approximately 26% of the total area of the city is covered by the forest canopy. The City of Hartford has been actively engaged in tree planting, and this venture has been successful. Unfortunately, Hartford's forest is ageing. Among Hartford's urban forest, trees with a diameter of 20 inches and larger account for around 50% of total canopy cover, even though they make up just 10% of the total number of trees. When large, old trees (that provide a lot of canopy cover) are removed, they are replaced by younger trees. Thus, in order to maintain the current canopy cover, it is not sufficient to simply plant one tree for every tree that is removed. As a result of pest activity, and damage from storms, an alarming number of trees are having to be removed, and as extreme weather events become more common, this number will only continue to increase. In recent years, Hartford has been planting approximately 200-300 trees per year. The purpose of this study is to determine the effect on canopy cover that the current planting strategy will have, the number of tree plantings that are needed to maintain the current canopy cover. To generate a forecast of canopy growth, a piece of software called iTree Eco v6.0 was used. If no new planting was to occur, the canopy cover in Hartford is predicted to drop to 22.03% within the next thirty years. If a plan of planting 1000 trees per year of the recommended species mix specified in the planting plan were enacted, the canopy cover would still decrease, to reach 24.16% by the year 2048. This is still a serious decline from the current canopy cover percentage, but it is significantly lower than the impact of planting no new trees at all. If a plan of planting 3000 trees per year were enacted, the canopy cover would increase to 28.42% by the year 2048 (See Figure 3), a very significant improvement from the current planting plan. In order to maintain the current canopy cover, 1465 trees would have to be planted each year, starting in 2018. A lack of tree planting now might not have an immediate effect, but decades down the line the consequences would be devastating. In order to preserve Hartford's canopy for the future, action must be taken now.

33.

MERCURY ACCUMULATION IN URBAN PARK STREAMS AND PONDS: HAS URBANIZATION CHANGED WOULD-BE WILDLIFE HABITATS INTO ECOLOGICAL TRAPS?

Joseph Ruggiero ‘19, Shane McLaughlin ‘19, Anna Maria Imwalle ‘20
Faculty Sponsor: Amber L. Pitt

Streams and ponds act as centers for biodiversity; however, those near urban settings often have altered hydrology, morphology, and water chemistry. These changes affect functionality and may create ecological traps. One particular concern is the accumulation of heavy metals such as mercury. Mercury is one of the most harmful contaminants in water even at very low concentrations, and presents a serious threat to living organisms due to bio-magnification. Plants accumulate mercury from both the soil and water, and if consumed, it can bioaccumulate throughout the food web. Our goal was to determine which plants and components of plants accumulated the greatest amount of mercury, and which plants could be most effective for bioremediation. We evaluated accumulation of mercury in various species of aquatic and riparian vascular and nonvascular plants, and within the roots, leaves, and stems of vascular plants. We collected plants and fine (<63 μm) sediment samples from within and along the banks of a stream and ponds in the Greater Hartford Area, Connecticut, USA. Fine sediment samples were gathered from within a 10 cm radius underneath each collected plant. Sediment samples in our study streams and ponds contained higher levels of mercury than the national average of 100 ppb and exceeded the threshold levels of 174 ppb. We found in vascular plants the roots accumulated the greatest amount of mercury, but roots varied highly both within and among species. However, non-vascular aquatic species on the surface of ponds and streams accumulated the most mercury overall. Mercury accumulation in our study area has the potential to negatively impact wildlife. Non-vascular aquatic plants may have the potential to be used for effective bioremediation within contaminated urban streams and ponds. This information may be utilized to improve management strategies in urbanized streams and ponds.

34.

METHODS FOR QUANTIFICATION OF PYRRHOTITE IN CONCRETE

Joseph Ruggiero ‘19, Kevin Oleskewicz ‘19
Faculty Sponsor: Jonathan Gourley

Pyrrhotite is an iron-sulfide prone to oxidation and subsequent deterioration. It has been implicated in the cracking of foundations in homes across northeastern Connecticut. Therefore, pyrrhotite testing of concrete has been a major subject of focus in the Trinity College Environmental Science Program, with the main objectives being to develop a comprehensive method for measuring pyrrhotite contamination and estimating probable-effect-concentrations.
Current Trinity sampling methods utilize a combination of X-Ray Diffraction (XRD), Carbon Nitrogen and Sulfur analysis (CNS), and magnetic susceptibility to determine mineralogy and sulfur concentration in addition to pyrrhotite concentration. The sulfur analysis and magnetic susceptibility results were then compared with qualitative data on concrete deterioration with the hopes of compiling a larger case database from which to better determine risk. The objective this summer was to determine the extent to which other sulfur-bearing minerals contribute to overall sulfur concentration, as well as to modify the current sulfur analysis method in conjunction to

include applications for XRD analysis, thereby providing a more comprehensive quantification of pyrrhotite and its oxidative products in concrete. Understanding these mineral behaviors is key to achieving better assessments of risk down the line, and could potentially allow for determinations of stage of reaction and better timescales for deterioration. However, more data are needed from both homeowners and lab experimentation before conclusions of risk and severity on pyrrhotite related issues can be drawn.

