



BROWN

SUMMER RESEARCH SYMPOSIUM
2022

Sayles Hall
11:00 am – 1:00 pm

Thursday, August 4
Life Sciences and Humanities

&

Friday, August 5
Physical and Social Sciences

PRESENTED BY
The College

SUMMER RESEARCH SYMPOSIUM

Sayles Hall
Main Green

Thursday, August 4

Life Sciences and Humanities Posters

- | | |
|--------------------|--|
| 11:00am – 11:10 am | Welcome and Brief remarks
Associate Dean Oludurotimi Adetunji |
| 11:10 am – 1:00 pm | Research Poster Presentations |

Friday, August 5

Physical and Social Sciences

- | | |
|---------------------|---|
| 11:00 am – 11:10 am | Welcome and Brief remarks
Associate Dean Oludurotimi Adetunji |
| 11:10 am – 11:20 am | Presenting the Excellence in Research
Mentoring Award
Dean Rashid Zia |
| 11:20 am – 1:00 pm | Research Poster Presentations |

~ A light lunch will be provided both days ~

Descriptions of each poster session include a poster number indicating the poster's placement in Sayles. To locate a poster, refer to the layout maps at the end of this pamphlet.

POSTER LAYOUT
Thursday, August 4
Humanities and Life Sciences

[STAGE]

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[ENTRANCE]

[LOBBY]

POSTER LAYOUT
Friday, August 5
Physical and Social Sciences

[STAGE]

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[ENTRANCE]

[LOBBY]

SYMPOSIUM ORGANIZERS

Oludurotimi O. Adetunji
Associate Dean for Undergraduate Research and Inclusive Science;
Director, UTRA Program

Linda Sutherland, Co-Curricular Program Manager

Anoop Reddi, UTRA Graduate Assistant

ACKNOWLEDGEMENTS

Christina Paxson, President

Richard Locke, Provost

Rashid Zia, Dean of the College

Brown University Library

PRESERVING YOUR RESEARCH

Students who opt to upload their posters to the Brown Digital Repository can do so using the self-deposit tool, available at <https://repository.library.brown.edu/deposits/>.

The deadline for this is **Friday, August 19, 2022**

SUMMER RESEARCH SYMPOSIUM POSTERS

Thursday, August 4

Humanities & Life Sciences

Humanities

Justin Cheng

Poster #A1

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: John Bodel, Classics

A digital approach to Classics

As a member of the US Epigraphy Project, I worked with a team of researchers to systematically collect, classify, organize and showcase inscriptions written in the languages of the Roman empire throughout the period of 800 BCE – 700 CE. Our database consists of about 3500 inscriptions from museums across the US, and my job has been to document Latin inscriptions, specifically from the Speed Art Museum in Louisville, Kentucky.

When I say “document,” I refer to the encoding of stone inscriptions in a markup language called XML. Following the internationally accepted guidelines of EpiDoc, I have used XML to tag semantic characteristics of inscriptions, such as their physical supports and materials (marble slab, stone tablet, etc.), their history and provenance, the inscribed words themselves, and much more. I have primarily focused on the transcription and translation of inscriptions, which involves careful scrutinization, notation of the text according to the well-established Leiden Conventions, translation into English, and finally transforming this information into a marked-up form in XML.

While this may sound straightforward, it is anything but. Even reading the inscriptions can be a challenge; one often finds that words carved into stone 2000 years ago are faded and damaged. Moreover, the physical stone may itself be chipped, fragmented or even missing entire pieces, making Processing the text itself can be challenging as well. In many ways, inscriptions have an idiosyncratic language of their own, consisting of various formulae such as “D.M.S.”, short for “D(is) M(anibus) s(acrum)” – “Sacred to the Divine Spirits.” Once I have fully understood the text, the subsequent encoding presents an entirely different task. The EpiDoc guidelines are rigorous, extensive and very particular. Each and every letter and marking, no matter how small, requires its own kind of tag. Names require their own system of tagging, along with abbreviations, symbols and highlighted characters. Each and every bit of information fits together like pieces of a puzzle, and deciphering the cryptic languages of inscriptions presents a unique challenge – and, as I have come to find, quite an enjoyable one.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Regina Longo, Modern Culture and Media

The Marshall Plan: Lessons from a Bygone Era of US Foreign Policy

The European Recovery Program—better known as the Marshall Plan, borrowing from the name of its principal architect, Secretary of State George C. Marshall—transformed the West as we know it today. Confronted with a Europe devastated by the Second World War, the US endeavored in 1948 to transfer what amounts to over \$100 billion today to the economies of Western Europe, including its former enemies Germany and Italy. This bold maneuver constituted a paradigm shift in international affairs when compared to the aftermath of the First World War, where the Western Allies laid punitive costs on the already devastated German economy. Ultimately, the Marshall Plan succeeded in stabilizing Western Europe and liberalizing the formerly authoritarian, fascist regimes of Central Europe.

The Marshall Plan owes part of its success to the vastly influential media and propaganda campaign conducted throughout its existence in the countries in which it operated. With Professor Regina Longo in the Department of Modern Culture and Media, I am working to process and digitize the archives of the late Linda Christenson, a documentarian who devoted her professional life to recording the impacts and origins of the Marshall Plan. Containing a wealth of visual information and insight on the propaganda campaigns conducted by the United States in Europe, Christenson's archives afford researchers an unparalleled view into the importance of media for the success of modern, multinational economic programs.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Gerhard Richter, German Studies and Comparative Literature

(Re)membering Lost Futures: Vaporwave and the Postmodern

Vaporwave is a form of electronic music that samples 80's elevator music, muzak, disco, and R&B, drenching them in reverberation and distorting them in the process. The genre is permeated by commentary on consumer culture, globalization, imagined memories, what it means to make music, and liminal spaces making it the perfect artform for critical-theoretical discourse. Three central themes will guide my approach: memory, late-stage capitalism, and space. Not only did I choose these three categories for their centrality in the genre, but also because they form avenues for me to investigate topics within critical theory I find interesting; I might suggest that memory would allow me to study Lacanian psychoanalysis, late-stage capitalism aligns with post-marxist theories by Althusser, Zizek, Lukacs, or Fisher, and space would let me explore Henri Lefebvre's *The Production of Space*. Of course, other topics will span the whole of my thesis: musicality, citation and sampling, postmodernism, and aesthetics will all be invaluable to the project.

My poster presentation will focus on several texts I have been studying this summer, including Fredric Jameson's "Postmodernism, or, The Cultural Logic of Late Capitalism", Gilles Deleuze and Claire Parnet's "Dialogues II", Gyorgy Lukacs' "History and Class Consciousness", and possibly some of Theodore Adorno's writings on aesthetics. I will also be including analysis of various vaporwave albums as I draw nearer to the writing stage of my thesis project.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Laura Snyder, Education Department

Reimagining Humanities Curriculum

The Reimagining Humanities Curriculum project aims to produce culturally sustaining curricula for middle and high school humanities classrooms, providing students with content that more adequately reflects them, their community, and the diversity of the world around them. Researchers read and analyzed three works of literary and adolescent fiction (Between Shades of Gray by Ruta Sepetys, Homegoing by Yaa Gyasi, and an independently chosen text), selected supplemental materials from contemporary and historical sources in genres such as poetry, news media, and art, and revised and created new culturally sustaining lesson materials based around essential questions. Researchers curated these materials into free and publicly accessible e-books for teachers.

Life Science

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Sheldon Holder, Pathology and Laboratory Medicine

Detection of a JAK independent pathway to PIM1 overexpression in RCC

Renal cell carcinoma (RCC), is the most common type of kidney cancer. A strong correlation between PIM1 overexpression and worse survival and prognosis among patients diagnosed with RCC has been identified. PIM1 is a constitutively active oncogenic serine/threonine kinase involved in many tumor promoting processes including cell proliferation, migration, angiogenesis, and evasion of apoptosis. The mechanism driving PIM1 overexpression in RCC is not well understood. IL-6 is a proinflammatory cytokine that activates STAT3 through JAK, a non-receptor kinase. Previous studies have identified STAT3 as directly inducing PIM1 expression in other cancers, such as pancreatic cancer. An IL-6/JAK/STAT/PIM1 signaling axis in RCC has been identified in our research group as a PIM1 modulating mechanism, with JAK inhibition resulting in decreased PIM1 protein levels in RCC cell lines. Interestingly, we have identified an RCC cell line, 769-P, that demonstrates increased PIM1 protein levels secondary to a JAK-independent mechanism. ELISA assays show that 769-P cells secrete a negligible amount of IL-6 compared to other RCC cell lines. Western blot analysis shows that JAK inhibition does not reduce PIM1 protein levels in 769-P cells but does reduce PIM1 levels in other RCC cell lines. On-going investigations aim to use 769-P cells in order to identify what JAK independent mechanisms may exist to influence PIM1 expression in RCC.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ming Xian, Chemistry

Exploration of Sulfur-Based Chemical Biology via Fluorescence Detection with SSP4

This project consists of several applications of fluorescent probe chemistry to analyze sulfane sulfur activity in the field of chemical biology. Recently, it's been discovered that cells utilize sulfane sulfurs in a variety of physiological functions. The detection and manipulation of sulfur compounds in cell environments is one of the most useful ways to study the purpose and mechanisms of these functions. SSP4, developed by the Xian Lab, serves a variety of purposes in this project and its utility is expanded in studying post-transcriptional protein modification, novel sulfane sulfur donors, fluorescence live cell imaging, and more.