MATHEMATICS

35.
PRICING AMERICAN OPTIONS
Noelle Casey ‘20, Lin Liu ‘20
Faculty Sponsor: Lina Ma

Options give holders the right to buy/sell stocks. The two main types of options are European and American. Compared to European options, which are priced through the classic Black-Scholes formula, the American options have the advantage of early exercising. This flexibility makes it challenging to price such options. In this project, we studied the early exercising boundaries as well as how to price American options. The two approaches we used were the binomial tree and the Longstaff method via the stochastic process. Numerical experiments were carried out by considering multiple periods for the binomial tree model and simulating significant amounts of paths for the Longstaff method. Results show that the two methods converge to similar prices.

36.
AN INTRODUCTORY LOOK AT THE VARIATIONS OF THE BEVERTON-HOLT MODEL, THE SIGMOID BEVERTON-HOLT MODEL, AND THE LESLIE GOWER MODEL
Mehluko Myanga ‘20, Muhammad Zeb ‘21, Physiwell Maume ‘21
Faculty Sponsor: Toufik Khyat

As one ventures upon the modern world, he is likely to be overwhelmed by the magnitude of biological growth within his surroundings. Such growth expands from macro biological ecosystems of the Amazonian Tropical regions, to that of the marine population in the eastern coast of Canada, to the microsystems of the bacteria upon one’s hand. Upon an elementary glance the notion of independent linear growth may wrongly be accepted as a valid population modeling method. However, it is vital to address the amalgamation of the dependently overlapping nature of biological populations with the variable mortality and birth rate characteristics of such. This brief paper seeks to introduce three population models that fulfill the above considerations. An analysis of the Beverton-Holt Model will be introduced following a brief historic relevance of such. Variations of the Beverton-Holt Model model will be viewed to draw cohesive parallels between such, as the paper ventures to analyze the Sigmoid Beverton-Holt Model. Consideration of the relationship between a set of species that share the same

ecosystem will be analyzed through the Leslie Gower Model. As this paper was compiled by undergraduate students, the conclusion will feature a selection of unanswered reference questions that may be investigated to further develop one's understanding of population growth modeling.

37.

GOOGLE PAGERANK IN COMPLEX NETWORKS

Thanh Son Phung '20
Faculty Sponsor: Per Sebastian Skardal

We analyze the characteristics of a complex network to construct a ranking system of all nodes, based on the likelihood of a random walk from a given node to any node in the network in an arbitrary interval of time. In addition to the analysis, we introduce a small perturbation to the network to investigate the changes in the ranking. The investigation is likely to give some insights on how the Google PageRank operates and how we may manipulate the perturbation in order to rearrange the ranking and produce a desirable outcome. A close and practical problem to the subject is how we can boost a particular page's ranking on Google to increase interactions to the specified page.

38.

COMPARISON OF THE EFFECTS OF MIXED DELAY/INSTANTANEOUS TERMS ON THE FREQUENCY OF DELAY OSCILLATOR

Kalsang Wangmo Sherpa'20
Faculty Sponsor: Lauren Lazarus

This research investigates the dynamics of an oscillator modelled by a delay differential equation under periodic external forcing, comparing variations on the system's cubic term. Perturbation methods were applied to these systems giving rise to a slow flow system of ordinary differential equations rather than delayed. Through linear stability analysis of the slow flow system, we find Hopf and saddle node bifurcations indicating behaviors of quasiperiodic and periodic motion for different parameter values. The findings show that the number of delay terms in the cubic term impact the nature of the oscillator, primarily its natural frequencies, and how it responds to the forcing term.

NEUROSCIENCE

39.

CHARACTERIZING THE TEMPORAL DYNAMICS OF VISUAL PROCESSING

Gabriela Christensen '21, John Albanese '21
Faculty Sponsor: Michael A. Grubb

A speed-accuracy tradeoff (SAT) procedure demonstrates the interaction between response time and accuracy across responses in psychophysical tasks. By quantifying the relationship between response time and a measure of accuracy, a more comprehensive analysis and conclusion can be drawn from the data, further advancing the study of cognitive psychology. In order to complete an SAT procedure, two observers completed a two-alternative, forced-choice task by deciding the apparent orientation of one of two gratings. A variable delay time was also present, during which the observer was unable to make a response until an audio cue signaled that a response could be made. By varying the delay time, one could observe the changes in accuracy based upon the amount of processing time available. Each trial in the experiment contained an exogenous cue, used to draw covert spatial attention, with the cue appearing equally near the location of the target grating (valid) or the distractor grating (invalid), and appearing equally on both sides of the screen. Analysis demonstrates that each of the speed-accuracy data sets can be fit with an exponential function, in which specific parameter values can be estimated to create the best-fit curve. An SAT function plots accuracy as a function of reaction time, and discriminability (d') was used as the specific measure of accuracy. Moreover, the parameters were estimated for both the valid and invalid trials for each participant independently. There were three parameters being estimated: asymptote, rate, and x-intercept. Participant one completed 5,040 trials, while participant two completed 7,560 trials, and upon completing randomization tests for each participant independently, it was determined that there was a significant difference in asymptotic discriminability between valid and invalid trials, demonstrating the attentional effect of exogenous cues.

40.

OXYTOCIN EXPRESSION IN THE BRAIN AS AN EFFECT OF GESTATIONAL EXPOSURE TO THE KETOGENIC DIET

Kiera Flynn '21, Julianna Armentano '20
Faculty Sponsor: Luis Martinez

The high-fat, low-carbohydrate ketogenic diet (KD) has been established as a reputable treatment for epilepsy. However, for pregnant women with epilepsy, the various impacts that a KD could have on developing offspring have not been fully examined. Previous studies have determined that gestational KD in mice improves affect and decreases anxiety, all without negatively affecting sociability. Given that oxytocin (OT) positively regulates affect, anxiety, and sociability, we sought to test how development of the OT system is impacted by gestational KD. We collected brains from mice previously exposed to a KD or control diet (CD) gestationally, and that had been tested for sociability and depressive-like behavior as adults. Brain tissue was then sectioned and processed for immunohistochemistry for OT. OT-immunoreactive cells were imaged and counted in the bed nucleus of the stria terminalis (BNST) and paraventricular nucleus of the hypothalamus (PVH), and while analysis is still ongoing, these data will provide a better understanding of the neural mechanisms mediating the positive behavioral effects of gestational KD exposure.

41.

MELODIES WITHIN RESTING STATE FMRI

Rachel Fox ‘21
Faculty Sponsor: Dan Lloyd

The Human Connectome Project (HCP) provided our resting state functional magnetic resonance imaging data, or rsfMRI, which was collected while subjects rested in the scanner. The rsfMRI data consisted of about 900 images collected for each of the 180 subjects analyzed. These data were then compared to six different genres of music that represent world music as a whole in their variation of melodic patterns. We chose to examine music against rsfMRI due to their similar levels of short sequential repetition. We processed the rsfMRI data and music in Matlab to find the maximally-correlated assignment of brain states per subject to each of the 120 songs. We could then gather the similarity of each subject to each song and genre through its p-value. We also constructed a note matrix of the brain data most similar to the music. We found the genre composed by George Gershwin to be the most generally similar to the rsfMRI data, while *Dithyrambe* by Franz Schubert was the most closely related single song to the brain data. After realizing this, we invite further speculation as to what aspects of *Dithyrambe* can tell us about brain dynamics as perhaps his use of repetition or inconsistent intervals may offer hints at how the brain functions. In the future, we plan to expand our study to look at more musical pieces and broaden our field of inquiry beyond the melody and into rhythm, repetition, and tempo to find out why the brain is so inherently musical.

42.

INVESTIGATION OF CONTINUOUS FLASH SUPPRESSION THROUGH VIRTUAL REALITY

Patricia Gaitan ‘19
Faculty Sponsor: Michael A. Grubb

Consciousness is one of the biggest mysteries that researchers aim to learn more about in the field of neuroscience. However, to begin the investigation, one must understand the path that stimuli take to reach consciousness. To begin, the eyes always receive slightly different images that are similar enough that the brain is able to combine them so that only a single perception is perceived. The brain uses the slightly different images to create depth and virtual reality can create the same perception by also presenting each eye with slightly different images. Continuous flash suppression is a method that is used to manipulate conscious awareness in the lab. The method calls for presenting each eye with a different stimuli: a dynamic, color-filled noise patch to one eye, and, in this experiment, an upright or inverted smiley face emoji to the other eye. The dynamic noise square grabs the participant’s attention and renders the emoji invisible. The objective is to test whether the visual information of the emoji’s orientation reached awareness based on the participant's response. Using a virtual reality headset and computer program Oculus Rift CV1, ten participants completed 400 trials in which there are equal amounts of suppressed and unsuppressed trials. The data showed three different categories. Two of the participants’ results were as expected, where they were at chance in both eyes when suppression was present. Two of the participants were above chance in both eyes and the other two were only above chance in one eye, suggesting ocular dominance. Participant recruitment is still ongoing and we hope to have a total of 20 by mid-November. To ensure that participants

aren't learning the emoji's features, in the spring, we will change the emoji that is presented each trial.