Home Institution: Brown University

Summer Research Program: Royce Fellowship

Faculty Mentor: Qian Chen, Orthopedics

Delivering functional antisense oligonucleotide drugs across the blood-brain barrier using Nanopieces

Antisense oligonucleotides (ASOs) are a class of single-stranded deoxyribonucleotides that attach to a complementary mRNA target to prevent translation of non-coding or toxic RNAs associated with disease pathogenesis. ASOs have broad applicability to neurological diseases like Huntington's disease and Alzheimer's disease but are unable to cross the blood-brain barrier (BBB), which has selective permeability to small, uncharged molecules. ASOs do not readily cross the blood-brain-barrier because they are highly polar, negatively charged molecules, which is a major challenge to effective clinical use. Nanopieces (NPs) are a class of delivery vehicles formed by bundles of Janus base nanotubes (JBNTs). JBNTs are composed of double-sided DNA bases with an amino acid tail, noncovalently assembling into a rod-shaped nanoscale architecture that wraps around nucleic acid cargo and disguises negative charge. NPs are characterized by smaller size, higher endosomal escape rate, and lower cytotoxicity than lipid-based counterparts such as those used in the COVID-19 vaccine. Herein, we used NPs to deliver functional ASOs intravenously to the brain of mice, knocking down the ubiquitously-expressed noncoding RNA MALAT1 as a proof-of-concept. This work identifies NPs as promising vehicles for intravenous neurological therapies.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Kristi Wharton, Molecular & Cell Biology; Erica Larschan, Molecular & Cell Biology

Investigating sex-specific defects in models of ALS

Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease characterized by loss of upper and lower motor neurons leading to paralysis. Mutations in the antioxidant enzyme superoxide

dismutase 1 (SOD1) have been implicated in familial cases of ALS in humans. We utilized G85R and A4V SOD1 mutants in *Drosophila melanogaster* to investigate sex-specific differences in the onset and presentation of ALS-related symptoms. Our preliminary investigations have found male A4V and G85R mutants exhibit higher severity and earlier onset of neuromuscular defects than A4V and G85R females, respectively. We also analyzed the lifespan of G85R and A4V mutant lines compared to wild-type flies to quantify this sex-specific difference. Analyzing sex ratios of the mutants at various developmental stages, we found homozygous G85R mutants exhibit sex-specific premature lethality. SOD1 mutants also demonstrate reduced productivity characterized by a reduced number of offspring surviving to adulthood. The physiological mechanism behind this reduced productivity was analyzed by quantifying the fertility of mutants as well as the percentage of embryos surviving through each stage of development. Our current goal of understanding differences in sex-specific gene expression utilizes a transcriptomics approach via Orlyqt-PCR to determine how expression of certain genes differs between sexes of SOD1 mutants. Using these techniques will potentially facilitate a greater understanding of the genetic mechanisms underlying sex-specific susceptibility in SOD1 mutants associated with ALS.

Beatrice Dominique Campilan

Poster #A9

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jennifer Sanders, Pediatric Metabolism at Lifespan

Investigating the role of transporters in cell competition during liver repopulation by fetal hepatocytes

For patients with acute or chronic liver disease associated with liver failure, liver transplantation is the only available treatment; however, the limited supply of donor livers severely limits its feasibility. Hepatic cell transplantation offers a potential treatment alternative. Previous literature demonstrates that fetal rat hepatocytes durably persist and proliferate compared to adult hepatocytes, which have a limited duration of efficacy. Given ethical considerations surrounding the procurement of fetal hepatocytes, it is important to characterize the mechanisms giving rise to their repopulation phenotype in order to induce this for transplantation. To identify such mechanisms, this project investigates the overexpression of ion transmembrane transporters and calcium signaling pathways in pre-transplant and post-transplant cells. We explored the differential expression of genes from an initial data set using log Fold Change (logFC), False Discovery Rate (FDR), and p-values to discern target transporters of significant interest with regard to the desired fetal phenotype. Following this quantitative analysis, we conducted a literature review on the activation, function, and levels of expression of the identified transporter genes involved in cell proliferation and cancer. Our results revealed five genes of interest: KCNJ12, SLC34A3, CACNA1B, TMC7, and WNT3A. Overexpression of KCNJ12 has been linked to increased colony formation and tumor growth in mouse tumor models, suggesting its likely role in tumor progression *in vivo*. While SLC34A3 has been proposed to contribute to the proliferation and tumorigenesis in breast and lung cancers, CACNA1B has been detected in breast, prostate, and non-small cell lung cancers. TMC7, when used in conjunction with other identified markers, serves as a promising indicator of the diagnosis and prognosis prediction of pancreatic carcinoma. Proliferation, morphological development, and migration in spermatogonial stem cells have been attributed to WNT3A. Western blotting and immunofluorescence analysis are in progress for the transporters of interest to determine whether their protein content is different in fetal colonies compared to surrounding host hepatocytes.

Home Institution: College of Mount Saint Vincent

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Daniel Spade, Department of pathology and laboratory medicine

The impact of retinoic acid and mono-(2-ethylhexyl) phthalate on mouse fetal testis germ cell population

Mono-(2-ethylhexyl) phthalate (MEHP) is a chemical used in the manufacture of flexible PVC plastics and consumer products. MEHP is also a reproductive toxicant that disrupts the formation of seminiferous cords in the fetal testis. Seminiferous cords are testicular structures formed by Sertoli cells surrounding aggregations of germ cells. All-trans Retinoic acid (ATRA) is a biologically active metabolite of vitamin A, which is critical for gonad development, but in excess disrupts the development of seminiferous cords. Because the mechanisms of phthalate toxicity are not fully understood, we sought to investigate whether phthalates adversely affect seminiferous cord development in the mouse fetal testis by disrupting retinoic acid signaling, leading to germ cell loss. We hypothesized that the MEHP and ATRA would have additive negative effects on germ cell development and cause germ cell loss. To test this hypothesis, GD 14 C57BL/6 mouse fetal testes were isolated and cultured on media containing 10⁻⁶, 10⁻⁵, or 10⁻⁴ M MEHP, 10⁻⁸, 10⁻⁷, or 10⁻⁶ M ATRA, and vehicle control for 3 days. To quantify germ cells, we performed indirect immunofluorescent labeling analysis of GCNA and counted GCNA-expressing cells using QuPath. ATRA significantly reduced the germ cell population, but MEHP did not significantly reduce germ cell number. We conclude that MEHP is less potent with respect to fetal testicular germ cell loss than ATRA.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jess Plavicki, Pathology and Laboratory Medicine; Shannon Paquette, Pathology and Laboratory Medicine

Loss of embryonic macrophages causes abnormalities in cardiac function and affects adult heart health

Macrophages are commonly defined as large phagocytic cells that respond to injury and infection. New and emerging research demonstrates that macrophages are more critical in heart development and function. However, it is still unknown how the loss of embryonic-derived macrophages affects heart health in adulthood. We are utilizing the *irf8* st96/st96 zebrafish model for our experiments. By completing swim tunnel tests, electrocardiograms (ECGs), analyzing vasculature, H&E staining, and Massons Trichrome staining we show how the loss of embryonic macrophages is detrimental to adult heart health and function, leading to arrhythmia and fibrosis. After completing swim tunnel tests and ECGs on one-year old *irf8* zebrafish our results indicated a slight but not significant increase in heart rate and decrease in P duration between the *irf8* mutants and wildtype. When reviewing the ECG traces the abnormalities between mutant and wildtype are more evident. The mutant ECGs appear to have fibrillation-like patterns, irregular distances between R waves, and inconsistent P waves. Since macrophages have previously been described to be important for vascular development, we took pictures of the vasculature of 100-day old fish revealing that mutant fish have overall less vasculature, which appears thinner and branches sporadically. After staining one year old hearts with H&E (Haematoxylin and Eosin) we observed that *irf8* mutant hearts are more prone to having thicker epicardium's, less muscle mass, and epicardium

detachment. Massons Trichome staining revealed that there may be fibrosis in mutants' hearts as well. Overall, the results from this data indicate that the loss of embryonic macrophages causes cardiac abnormalities and helps expand our knowledge of the specific functions of macrophages involved in long-term adult heart health. In the future we will continue to complete and analyze more of these experiments while increasing our sample size to reinforce our results and better understand our data.

Angelica Aragon Vasquez

Poster #A12

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Erica Larschan, MCB

Targeting Dosage Compensation to the Drosophila Male X-chromosome

Sex differences in response to clinical therapeutics are common but little is understood about the underlying mechanisms. Therefore, a deep understanding of male versus female gene regulation is essential to reveal these mechanisms. As a model for understanding sex differences in gene regulation, we are investigating how the Drosophila single male X-chromosome achieves its essential sex-specific role of upregulating all its active genes approximately two-fold, a phenomenon known as dosage compensation. A key pioneer transcription factor, Chromatin Linked Adaptor for MSL Proteins (CLAMP), is critical in targeting dosage compensation to the male X-chromosome. However, CLAMP is also found on all chromosomes in the male and female genomes. I hypothesize that CLAMP works alongside other cofactors to form a specific chromatin environment which helps target the Dosage Compensation Complex (DCC) specifically to the male X-chromosome. By performing Cleavage Under Targets and Release Using Nuclease (CUT and RUN), I will map all CLAMP and DCC binding sites in both male and female larvae for wild-type and clamp mutant lines. Preliminary data has shown there is a loss in wild-type DCC binding but an increase in ectopic autosomal DCC binding in clamp mutants. After identifying novel loci via CUT and RUN, I will then perform bioinformatic analyses, MEME and R-cis-target, which will reveal novel motifs and cofactors involved in X-chromosome targeting of dosage compensation. My research will provide novel insight into sex differences in gene regulation, which will shed light on how future therapeutics will affect males and females differently.

Anna Shlimak

Poster #A13

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Maria Guglielmo, BioMed / Warren Alpert Medical School, Dept. of Neurosurgery

The Effects of Marijuana on Nine-Month Spinal Surgery Outcomes and Reported Postoperative Opioid Management as Determined by Urine Toxicology

Introduction: Although previous studies have examined the impact of substance use on spinal surgery outcomes, analyses have frequently relied upon self-reported patient histories, which may not reflect preoperative patient substance use. We present a prospective cohort study which utilizes urine toxicology screening to evaluate the impact of marijuana use on patient outcomes and postoperative opioid management following elective spinal surgery.

Methods: Patients undergoing elective spinal surgery between August 2020 and July 2022 with a single neurosurgical provider were offered study enrollment. Participants completed urine toxicology screenings

at preoperative baseline visits and reported Oswestry Disability Index (ODI), Neck Disability Index (NDI), Visual Analogue Scale (VAS), and opioid use (quantified using Morphine Milligram Equivalents (MME)) at baseline and postoperative follow-up visits over a nine-month period. Outcome measures for the marijuana user and non-user groups were analyzed using single factor ANOVA analyses ($P < 0.05$).

Results: 97 participants (mean age 59, 61% female, 96% white/caucasian) were included in the study. Patients commonly underwent lumbar decompression with laminectomy (31%), lumbar fusion (15%), and cervical fusion (12%). Preoperative urine toxicology screenings revealed that marijuana (24%) and opioid (14%) use were inconsistent with patient-reported frequencies (14% and 24%, respectively). 2% of urine toxicology reports demonstrated concurrent use of marijuana and opioids. Single factor ANOVA analyses demonstrated a statistically significant change in VAS ($P = 0.016$) among non-marijuana users relative to marijuana users ($P = 0.079$) over the nine-month postoperative period. However, no significant changes were observed in ODI ($P = 0.13$), NDI ($P = 0.51$), VAS ($P = 0.079$), and MME ($P = 0.29$) among marijuana users or ODI ($P = 0.15$), NDI ($P = 0.13$), and MME ($P = 0.71$) among non-users.

Conclusions: Non-marijuana use, relative to marijuana use, as determined by urine toxicology, was associated with changes in postoperative subjective pain outcomes. Patient-reported use of marijuana and opioids underestimated and overestimated, respectively, actual use in the study as measured by urine toxicology. These results suggest a potential role for urine toxicology screening in patient risk stratification before spinal surgery. Future analyses will evaluate marijuana use within a larger cohort to enhance statistical power.

Anne-Emilie Rouffiac

Poster #A14

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Kyle Denison Martin, Warren Alpert Medical School, Global Emergency Medicine

Trauma Management Trainings for Standardization of Emergency Care in District Hospitals in Rwanda

Background: Globally, over 5 million deaths result from trauma/injuries, but the burden is greater for lower and middle income countries (LMICs). In Rwanda, road traffic injuries are the leading cause of death for citizens aged 10-29 years. The need for trauma management training was expressed and a 2-day course was developed for the country's district hospitals.

Objective: The course aims to increase providers' knowledge, skills, and confidence in trauma management while reviewing the need for inter-hospital transfers in certain trauma cases.

Methods: Powerpoint lectures were used to review primary and secondary surveys, trauma scoring systems, FAST exams, chest intubations, and specific trauma types. Simulations were also conducted to provide hands-on experience. A demographic survey was given and a test was administered before and after the training to measure knowledge and confidence in trauma care. Data was analyzed with Excel programming.

Results: Nurses accounted for 62.26% of trainees ($n = 33$), nursing and medical students for 28.30% ($n = 15$), and doctors for 9.434% ($n = 5$). Kigali trainees were 18-44 years old, with 52.94% female, 47.06% male. In Kibuye, providers were 25-54 years old, with 64.29% male, 35.71% female. The Butare pilot corresponded to a 15% increase in trainees' knowledge regarding trauma care. In Kibuye, test scores increased by 31.80% (pretest=11.892.647; post-test=14.771.536) while the level of confidence rose by 22.3%. In Kigali, trainees' knowledge grew by 32.22% (pretest=10.122.240; post-test=13.342.844) and confidence by 32.5%.

Conclusion: Through structured training, Rwandan providers elevated their competencies in trauma

management. Provider skills correlate with health outcomes, thus, trauma training can augment the quality of care. Future research with providers may investigate sustainable course implementation and track effects on health outcomes.

Ashley Choi

Poster #A15

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)Yang

Faculty Mentor: Yang Zhou, Molecular Microbiology and Immunology

Phospholipid Scramblase-1 Regulates CRTH2 Signaling and Innate Type 2 Immune Responses

Exaggerated Type 2 immune responses are critical in the pathogenesis of a variety of lung diseases including asthma, allergy, and pulmonary fibrosis. Recent studies have particularly found the importance of innate lymphoid 2 cells (ILC2s) in these diseases. Phospholipid scramblase-1 (PLSCR1) is a type II transmembrane protein that is mainly known for its ability to bidirectionally translocate phospholipids between the plasma membrane. Previous studies from our lab suggest that PLSCR1 plays a critical role in regulating pulmonary innate type 2 responses. Specifically, ILC2-mediated innate type 2 immune responses are inhibited in mice that overexpress PLSCR1. Further studies demonstrate that PLSCR1 interacts with CRTH2 (chemoattractant receptor-homologous molecules on Th2 cells), a G-protein coupled receptor used to identify ILC2 cells. CRTH2 regulates ILC2 accumulation and activation when stimulated with prostaglandin D2 (PGD2). Thus, we hypothesize that PLSCR1 regulates ILC2 activation and innate type 2 immune responses via modulating CRTH2 signaling. This project aims to determine the expression and signaling of CRTH2 and its interaction with PLSCR1.