43.
TREATMENT MODULES FOR PROSPECTIVE MEMORY TRAINING POST TBI
Anna Hackett '20, Anna Lee '20
Faculty Sponsor: Sarah A. Raskin

The goal of this study was to make a series of treatment modules that patients and practitioners could use as training guides to improve prospective memory in people with brain injury. The memory of each patient was first tested using the Memory for Intentions Test (MIST) a standardized test of prospective memory. Based on these results, the participant would then begin whichever module was determined to be best suited for his or her condition. Seven modules were created: Enactment, Visualization, Increasing Cognitive Load, Increasing Cue-Intention Relatedness, Decreasing Cue Focality, Implementation of Intentions, and Time Perception training.

44.
THE ROLE OF OXYTOCIN AND GABA IN A MOUSE MODEL OF SOCIAL ANXIETY DISORDER
Bilal Hamzeh '19
Faculty Sponsor: Luis Martinez

Social anxiety disorder (SAD) is characterized by excessive and unwarranted fear of either specific or general social situations resulting in physical and/or psychological manifestations of distress. The present study aims to identify and characterize the role of the neuropeptide oxytocin (OXT) in mitigating symptoms of SAD, specifically focusing on whether this mechanism is independent or dependent of the neurochemical gamma aminobutyric acid (GABA). OXT has been found to play a role in linking social behavior and reward in the brain, while GABA is the primary inhibitory neurotransmitter of the mammalian nervous system, possessing general anxiolytic actions – explaining why it is the target of anxiolytics such as benzodiazepines (used to treat SAD). In the present study, adult CD1 mice are subjected to a conditioning apparatus which delivers a shock when they interact with a novel stimulus mouse. Mice are then tested for expression of social fear by introducing a novel stimulus mouse into their home cage and recording and analyzing the interactions. Both treatment (shocked) and control (no shock) mice receive intracerebroventricular injections of either OXT (or vehicle) combined with systemic injections of the GABA-A antagonist bicuculline (or vehicle), in order to determine whether

GABA signaling mediates the anxiolytic effects of OXT in SAD. Mice are then euthanized and brain tissue examined microscopically to confirm brain injection sites. With these data, the present study seeks to classify a potentially novel neural basis of SAD – furthering the development of pharmacotherapies which specifically target social subtypes of anxiety.

45.

THE EFFECTS OF A KETOGENIC DIET ON THE PROGRESSION OF ELECTRICALLY KINDLED SEIZURES IN A RAT MODEL

Carter Jones ‘19
Faculty Sponsors: J. Harry Blaise, David Ruskin, Susan Masino

The ketogenic diet (KD) has been used for decades as an effective anticonvulsant. Its powerful and natural processes result in some patients, suffering from conditions such as Epilepsy, becoming seizure-free. In some cases, these patients remain free of seizures after returning to a normal diet (Marwa et. al., 2017). Kindling is a modern technique of training the brain to be more susceptible to synchronicity and therefore seizures overtime through the electrical or chemical stimulation of specific areas. The objective of this project is to see if a KD can prolong the development of major seizures in an electrically kindled rat model. Rats between 280 and 300 grams will be used. Stereotaxic surgery will be performed to implant the electrodes. After a two-week recovery period the brain will be stimulated daily according to an electrophysiology timeline until ten class five seizures are obtained. The resulting data will be analyzed, and any significant data will be assessed.

46.

NEUROMUSCULAR PHYSIOLOGY OF THE ESCAPE WITHDRAWAL BEHAVIOR OF THE CHINESE MUD SNAIL, *CIPANGOPALUDINA CHINENSIS*

Ashley Kupferschmid ‘20
Faculty Sponsor: Charles Swart

Behaviors that allow an escape from danger are critical to survival. Snails can withdraw into their shells when threatened and can remain withdrawn for many hours if necessary. Long-term contraction of muscles during this behavior should be very energetically expensive. A special low-energy, Calcium-independent muscle contraction condition known as “Catch State” is known in bivalves (clams, oysters etc.) but has not been explored in snails. This project aims to describe the neuromuscular physiology of the withdrawal escape behavior in the freshwater snail, *Cipangopaludinachinensis*. To do so, several variables are tested and measured, including muscular anatomy, electrophysiology, neurotransmitter activity and muscle fiber type.

47.