Lung tissue from three experimental groups were harvested: wild-type mice, PLSCR1 knockout mice, and IL-7RCre-PLSCR1 transgenic mice in which PLSCR1 is specifically overexpressed in ILC2 populations. ILC2s are sorted by FACS as lineage-CD90.2+ICOS+T1/ST2+ population. Due to the low cell count for ILC2s, cells are cultured in vitro to increase the number. ILC2 cells from the lungs are stimulated with PGD2 or DMSO vehicle control. CRTH2 expression is examined by immunostaining, and the expression levels of IL-33 and IL-25 receptors on ILC2s are examined by qRT-PCR as readouts of CRTH2 signaling. We expect that the PLSCR1 knockout ILC2s stimulated with PGD2 to have an increased expression and signaling of CRTH2, and PLSCR1 overexpressing ILC2s to have decreased expression and signaling of CRTH2. These results suggest that PLSCR1 regulates CRTH2 signaling in ILC2s and innate type 2 immune responses.

Austin Roy

Poster #A16

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Diane Hoffman-Kim, Neuroscience/Biomedical Engineering

Genetically Encoded Calcium Indicators in a 3D Neuronal Spheroid Model

Genetically encoded calcium indicators (or GECIs for short) can be viewed as superior to traditional exogenous fluorescent calcium dyes (like Oregon Green BAPTA) since GECIs allow for labeling of specific cell types, subcellular compartments, and allow for longer-term imaging of cells in-vivo. GECIs are classified by their dynamic ranges, brightness, and whether they are utilizable at single or multiple

wavelengths. Challenges still yet to be overcome with GECs pertain to their sensitivity, response kinetics, signal linearity, and the availability of fluorescence other than the traditional green. Single wavelength GECs will be of focus in this project since they demonstrate larger signal intensities and are more compatible with conventional fluorescence microscope and imaging systems in addition to other optical sensors.

Thus, this project is aimed at exploring the best method of transfection of genetic material encoding for these GECs in the neuronal cell types of our lab's 3D rat cortical tissue spheroid model. Through this aim, the hope is that this procedure can be used in our lab's other experiments moving forward, with varying GECs, in order to achieve better data through calcium imaging in various models and cellular environments and address problems that cannot be overcome with traditional exogenous calcium dyes.

Baihe Sun

Poster #A17

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Lorin Crawford, Center for Computational Molecular Biology

SINATRA Pro: A Topological Data Analytic Approach to Correlate Protein Structure with Biophysical Properties

Understanding protein structure is integral to learning about the biophysical properties of proteins as it relates to their function. SINATRA Pro is a topological data analytic pipeline that was previously used to identify biologically relevant topological differences between protein structures by (1) converting three-dimensional atomic structure into topological summary statistics, (2) analyzing those statistics using nonparametric regression, and (3) performing association metrics back onto the protein structure for visualization of structural enrichment between protein phenotypic classes. Here, we build upon SINATRA Pro's previous capabilities by developing an approach to computationally identify structural features relevant to biological properties encoded as continuous response variables (e.g., fitness). In comparison to the classification setting, computations performed with linear protein phenotypes involve many challenges including: (1) using a different likelihood function to estimate parameters in the nonparametric regression, (2) integrating external data involving the measured phenotype, and (3) greater variations between proteins depending on the phenotype being studied. We test our new approach on two different systems: one control using structures perturbed with known magnitude, and one experimental system that contains intrinsic topological deviations. In each of these cases, SINATRA Pro reflected both significant and null results reflective of the biological basis behind the measured variable. Our results indicate a starting point for topological data analysis on linear systems that can be used to identify correlations between topology and binding that may be used to gain insight into models such as induced fit.

Alexander Griffin

Poster #A18

Home Institution: Brown University

Summer Research Program: Department of Ecology, Evolution, and Organismal Biology

Faculty Mentor and Department: David Rand, Department of Ecology, Evolution, and Organismal Biology

Investigating the role of transcription factor *giant* in regulating mitonuclear communication

The mitochondrial genome encodes protein subunits of the electron transport chain and is therefore important to metabolic processes in eukaryotic cells. The work described investigates the significance of the transcription factor *giant* (*gt*) as a candidate transcription factor for regulating communication between the nuclear and mitochondrial genomes. Using an RNAi knockdown for *gt* in *D. melanogaster*, we identify significant disruption to development, fecundity, and morphological traits in five distinct mtDNA genotypes or “mitotypes” relative to a control. Furthermore, knockdown of *giant* is significantly disruptive between individual mitotypes, suggesting the involvement of *giant* in mitonuclear communication is modulated by mtDNA.

Brendan McMahon

Poster #B1

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: David Borton, Brown University School of Engineering

Toward Clinical Translation of the Intelligent Spine Interface Project

The Intelligent Spine Interface Project consists of an implantable spinal electrode device that bypasses severed neural connection due to spinal cord injury. To achieve this, motor control signals from the brain descend down the spinal cord to the rostral array of the device. A trained artificial intelligence classifier interprets that information, and the desired motor outcome is predicted. Using a second neural network, stimulation parameters that produce motor outcomes matching the volitional intention of the initial motor command are determined. To generate training data for the first neural network, exact knowledge of the transmission latency of the marker network is required. This necessitates the development of custom hardware to characterize this behavior. To train the second AI, we directly stimulated the lumbosacral spinal region of a sheep, varying in stimulation amplitude, frequency and electrode location. By analyzing the data collected during these sessions, we elucidated selectivity of evoked muscular responses. These response patterns and transmission characteristics are both crucial for the development of a clinical trial with human participants.

In preparation for such a research setting, we have developed user-controlled software to assist in stimulation delivery. These apps allow the researcher to control stimulation parameters continuously and wirelessly, creating a flexible and safe research environment. The software will also allow for a number of different experiments to be carried out. Analyzing percept data will allow us to first fit a psychometric function, and then determine the just noticeable difference for rostral stimulations varying in amplitude, frequency, pulse width, and electrode location. Additionally, distinct groups of caudal stimulations can be identified and used to produce a range of correspondingly distinct muscle responses. This combination of multivariate stimulation parameters and a wide array of experiment conditions contributes to the creation of a robust, closed-loop research and development system with the potential to greatly benefit current neurorehabilitation methods.

Brynn Kroke: Mark Appleman

Poster #B2

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: John Marshall, Molecular Biology, Cell Biology & Biochemistry

Investigating neuroprotective effects of the novel compound Syn3 after hypoxic-ischemic brain injury in neonatal rats

Hypoxic-ischemic (HI) brain injury is one of the most common neurological problems occurring in the perinatal period. Currently, the only approved intervention for neonatal HI encephalopathy is therapeutic hypothermia; however, this treatment is only partially protective, has a narrow therapeutic time window after birth, and can be used to treat full-term infants. Investigations into other treatments for HI brain injury such as systemic treatment with the blood-derived Inter-alpha Inhibitor Proteins (IAIPs) immediately after HI have shown neuroprotective effects of IAIPs and have reduced brain injury from HI. Conclusions from the studies on IAIPs have led to further interest into neuroprotective substances as treatment for HI brain injury. [transition sentence] The objective of the present study was to investigate the neuroprotective effects of the novel compound Syn3 developed in Dr. John Marshall's lab. The compound Syn3 works on the brain-derived neurotrophic factor (BDNF) signaling pathway which has been shown to provide neuroprotection. Neonatal rats were treated with Syn3 after the induction of HI, and the infarct volume was measured to quantify the effectiveness of the compound. If Syn3 proves to reduce infarct volume, it may provide another treatment for hypoxic-ischemic brain injury.

Caleb Ukaonu

Poster #B3

Home Institution: Georgia Institute of Technology

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Jung-Eun Lee, DEEPS

How Amazonian Transpiration Affects South American Climate

The Amazon's hundreds of billions of trees help to maintain themselves by exhaling water into the atmosphere, a process called transpiration. The water vapor they release results in increased precipitation and cooler temperatures, which favors the growth of more vegetation. However, deforestation threatens to offset this delicate balance. In theory, fewer trees mean less transpiration, less transpiration results in less precipitation and higher temperatures, and these mean less vegetation. Here, we show exactly how transpiration affects the climate in different regions of the Amazon. Using the Community Earth System Model (CESM), we modeled the Amazonian climate with and without transpiration. After analyzing the differences in leaf area, precipitation, and temperature between these two scenarios, we expect to find a marked increase in temperature and decrease in precipitation. These results show that transpiration is a major factor in determining climate in not only the Amazon, but in other regions of South America as well. Also, these effects are varied in specific regions. We anticipate this finding to initiate more region-based solutions to Amazonian deforestation. Furthermore, we expect more region-based research to be used to study other rainforests around the world.