DIET PREFERENCE BETWEEN THE HIGH FATS AND HIGH CARBOHYDRATES DIETS IN MICE

Jean Lewis Nikuze ‘21
Faculty Sponsors: Susan Masino, David Ruskin

Diets given to mice can influence the results of an experiment. We wanted to know mice’s preference between the ketogenic diet and the control diet. We fed male and female mice from C57 and BTBR strains the control diet before the experiment. For a six days period, we fed one group of mice the ketogenic diet and the control diet to the other group. During the following eight days, we gave both diets to all the groups of mice. We found that mice which were fed the ketogenic diet in the first phase of the experiment ate more ketogenic food in the second phase too. However, there was no specific diet preference because they ended up eating nearly the same amounts of both diets. Moreover, mice’s food preference was not influenced by sex or strain. They also did not significantly increase weight. We suggest that experiments done for a longer period of time would give different results.

48.

THE PRESENCE OF TRAUMATIC BRAIN INJURY FROM DOMESTIC VIOLENCE IN ADULT FEMALE WOMEN

Chloe Ouchida ‘21
Faculty Sponsors: Olivia DeJoie, MA, Sarah A. Raskin

Domestic violence often results in physical injuries to the head and shoulders resulting in traumatic brain injury (TBI) to the brain from blows to the brain or violent shaking or strangulation. Often victims do not know the extent of their injuries. The results of TBI often produce symptoms of memory and attention impairment, sensitivity to sensory stimulants, and emotional trauma. The participant’s health, cognitive and emotional abilities were examined by using various tests that involved assessing the attention, quality of life, executive function, post-traumatic stress disorder (PTSD) symptoms, and health history of the participant. This study was done to determine the effect of TBI from domestic violence on memory, cognitive ability, and daily functions and whether survivors of domestic violence correlate with PTSD. The results suggest that individuals who experienced TBI from domestic violence experience a difficult in daily functioning from their TBI. Future applications would include identifying the signs of domestic violence with individuals with TBI within emergency care facilities to improve treatment for injuries.

49.

FEASIBILITY AND ACCEPTABILITY OF USING TABLET-BASED BEHAVIORAL HEALTH SCREENING IN THE PEDIATRIC EMERGENCY DEPARTMENT AND REFERRALS TO CARE COORDINATION

Jasmine Patel ‘19
Faculty Sponsors: Steven Rogers, MD, Danielle Chenard, BS, Glenn Flores, MD, FAAP, Connecticut Children’s Medical Center

Behavioral health refers to an individual's state of well-being and how changes in behavior contribute to their mental and physical health outcomes. An estimated 49.5% of youth will meet criteria for a diagnosable behavioral disorder, including 22.5% with severe impairments. Additionally, more than half of behavioral health issues begin in childhood, with suicide as the second leading cause of all deaths among all adolescents. The large proportion of high-risk adolescents entering the ED suggests the need for better implementation of behavioral health resources. Brief screening measurements are a proposed solution for harm prevention in children and adolescent populations. The Pediatric Screening Checklist (PSC) is a validated psychosocial screen designed to improve the recognition of cognitive, behavioral and emotional problems in children and adolescents so that early interventions can be initiated. The planned study is a single-center prospective cross-sectional pilot study conducted to determine the incidence of PSC positive scores in a child and adolescent population. Once identified, we will be tracking if those subjects can be referred to Care Coordination services and able to attend services offered. The target population includes children ages 4 to 18 years seen in the emergency department at Connecticut Children's Medical Center. Research assistants (RAs) will be trained to approach patients in the ED and obtain the proper consent for interested subjects. Patients meeting the inclusion criteria will perform the screen in the pediatric ED waiting room on a tablet. If the patient screens positive, the tablet screen will cue the RA to call the scheduled social worker. Collection of data will occur during various mornings, afternoons and nights on both weekdays and weekends. A follow-up period of 60 days will determine whether the patient showed up to the appointment(s) made over the phone with the care coordinator. Care Coordination will provide a report of patient attendance to the shared tracker within Connecticut Children's. Results from this study can be used as pilot data for a larger funded implementation study to determine whether tablet based screening measures can be integrated into routine emergency care with minimized interference.

50.

THE USE OF fMRI TO INVESTIGATE PHYSIOLOGICAL FUNCTIONING ASSOCIATED WITH PROSPECTIVE MEMORY PERFORMANCE BEFORE AND AFTER COGNITIVE REHABILITATION IN INDIVIDUALS WITH ACQUIRED BRAIN INJURY

Meaghan Race '18, Gianna Barbadillo '21
Faculty Sponsor: Sarah A. Raskin

Acquired brain injury (ABI) affects approximately 3.5 million Americans each year and is associated with cognitive and emotional changes. Prospective memory (PM) deficits are important predictors of functioning in daily life for individuals with ABI. Previous studies have shown that cognitive rehabilitation therapy via PM training has a high rate of success in improving quality of life, independence and productivity for ABI survivors. There is limited information on utilizing imaging techniques in relation to changes in cognition and behavior following rehabilitation; however, previous studies suggest that imaging provides evidence that cognitive treatment could be related to changes to underlying brain plasticity. The aim of this study was to evaluate what brain areas were activated during prospective memory task stimuli in ABI individuals compared to healthy adults. Furthermore, a post-scan was used to determine if there were changes in the cortical regions used for the PM task following cognitive rehabilitation therapy compared to pre-therapy. 34 participants were recruited (18 with ABIs and 16 healthy

adults) and given a series of neuropsychological tests and an fMRI at baseline. Participants with ABI then participate in six weeks of PM cognitive rehabilitation treatment (CRT) individualized based on their pre-testing performance. Following treatment, the ABI participants received the neuropsychological battery and a follow-up fMRI. The results of this pilot study suggest strong statistical evidence for sub region activation in frontal, cingulate, parietal, premotor, and temporal cortexes relative to pre-treatment baseline levels for ABI participants. Further investigation is being conducted to determine significance between the ABI subgroups: cognitive rehabilitation treatment (CRT) and attention control condition (ACC) group pre- and post-treatment.

51.

THE MEMORY FOR INTENTIONS SCREENING TEST (MIST) SHORT FORM

Meaghan Race ‘18, Katie Marsden ‘21
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. 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 (MIST-S). These revisions allow the MIST-S to be administered in 18 minutes as opposed to 35 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 data given supports the psychometric properties of the MIST-S. Results are consistent with the data collected from the original MIST. There were significantly lower scores seen in the older age groups. Additionally, there appeared to be a significant correlation between education and the total MIST-S score. The MIST-S performs the same objective as the original MIST with an improved ease of administration.

52.

SONIFICATION OF HARMONIC SIGNALS IN THE BRAIN

Emily Wertheimer ‘20
Faculty Sponsor: Dan Lloyd

This study was conducted in order to determine the validity of data sonification as it pertained to resting-state functional magnetic imagine (rsfMRI) data. Particular attention was paid to the sonification of harmonic signals present in these fMRI scans. To achieve this aim, a thorough review of the literature pertaining to data sonification was conducted, followed by the creation of a YouTube video that contained an animated graphic of the density of harmonic signals in a resting-state scan. The sonified rsfMRI scans assisted us in perceptualizing the data, while the “musified” data began to clarify the pulsing patterns of harmonic activity as revealed by the fMRI scans. This result is significant due to its novel, sonic approach to observing and classifying harmonic brain signals.

PHYSICS

53.
COINCIDE – DIGITAL DATA ACQUISITION OF MULTI-PARTICLE EVENTS
Stephen J. DeMonico ‘17, Aashwin Basnet ‘19, Alex Bellas ‘20
Faculty Sponsor: David Branning

In nuclear, particle, and optical physics experiments, pairs of particles are often detected simultaneously or “in coincidence”. For instance, this technique is particularly important in the study of photons that exhibit quantum entanglement. Coincidence counting is equally useful in experiments that test non-locality of particles. There are many existing solutions to this problem, but their usability and functionality correlate directly with cost, leaving most outside the means of small educational labs, such as one might find here at Trinity. Therefore, we have taken benefit of the recent explosion of inexpensive and powerful DIY electronics to develop an all-digital coincidence counter with a low price-point and a full feature stand-alone interface.

PSYCHOLOGY

54.
EXPLORING ASSOCIATIVE LEARNING WITH MEANING-IMBUED STIMULI AND POSSIBLE EFFECTS ON COVERT EXOGENOUS SPATIAL ATTENTION
Devin Butler ‘19
Faculty Sponsor: Michael A. Grubb

Introduction: Preliminary work has shown that neutral stimuli imbued with meaning can accelerate the timecourse of exogenous attention. The appearance of an emoji led to significantly higher efficiency on correct trials as opposed to when an emoji did not appear. Here, we’re exploring a possible reward and/or motivational effect through associative learning: when a monetary reward system is implemented, can the timecourse of covert exogenous spatial attention be accelerated?

Methods: On each trial, covert attention will be manipulated with a peripheral onset and two Gabor patches will be presented (left/right of fixation). Using a response cue, observers report the target Gabor’s orientation: counterclockwise or clockwise from vertical. Exogenous cues are valid (small circle near target location) or invalid (near distractor), and cue validity is 50%. Cue-target SOA will be varied into early and late parameters, and the cue is equally likely to be white or black (counterbalanced across observers). Thus, observers learn to associate cue type with reward: one cue type yields bonus monetary compensation, with the other cue type leading to no reward. A centrally-presented X follows all incorrect responses.