Camille Donoho

Poster #B4

Home Institution: Brown University

Summer Research Program: Carney Institute Summer Scholars

Faculty Mentor: Jason Ritt, Neuroscience

A novel task to explore sensory-spatial association in freely-moving mice

Neural activity in lateral entorhinal cortex (LEC) includes prominent spatial feature encoding, and LEC

receives major inputs from piriform and insular cortices—regions associated with olfaction and proprioception— suggesting that the LEC may play a key role in sensory-spatial associative memory. In rodents, the LEC may specifically underlie odor and tactile associations with place. Our long term aim is to identify and characterize LEC neuronal populations that support olfactory and tactile associated navigation in freely moving mice; towards this goal, we present a novel arena and task design that dissociates cue and reward locations and is compatible with fluorescent measurement of LEC neural activity, to support investigation of sensory-place processing. Preliminary results showed significant variation in learned task strategy, such that some mice performed with high accuracy in small numbers of trials, while others performed near chance but rapidly over many trials. In an attempt to lessen the degree of variability along this speed-accuracy trade-off, in ongoing work we are modifying shaping procedures to promote engagement with cues, and attempting to identify more refined markers of task strategy through advanced analyses including videographic tracking.

Camille Leung

Poster #B5

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Nicola Neretti, Molecular and Cell Biology; Miiko Sokka, Molecular and Cell Biology

High-resolution mapping of common fragile sites using oligopaint FISH microscopy

Through this independent project, I will be studying common fragile sites in DNA. These sites are of interest because they are where chromosomal breaks occur, and are often hot spots for chromosomal rearrangements, a common feature of cancer cells. Our greater goals are to better understand aging and age-related diseases; studying these common fragile sites will give us a better understanding of how cancerous cells develop and evolve. We will be identifying these breakage sites with the help of oligopaints, which are single stranded DNA sequences that can be used to identify specific genomic regions.

My task will be to prepare cell samples using oligopaints for microscopy. I will image these samples, then identify and observe where breaks occur in the chromosomal samples. With these results, we hope to have a better understanding of where breakage tends to occur and why, since the breakage phenomenon is not yet completely explained.

Carleigh Oberkfell

Poster #B6

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Anita Shukla, Biomedical Engineering

Visualizing Methicillin-resistant Staphylococcus aureus (MRSA) Biofilms Using Scanning Electron Microscopy

Methicillin-resistant Staphylococcus aureus (MRSA) can result in life-threatening infections that are difficult to eliminate due to antibiotic resistance and biofilm formation. Recently, MRSA has become a growing public health concern with these infections contributing to over 10,000 deaths in 2017 in the United States (Center for Disease Control and Protection, 2017). Biofilms are aggregates of bacteria and self-produced extracellular polymeric substances (EPS) that are less susceptible to antibiotics than planktonic cells (Boudent et al., 2021). However, combination therapies utilizing an antibiofilm agent in

addition to an antibiotic have shown promising results in preventing and eradicating biofilms (Hawes et al., 2022). Scanning electron microscopy (SEM) is a powerful tool that can be used to observe bacterial cell morphology and biofilm structure to gain insight into the potential mechanisms of synergy of these therapeutics. In this work, we developed an optimal procedure to obtain SEM images of MRSA biofilms. We will apply these methods to the investigation of the impact of combination therapies on MRSA biofilms. MRSA biofilms were grown by incubating log phase MRSA with 1x1 cm² silicon wafers in cation adjusted Mueller Hinton broth supplemented with glucose for 24 hours. To optimize visualization of the biofilm cells and EPS we tested both glutaraldehyde and paraformaldehyde fixation agents to crosslink and preserve the proteins of the sample, followed by dehydration and carbon coating. Images were analyzed using ImageJ and qualitative visual comparison to ascertain conditions that would yield the highest resolution images and that would preserve the surface proteins and extracellular products of MRSA biofilms. We found that using a combination of glutaraldehyde and paraformaldehyde resulted in more visible EPS than glutaraldehyde alone. Furthermore, we found that inclusion of carbon coating produced more defined cells in addition to more visible EPS components. Having established an optimal imaging protocol, we will now use SEM to investigate the impact of combination treatments on MRSA biofilms.

Caroline Troy

Poster #B7

Home Institution: Brown University

Summer Research Program: Voss Environmental Fellows

Faculty Mentor: Matthew Fuxjager, Ecology, Evolution and Organismal Biology; James Kellner, Ecology, Evolution and Organismal Biology

Exploring Environmental Predictors of Biogeographical Variation in Great Spotted Woodpecker Drumming Performance

To fight during territorial contexts, woodpeckers drum at each other by hammering their bill on a tree, producing a loud staccato-like sound. This behavioral signal varies among species with species-specific patterns that can be measured. For my thesis, I researched what environmental parameters may be predictors of variation in performance of the drumming behavior across large-scale geographic areas. While prior research has indicated the existence of biogeographical variation in bird communication, few studies have examined environmental predictors of these differences across landscapes. I analyzed over 1000 recordings of drumming by the great spotted woodpecker (*Dendrocopos major*) available from citizen science and museum databases. From these recordings collected across the palearctic, I measured the number of beats, duration, speed, and length between beats in each drum using Adobe Audition. The latitude and longitude of each recording was collected as well. A random forest machine learning algorithm was then used to determine the predictive power of numerous environmental parameters as predictors of these collected *Dendrocopos major* drumming behavior metrics. Some of the data sets included in the random forest analysis were temperature, precipitation, elevation, wind speed, solar radiation, human population density, and nighttime lights. The analysis found that there were no strong environmental predictors of metrics of drum performance, and almost no spatially specific drumming patterns. This indicates that woodpecker drum behavior performance may not be not influenced heavily by the environment.

Home Institution: Brown University

Summer Research Program: Weiss Summer Fellowship, RI-INBRE SURF

Faculty Mentor: Dioscaris Garcia, Orthopedics; Christopher Born, Orthopedics

Silver Carboxylate's Ability to Penetrate the Bacterial Outer Membrane and Disrupt the Integrity of Biofilms

As antibiotics are proving less effective due to resistance, alternative methods of prevention and treatment of infections are required [1]. Recently, nanoparticle and colloidal silver have been the focus of renewed interest due to their antimicrobial properties, possessing the ability to penetrate bacterial cell walls resulting in cell death [2]. Our lab developed a coating consisting of a 95% titanium-dioxide:5% polydimethylsiloxane matrix which achieves a controlled release of silver carboxylate. We hypothesize that the addition of the carboxylate functional group will increase penetrance across the outer cell membrane and cell wall of gram positive and negative pathogens. This study assesses the efficacy of silver carboxylate as an antimicrobial agent in comparison to colloidal and silver nanoparticles to determine its relative safety for use in orthopedic patients. 96-well plates containing differing concentrations of the silver conditions were incubated containing 1×10^6 cells per well of one of the two bacteria, *Staphylococcus aureus* or *Serratia marcescens* (N=9). Dose response curves were generated to compare the cytotoxicity of silver carboxylate against the other conditions plated, with vehicle-only 95% TiO₂:PDMS as the negative control and 1% Triton X and 100% silver carboxylate-only as positive controls. The penetrance of silver conditions into the bacterial cell wall was evaluated with an assay measuring the uptake of hydrophobic 1-N-phenylnaphthylamine. Two *Staphylococcus aureus* strains, VRS1 and MW2, were plated on 24-well plates at 2×10^8 CFU/ml and grown on filter disks overnight. The resulting biofilms were treated with silver carboxylate and stained for visualization of structural integrity. Silver carboxylate coatings ranging from concentrations of 1x to 300x outperformed all other conditions, including nanoparticle and colloidal silver formulations, as expressed in a lower optical density corresponding to decreased bacterial viability. High fluorescence values observed for the 10x silver carboxylate represent the increased penetrance of the silver carboxylate and subsequent cell lysis. Based on preliminary data, silver carboxylate is a promising tool towards the treatment of biofilm-containing infections. Our lab's novel antimicrobial agent has the potential to establish a new standard for the treatment of biofilms and persister cells found on implants and prosthetics.