Possible Outcomes and Conclusions: We expect both cue types to modulate task performance, but for cuing effects to be significantly larger at early SOAs for reward cues relative to non-reward cues. If this is the case (as with emojis), we conclude the temporal dynamics of covert exogenous spatial attention are accelerated when attentional allocation is triggered by a meaning-imbued onset, and that the reward cue served as a rewarding factor. If there is no difference in

performance for each SOA or between cue types, it may suggest that the emoji served as a visually-pleasing stimulus while the monetary reward system did not yield the same interest or incentive for the participant.

55.

COMPARISON OF OPEN-ENDED AND CLOSED-ENDED MEASURES OF METACOGNITION

Daisuke Katsumata IDP, Isabella Chen ‘19, Madison Kane ‘20, Emily Schroeder ‘20
Faculty Sponsors: Dina Anselmi, David Reuman, Ms. Debra Avery, Hartford Magnet Trinity College Academy

Metacognition is an awareness and control over one’s learning strategies. Metacognition is especially important in academic contexts because it is directly related to learning outcomes. We aimed to determine whether open-ended and closed-ended measures of metacognition agree with each other. We also aimed to determine whether feedback affects metacognition, regardless of how it is measured. The study was conducted with 9-12th grade students at Hartford Magnet Trinity College Academy during a world history class unit on World War II. Students were split between the standard feedback group (n = 26), which received grades and minimal comments on unit assignments, and the enhanced feedback group (n = 27), which received extensive comments and no grades. Pre- and post-intervention measures of metacognition were collected with both the open-ended and closed-ended formats. The open-ended responses were transcribed and coded by four individuals. Multiple measures of inter-rater reliability were established for each coding set and the individuals met to discuss any discrepancies in coding decisions. The results indicated the open-ended measure was moderately correlated with closed-ended measures at pre-intervention (r = .59; $p \leq .001$) and at post-intervention (r = .54; $p \leq .001$). There were no significant effects of feedback on metacognition regardless of how it was measured; however, a significant time related decline in metacognition was observed with only the open-ended measure ($p \leq .001$). While both the open-ended and closed-ended questions are appropriate measures of metacognition, given the labor-intensive nature of transcription and coding, use of the open-ended questions may not be necessary.

PUBLIC POLICY & LAW

56.

ASSESSING THE ROLE AND DISTRIBUTION OF IMMIGRANT ORGANIZATIONS IN THE UNITED STATES

Julia Tempesta ‘19
Faculty Sponsor: Abigail Fisher Williamson

In researching local governments responses to immigration, the presence of non-profit organizations is an important factor to consider. With President Trump’s national anti-immigration rhetoric and policies, many local organizations have striven to assist immigrants, refugees and foreign born populations. Héctor R Cordero-Guzmán, an Associate Professor at CUNY University who studies immigrant organizations in New York, argues that nonprofits “play a central role during all parts of the immigration process and in the social, cultural and political, and economic” integration of immigrants. Nonprofits can not only provide immigrant populations with integrative services, but networks and tools for advocacy. While many immigrant organizations are concentrated in major gateway cities (i.e. New York City, Los Angeles), the distribution and prevalence of immigrant organizations across smaller United States localities raises three important questions: (1) Does the presence of immigration-related organizations increase municipal responses (accommodation or restriction) to immigrants? (2) Are immigration organizations associated with demographic factors related to socio-economic class, political orientation or immigrant status? (3) In which part of the country are immigrant organizations concentrated or more disperse? Our summer research, a statistical analysis of 813 municipalities from Professor Williamson’s 2016 Municipal Responses to Immigration Survey, provides important policy information to answer these questions.

PUBLIC HUMANITIES COLLABORATIVE

57.
CONNECTICUT IN WORLD WAR I TO FRENCH NOVELISTS
Megan Caljouw ‘20, Melani Norsigian ‘20
Faculty Sponsors: Sara Kippur, Christine Pittsley of the Connecticut State Library

Our research at the Connecticut State Library focuses on civic engagement on the Connecticut homefront during World War One (1914-1918). Specifically, we began to ask the question: what were the men, women, children, and organizations doing in Hartford and surrounding Connecticut towns to aid with the war efforts? Much of our archival findings highlight the rich hub of activity that Hartford became during this time, as it closely competed with large cities like New York City and Boston in selling war bonds, hosting rallying parades, and conserving food and clothing items. More specifically, we explore the impact that the American Red Cross, Liberty Bond Cottage, Boy Scout troops, and women’s suffrage groups had on supporting and conserving during these wartime years, and contemplate the concept of what civic engagement means to us today. Our research on French novelists considers two specific novelists of the late twentieth century: Alain Robbe-Grillet and Nathalie Sarraute. Through letters to their spouses, we each tracked the specific American universities that each writer traveled to during their time spent in the United States. This included noting the varying publishers or professors that each novelist interacted with while speaking at or when teaching at a university, and the nature of academia that was discussed. Although there was little overlap between the travel of the two novelists, both novelists seemed to repeatedly return to specific colleges. Through digital Storymapping projects, we demonstrate how both French authors’ travels show patterns across the United States.