Home Institution: Lafayette College

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA), Learn Scholarship (Lafayette College)

Faculty Mentor: Andrea Simmons, CLPS; James Simmons, NEUR

Electrophysiological correlates of perceptual discrimination in big brown bats

Big brown bats (*Eptesicus fuscus*) echolocate by emitting frequency-modulated (FM) sweeps, which reflect, or glint, off of target insects, the primary component of their diet. When closely spaced glints overlap as they reflect from an insect's body, they generate characteristic echo spectra used to perceive object shape. Behavioral experiments have shown that these bats are able to recognize a range of insect-sized virtual objects composed of FM sweeps (glint separations of 36-300us), as similar to a standard stimulus (glint separation of 100us). Smaller or larger virtual objects were not perceived as similar to the standard stimulus. Using a novel tripolar electrode, we recorded auditory evoked potentials

from the scalps of unanesthetized and unrestrained bats, a noninvasive technique with great potential to analyze electrophysiological signatures of perceptual and cognitive processing of biosonar signals. We compare auditory evoked potentials in response to stimuli with differing glint separations to the behavioral data. We find that short latency components (<6ms) are similar across stimuli with different glint separations. These short latency components reflect neural activity from the cochlea to the auditory midbrain. Longer latency components (6-20ms) differ with glint separation—these components are believed to reflect processing from the midbrain up to the auditory cortex. Differences in these long latency components may reflect attention.

Claire Gray

Poster #B11

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Erica Larschan, MCB

Targeting an Active Chromatin Domain to the X-chromosome

Transcription must be tightly regulated to drive normal organismal development and to prevent the formation of disease states from cancer to neurodegeneration. To coordinate the regulation of genes, chromatin domains are formed to concentrate key factors at discrete genomic loci that activate or repress sets of genes. Pioneer transcription factors—which have the ability to bind to closed chromatin, recruit chromatin remodelers to open chromatin, and target additional transcription complexes—play a significant role in generating active and repressive chromatin domains. Using the male *Drosophila* dosage-compensated X-chromosome as a model, I am investigating how protein-binding domains of the genome-wide pioneer transcription factor, Chromatin Linked Adaptor for MSL Proteins (CLAMP), functions to specifically target an active chromatin domain to the X-chromosome. I hypothesize that mutations in CLAMP protein-binding domains will alter proper chromatin domain formation, resulting in the misregulation of dosage compensation. First investigating CLAMP genome-wide targeting, I performed Cleavage Under Targets and Release Using Nuclease (CUT&RUN) on wildtype and clamp mutant larvae to reveal the role of CLAMP protein-binding domains in its global binding. Concurrently, I checked the functionality of dosage compensation in all larvae by performing mRNA-seq, specifically monitoring for significant changes in the X-chromosome transcript output. This study will reveal the importance of specific CLAMP protein-binding domains in chromatin domain formation, which is critical in robust dosage compensation. Subsequently, I will perform Hi-ChIP to define the three-dimensional chromatin interactions mediated by CLAMP, shedding a complete light on the basic mechanisms of chromatin domain formation.

Courtney Frazier

Poster #B12

Home Institution: California State University Northridge

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Craig Lefort, Department of Surgery; Kirstina Hinman, Department of Surgery

Eradication of *Staphylococcus aureus* from Engineered Neutrophils through ACE Expression

Neutrophils, a type of white blood cell, are an important part of the innate immune system. When there is inflammation or an infection, neutrophils are able to detect these bodily responses, migrating to tissue

sites in high abundance in an attempt to eradicate microbes. The eradication process is through reactive oxygen species (ROS) which are able to kill off internalized microbes inside of the neutrophil's phagosomes. Previous studies illustrated that over expressing Angiotensin-converting enzyme (ACE) can lead to an enhanced production of ROS, promoting neutrophil eradication of *Staphylococcus aureus*, a highly toxic bacterium. From previous research done in another lab, they discovered that the up-regulation of ACE leads to an increased immune response. In this study, through the processes of PCR, gel electrophoresis, and restriction enzyme digest, our lab is attempting to generate a lentiviral plasmid with which we will transduce neutrophil progenitors to achieve ACE over expression. Using mice as test subjects, and infecting them with *Staphylococcus aureus*, we later plan to be able to look at the engineered neutrophils produced after neutrophil progenitor transplantation and determine if they are better able to clear *Staphylococcus aureus* as a result of their high ACE expression levels. In the long run, we can look at neutrophil progenitors as a possible therapeutic solution for future patients that is complementary to antibiotics and can combat drug-resistant infections.

Elizabeth Ding

Poster #B13

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Wafik El-Deiry, Pathology and Laboratory Medicine

Neuroendocrine differentiation (ND) in sensitivity of neuroendocrine tumor (NET) cells to ONC201/TIC10 cancer therapeutic

Neuroendocrine tumors (NETs) harbor neuroendocrine differentiation (ND) with specific markers including protein gene product 9.5 (PGP9.5) and Chromogranin A (CgA). In prostate cancers (PC), ND is induced by BRN2/SOX2 transcription factors. NET-like cells with low or absent androgen receptor (AR) signaling cause hormone therapy resistance and poor prognosis in PC. Small cell lung carcinoma (SCLC), a high-grade NET, presents with metastasis early and has poor survival. ONC201/TIC10 is a small molecule inducer of TRAIL signaling in clinical trials. ONC201 antagonizes dopamine D2 or D3 receptors (DRD2/DRD3) and is an agonist of mitochondrial caseinolytic protease P (ClpP) resulting in activation of DR5/TRAIL-dependent apoptosis involving the integrated stress response (ISR). ONC201 is active in various malignancies including H3K27M-mutated glioma and NETs expressing high levels of DRD2. We hypothesized that altered BRN2/SOX2 may impact NET apoptosis by ONC201 through the ISR and TRAIL/DR5. We analyzed the expression of PGP9.5, CgA, SOX2, BRN2, ATF4, DR5, ClpP, ClpX, and DRD2/DRD3 in PC and SCLC cell lines (N=6) +/- treatment with ONC201. Our results reveal that DU145 (IC50=3.11 μ M), PC3 (IC50=3.02 μ M), and LNCaP (IC50=1.33 μ M) are ONC201 sensitive. H1417 SCLC expresses CgA, unlike PC3 and DU145. PGP9.5 is expressed in these lines. Additionally, PGP9.5 is expressed in PC3, DU145, H1417, and H1048 but not in LNCaP and 22RV1. BRN2 is expressed in PC3, H1417, and H1048 but not DU145, LNCaP, or 22RV1. ClpX is expressed in all 6 lines but at lower levels in SCLC. ClpP is expressed in the 6 lines. DR5 is expressed at higher levels in PC3, DU145, LNCaP, and 22RV1 PC versus H1417 and H1048 SCLC. SOX2 is expressed at high levels in H1417 cells. These results are establishing the landscape of ND in PC and SCLC lines for further experimentation and testing of our hypothesis. To characterize the association of BRN2 dysregulation with ONC201 sensitivity, we are performing BRN2/SOX2 knockdown experiments and evaluating effects towards ONC201 sensitivity. Our results provide insights into molecular mechanisms of ND in PC and SCLC sensitivity to ONC201.

Daniel Betensky

Poster #B14

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Chat Jayasuriya, Orthopaedics

Meniscus tears are one of the most common orthopaedics injuries and are found in people of all ages. Injuries to the meniscus are both debilitating in the moment and increase the risk of osteoarthritis (OA) development later in life. The inner white zone of the meniscus contains little to no vascularity, presenting a significant challenge for clinical repair because tears in this area have very limited intrinsic healing capabilities. Our lab group has recently shown human cartilage derived progenitor cells (CPCs) can effectively stimulate meniscus healing following injury. While we have gathered in vivo and in vitro evidence demonstrating the repair abilities of CPCs, it is still unclear how these cells mediate fibrocartilage anabolism. In this regard, it is still unknown whether CPCs mediate these effects directly or rather through a paracrine (indirect) mechanism of action. More recent data shows that CPCs produce extracellular vesicles, which carry small biologically active molecules and nucleotides that can be transferred from cell to cell. This project explores the function of CPC derived extracellular vesicles (EVs) in stimulating meniscal tissue healing. Our preliminary results indicate that CPCs produce EVs under normal conditions and conditioned media collected from CPC cultures can increase cell migration to an injury site. Next steps include isolating CPC EVs and using gene expression and protein analyses along with further cell migration and toxicity assays as a way of characterizing the biological impact of these vesicles on cells, in vitro. We will also examine the impact of the EVs on meniscus healing in an ex vivo meniscal injury model and evaluate outcomes using histology analysis. We are hoping to find that treatment with CPC EVs can improve meniscus healing rates. Successful completion of this proposed research project would provide insight into the mechanism by which CPCs instigate meniscus healing and improve the general knowledge and understanding of cell therapy use in musculoskeletal injury and regeneration.