58.

POETRY ON THE PAGE: AN EXPLORATION OF LITERATURE IN THE WATKINSON

Tiara Desire-Brisard ‘19
Faculty Sponsor Chloe Wheatley

While working with Professor Wheatley at the Watkinson Library, I was able to experience the ways in which the Watkinson is an amazing resource for learning firsthand. Our project centered on how the tools used by book designers and editors contribute to the contents within. At the end of our analysis, we had to write a blog posting about what we learned, its relevance, and the ways in which the Watkinson is a key learning tool. Before we could prove this, we first had to understand the tools used by editors and book binders not just to create the material form but also to connect the form to the content within. Of the books that I looked at, two stood out to me the most as marrying the form to the content. *Seven Trees* by Julia Alvarez, and *The Face of Edgar Allan Poe* by Antonio Fransconi. These two books all stood out not only due to their differences but also due to the way that the binders and editors allowed for the authors and artists’ works to stand out on their own. Alvarez’s collection of poetry centered around key moments in her life was placed in a box which was designed to mirror that of a tree. Additionally, the placement of each lithograph on a separate page allows for Alvarez’s poetry to stand on its own. The artist book by Fransconi isn’t simply images of Poe but images of Poe in relation to pop culture and his own poetry. Yet, that isn’t the only important aspect. The binding follows the Gothic imagery that Poe is known for while also adding wood engravings of Poe to give the reader a piece of what they are going to see within.

59.

PUBLIC HUMANITIES COLLABORATIVE: HURRICANE MEMORIAL AND CONNECTICUT’S WEST INDIAN DIASPORA

Kyle Fields ‘21, Jerry Rodriguez ‘20
Sponsors: Christina Boyles, Trinity College Digital Scholarship Coordinator, Dr. Fiona Vernal, University of Connecticut

This two-part research project focused on under-represented and under-studied populations, namely Puerto Ricans and West Indians, to understand the effects of events within these communities. In the project entitled “Hurricane Memorial: Remembering Maria & San Felipe,” led by Dr. Christina Boyles, Kyle Fields ‘21 and Jerry Rodriguez ‘20 traveled to Puerto Rico through a grant from the Center for Caribbean Studies at Trinity College to collect interviews and footage on Hurricane María, which devastated the island in September 2017. These interviews were filmed on the island and then transcribed, and were edited for production by Kyle Fields ‘20 using Final Cut Pro. The trip to Puerto Rico also involved photographing police records from 1928, when Hurricane San Felipe II similarly devastated the island. These archives were transcribed for easier use of the written data. Our findings show that much of the island remains devastated by Hurricane María, and the effects are similar to those caused by Hurricane San Felipe II and the subsequent government response.

The second portion of the research, conducted with Dr. Fiona Vernal, is entitled "Immigration Narratives from Connecticut's West Indian Diaspora." This project focused on the movement of West Indians, especially Jamaicans, to Connecticut as a temporary labor force for the shade tobacco industry. This project largely consisted of archival research, using newspapers including the Hartford Courant to track the movement of West Indians and other migrant labor forces to Connecticut. Additionally, Kyle Fields '21 studied reports on the US Farm Work Program and the British West Indian Central Labor Organization, while Jerry Rodriguez '20 worked on a timeline of Puerto Rican migration to Connecticut, as Puerto Ricans competed with West Indians for farm work in the state. This project is still in early stages, but the work by Kyle Fields '20 and Jerry Rodriguez '21 will be used for exhibit panels, a book on West Indians in Connecticut, and more.

60.
500 CITIES DATA CHALLENGE: HOUSING QUALITY AND PUBLIC HEALTH OUTCOMES IN HARTFORD

Garret Forst '19
Faculty Sponsor: Megan Brown, Connecticut Data Collaborative

This project was a joint effort between Trinity College's Liberal Arts Action Lab and the Connecticut Data Collaborative. With the two organizations having been awarded the 500 Cities Data Challenge Grant to study local public health data compiled by the Centers for Disease Control's 500 Cities project, our team studied housing quality and its connection to health outcomes for the entire city of Hartford. The project team first collected diverse housing data on the city pertaining to affordability, neighborhood stability, and property conditions at the Census tract level. These data were then spatially displayed and analyzed in comparison to health outcomes data from the CDC. This project, one in which over 30 variables and measures were analyzed, resulted in a rich understanding of both the complexities of housing and health as they stand by themselves in addition to the complexities of their relationship as they currently play out in the city.