Diane Story

Poster #B15

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Diana Grigsby-Toussaint, Center for Health Promotion and Health Equity

Greenspace Exposure and Children's Mental Health: A Scoping Review

Background:

Childhood is a critical period for brain development, and a child's environment can positively or negatively impact their mental health. Greenspace is any open space that is accessible to human use and includes grass, trees, and other vegetation (Ward et al. 2016). This environmental exposure can directly benefit mental health through physical activity, stress reduction, and socialization (Amoly et al. 2014). It can also indirectly benefit mental health through a reduction in air pollutants (Dadvand et al. 2015). However, these findings are mixed, and would benefit from further study. This scoping review seeks to answer the question, "How does time spent in greenspace impact the mental health of children ages 0-12?" It will also inform an ongoing project relating greenspace exposure, physical activity, sleep, and mental health.

Methods:

Inclusion criteria:

The target population of the review is children between the ages of 0 and 12. The concept of interest is time spent in greenspace. Greenspace includes any accessible open space with vegetation, including parks, agricultural spaces, and forests. The outcome is mental health, operationalized using measures of cognitive function, motor function, the absence of mental disorders and negative states like stress, and

the presence of positive states and assets like happiness and peer relationships.

Exclusion criteria:

Studies that used qualitative methods were excluded. This review also excluded studies not published in English.

Search strategy:

A preliminary search of PubMed and PROSPERO was conducted on June 13, 2022 and no reviews had addressed time spent in greenspace. A search of PubMed on June 20, 2022 returned 168 results. The titles and abstracts of these articles were screened in Covidence for the above inclusion criteria.

Eighty-seven studies were included after title and abstract screening. Full text screening will also be completed.

The completed search process will be documented in a PRISMA flowchart. Study methodology, participant characteristics, measures of mental health, measures of greenspace, and effect sizes of greenspace on mental health will be tabulated. Separate tables will be created for each aspect of mental health. Results will also be synthesized in narrative format.

Eden Allen

Poster #B16

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jess Plavicki, Department of Pathology and Laboratory Medicine

Determining the Impact of “Forever Chemical” Exposure on Microglia Function

Per- and Polyfluoroalkyl Substances (PFAS) are manufactured, toxic chemicals present in many household and industrial products. PFAS congeners are found in stain-resistant fabrics, firefighting foam, non-stick coatings, and in the aerospace, automotive, and electronics industries. The prevalence of PFAS in commonly used products and its contamination of food, water, and air has led to near universal exposure in humans. The strong carbon-fluorine bonds of PFAS compounds make them biopersistent and resistant to degradation, resulting in accumulation in the body and variable rates of excretion. PFOS and PFOA are the most widespread and commonly studied PFAS compounds. PFOS, in particular, causes hyperactivity and has several effects on the adaptive immune system, including attenuating the adaptive immune response, curbing antibody production, and limiting vaccine efficacy. In an earlier portion of this study, PFOS was found to increase neuronal firing and alter the functioning of the innate immune system. We found PFOS exposure increases the responses of innate immune cells, particularly microglia, to injury. More microglia are recruited to and retained at the injury site. The heightened and prolonged microglial response is concerning, because neural inflammation impairs brain health. The increased neuronal activity observed following PFOS exposure led us to hypothesize that the neural signaling environment contributes to the heightened microglial response. While PFOS and PFOA are both 8-carbon PFAS compounds, they have different functional groups. Unlike PFOS, zebrafish exposure to PFOA does not result in behavioral hyperactivity nor an increase in neuron activity. Therefore, we asked whether microglial responses were exacerbated in PFOA-exposed zebrafish. To determine if the difference in functional groups impacts microglia behavior, we are exposing a fluorescent zebrafish transgenic line that marks microglia to PFOA, performing brain injuries, and quantifying the response of microglia at the injury site. Our preliminary data suggest that PFOA exposure produces an activated microglial phenotype without affecting microglial behavior. This implies that heightened neuronal activity and corresponding altered neuronal-microglial communication drives the exacerbated microglial response to injury following PFOS exposure. Our studies give us new insight into how toxicants impact microglial function and the impact of widespread pollution on human health.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Alison DeLong, MCBBM

Where are you, B72?

The protein phosphatase 2A (PP2A) enzyme family is a highly conserved regulatory hub that controls the phosphorylation status, and thus the activities, of many key cellular players in eukaryotes. Each PP2A complex contains a catalytic (C) subunit bound to a scaffolding (A) subunit and a regulatory (B) subunit. The DeLong laboratory has identified two regulatory B subunits that control leaf expansion, which is an important agronomic trait because leaf area is a major determinant of photosynthetic capacity and yield of leaves, roots, fruit, and seeds. We are using quantitative phenotypic analysis and molecular tools to analyze the basis of increased leaf expansion. This project focuses on using green fluorescent protein (GFP) reporter constructs to analyze the subcellular localization of these important B subunits that regulate leaf expansion and determining which domains of the B subunit protein are required for normal function. The project also will test the hypothesis that the amino-terminal domain contains functionally important sequences. I learned and will learn fundamental tools of plant molecular genetics and fluorescence microscopy, characterizing the overall tissue distribution and subcellular accumulation of B-GFP fusion proteins, and testing the biological activity of the fusions. These experiments will provide important insights into the cellular compartments and pathways in which PP2A acts to control leaf size and plant growth.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentors: Christopher Moore, Neuroscience and Kevin Bath, Developmental Neuroscience, (Columbia University)

Adverse experiences in early life stunt reward learning and disrupt dopamine signaling

Exposure to stress during early childhood increases risk for negative mental health outcomes such as depression and substance use disorder, with dopamine-related psychopathology suggesting critical changes in dopaminergic signaling and reward processing. Dopamine signaling uniquely drives neuromodulation in the brain to reinforce behavior. Therefore, disruptions to dopamine signaling – induced by early life adversity (ELA) – may undermine reinforcement learning and decision making. Within the context of ELA, the amount of adverse experiences also correlates with negative outcomes. Here, we use a rodent model of ELA to elucidate the long-term consequences of negative early life experiences on acquiring information and updating expectations about our environment. We hypothesize that ELA – and more specifically, the degree of adverse experiences – increases reward prediction errors and impairs reward learning rates on a probabilistic reward task, with higher dopamine-encoded reward prediction errors in ELA animals. To address this, we assessed the quality and predictability of early life experiences using continuous home cage monitoring and scoring. Rough and unpredictable maternal care led to worse performance on a probabilistic reward task, with potential implications for dopamine signaling. Ongoing work seeks to measure dopamine during the probabilistic reward task using fiber photometry. Understanding the significance of detrimental early life experiences and effects on negative mental health outcomes is important as it can lead to earlier intervention and prevention in children.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Suzanne De La Monte, Pathology and Laboratory Medicine, Neurosurgery

Neuroprotective Effects of Dietary Soy and its Bioactive Constituents in a Chronic Ethanol Exposure Model

Background: Chronic ethanol exposure leads to alcohol-related brain degeneration, cognitive-motor deficits, and impaired signaling through insulin/insulin-like growth factor type 1 (IGF-1)-Akt pathways that regulate cell survival, plasticity, metabolism, and homeostasis. Impairments in insulin/IGF-1 pathways also inhibit Aspartyl-asparaginyl-B-hydroxylase (ASPH), which activates Notch networks. One of our recent studies showed that dietary soy, which has insulin sensitizer actions, was neuroprotective and could reduce or prevent ethanol's adverse effects on neurocognitive function and signaling through the insulin receptor and Akt. Objective: As an extension of this work, we sought to determine the degree to which genistein, a bioactive constituent of dietary soy, could replace soy isolate as a therapeutic intervention in an established experimental model.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Alexander Fleischmann, Department of Neuroscience

Odor Learning and Spatial Memory in Mice

As a result of previous positive or negative experiences, organisms learn to respond differently to various stimuli. This can lead to organisms associating a previously neutral stimulus with a positive or negative valence outcome, greatly changing their response to that stimulus through associative learning. Mice are known to place a particular emphasis on odors for guiding their behaviors in numerous contexts such as social communication and navigation through a novel environment. It is hypothesized that odor-associative learning can lead to a change in how odor information is encoded in brain regions such as the piriform cortex and prefrontal cortex, as well as a change in the behavior of mice in response to an odor.

In order to further examine how associative learning can alter a mouse's response to a given odor, we aimed to observe how mice are able to form odor-place associations within a given T-maze paradigm. This was done through training cohorts of mice to be presented with an odor at the base of the T-maze, and based on the odor's identity, going to the top left or right corners of the T-maze to receive a water reward. Through this odor-place associative learning, we have hypothesized that the mice would learn to associate a given odor with a specific corner of the T-maze, and move to the correct corner of the T-maze following odor presentation.

This summer, we have been able to train mice in this behavioral experiment and have begun to examine more efficient ways for the mice to learn the expected odor-place associations. Soon, we would like to additionally record activity from neurons in brain regions associated with both odor information processing and associative learning, following odor-place association formation, to see how this information may be encoded. We hypothesize that this information would be encoded in ensembles of neurons within the piriform or prefrontal cortices.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ting Zhao, Department of Reconstructive and Plastic Surgery

Irisin Plays a Protective Effect in Mice Exposed to Hemorrhage

Irisin is a newly derived hormone cleaved from fibronectin type III domain containing protein-5 (FNDC5). This hormone plays an important role in stimulating glucose uptake, promoting metabolism, and modulating tissue injury. According to previous studies, mice with metabolic disorders showed improved cardiac function when treated with irisin. Previous studies have also suggested that irisin induces cardiac protection, particularly against myocardial ischemia and associated reperfusion injury. In considering the protective effects induced by irisin, this project aims to determine whether irisin plays a role in the development of a protective effect against hemorrhagic injury and outcomes—including tissue damage, edema, and inflammatory cell infiltration. This was achieved through the simulation of hemorrhage conditions and subsequent resuscitation in male CD-31 mice treated with irisin, as well as those with deleted irisin receptors through CRISPR/Cas-9 genome editing technology. The response of the mice to the hemorrhage was measured and analyzed through echocardiography, glucose tolerance testing, enzyme-linked immunosorbent assay, immunoblotting, and histology analysis. Echocardiography revealed that mice treated with irisin had significantly improved cardiac performance in hemorrhagic conditions compared to the control, as indicated by increased ejection fraction and fractional shortening. Histology analysis illustrated that irisin mitigated edema and inflammatory cell infiltration in lung tissue, skeletal muscle, and cardiac muscle. Furthermore, in mice whose gene encoding irisin receptors had been deleted through CRISPR/Cas-9 genome editing technology, decreased myocardial performance indicated intensified hemorrhage-induced injury. The results suggest that irisin induces a protective effect against damages from hemorrhage, improved cardiac performance, and the suppression of tissue injury.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Richard Freiman, MCB

Meiotic Progression and Oocyte Quality Control in a Murine Model of Primary Ovarian Insufficiency

Establishment of the ovarian reserve is a critical component of fetal development and determines a woman's reproductive potential and overall health. Throughout embryonic ovary development, more than two-thirds of oocytes are eliminated during the process of fetal oocyte attrition (FOA). Excessive FOA can contribute to premature follicle depletion in adulthood, which is a major cause of Primary Ovarian Insufficiency (POI). This condition affects approximately 1% of women under the age of 40 and often results in infertility as well as increased risk of developing cardiovascular disease, osteoporosis, and early cognitive decline. TAF4b, a germ cell enriched subunit of the TFIID complex, is essential for proper embryonic ovary development in the mouse. Our TAF4b-deficient mice display key hallmarks of POI and thus present a valuable model for uncovering the molecular etiology of POI pathogenesis. To investigate the precise mechanisms of FOA in TAF4b-deficient mice, we analyzed meiotic progression and quality control throughout meiosis prophase 1, which is subdivided into leptotema, zygotema, pachytoma, and diplotema. Proper homologous chromosome pairing, DNA recombination, and regulation of DNA damage are essential for timely progression through prophase 1. We performed immunostaining of meiotic

chromosome spreads for synaptonemal complex protein 3 (SYCP3) to analyze homologous chromosome pairing and γ H2AX, an established marker of double stranded DNA breaks. At E18.5, the majority of WT and TAF4b-deficient germ cells are in pachynema. However, WT oocytes that are not in pachynema have progressed into diplotene by E18.5, whereas the remaining TAF4b-deficient oocytes at E18.5 are delayed in leptotene or zygotene. By PND0, most WT oocytes reached diplotene arrest but TAF4b-deficient oocytes largely arrest in pachynema. TAF4b-deficient oocytes also contain more γ H2AX patches than aged-matched WT controls in pachynema and diplotene, indicating that TAF4b-deficient oocytes are unable to properly repair DNA damage. Taken together, these results demonstrate that TAF4b-deficient oocytes are unable to complete crucial hallmarks of prophase 1 and are culled from the early postnatal ovary. These studies further our understanding of the mechanistic details of excessive FOA, a critical step towards developing treatments to protect the fertility and overall health of individuals with POI.

Hanna Wang

Poster #C6

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Stephen Helfand, Department of Molecular Biology, Cell Biology and Biochemistry;
Jackson Taylor, Department of Molecular Biology, Cell Biology and Biochemistry

Tissue-specific effects of jim overexpression on epigenetic regulation of aging in *Drosophila melanogaster*

Transposable elements (TEs) are repetitive DNA sequences that can replicate and move within the genome. TEs are normally silenced by host defense mechanisms that induce their heterochromatinization from an early developmental stage. However, loss of silencing occurs during aging, a process that is associated with extensive epigenetic remodeling. When transposons are de-repressed, they accumulate and insert randomly into the genome, leading to inflammation and DNA damage that contribute to the phenotypes of age-associated disease. Conversely, interventions aimed at maintaining heterochromatin structure and reducing TE activity extend lifespan and slow age-related decline.

The jim transcription factor has previously been found to enhance heterochromatic silencing in the *Drosophila melanogaster* genome but its cellular function has not yet been clearly defined. To better understand jim's role in TE silencing and regulation of aging, we carried out a series of experiments with flies modified to overexpress jim. Overexpressing jim ubiquitously in the whole body dramatically shortened lifespan. Subsequent screening of several tissues in which jim was selectively overexpressed revealed the highly tissue-specific and often differing effects of jim overexpression throughout the body. While overexpression increased lifespan in the brain and fat body, overexpression in the oenocytes shortened lifespan comparably to whole-body overexpression.

Oenocytes are secretory cells located in the abdomen of insects that play an essential role in lipid metabolism and cuticular hydrocarbon synthesis required for desiccation resistance. Further examination of jim overexpression flies showed that these flies were less resistant to desiccation, suggesting that jim may mediate the conversion of larval fat stores to protective cuticular hydrocarbons in the oenocytes. Further study of jim may reveal therapeutic genetic interventions to mitigate deleterious aging phenotypes related to TE activity.

Home Institution: Brown University

Summer Research Program: Brown Center for Biomedical Informatics (BCBI) Summer Internship

Faculty Mentor: Liz Chen, Brown Center for Biomedical Informatics

Exploratory Data Analysis of COVID-19 and Intellectual Developmental Disorders in Rhode Island

Intellectual developmental disorders (IDD) encompass a range of disorders that affect intellectual and adaptive functioning. The literature on IDD and COVID-19 in the pediatric population in the United States is sparse and suggests that individuals with IDD have worse outcomes with COVID-19. This study has two aims: (1) conduct a literature review focused on IDD and COVID-19, and (2) perform exploratory data analysis of individuals with IDD in Rhode Island. The literature search involves using keywords in Google Scholar and MeSH descriptors in PubMed to find relevant articles. Statewide electronic health record (EHR) data from CurrentCare, Rhode Island's Health Information Exchange, operated by the Rhode Island Quality Institute, are being used to identify individuals with IDD. The first step will be to characterize the patient population through demographic data, including age group, ethnicity, and gender. A pipeline will be designed to filter the dataset according to characteristics of interest, including IDD diagnosis, COVID-19 vaccination status, and COVID-19 positive status. We hypothesize that in the experimental group, those with a history of COVID-19 infection, will experience more severe outcomes, measured using hospitalization rate and ventilator use, than the control group. In all, the results of this study may have implications for standard of care and development of appropriate guidelines for management of COVID-19 in individuals with IDD.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ahmed Abdelfattah, Neuroscience

Developing Genetically Encoded Opioid Sensors

Understanding how neuromodulatory systems influence the brain is a rapidly growing field that requires the ability to precisely measure neuromodulator and neuropeptide release. To do so, scientists have developed tools, such as biosensors, to provide accurate visualization of ligands within the brain. While sensors have been engineered to measure dopamine levels in the brain, there is currently no adequate counterpart to measure endogenous and exogenous opioid levels. Pre-existing opioid sensors have been made by inserting a fluorescent protein into the μ and κ opioid receptors, allowing for a change in fluorescence in response to ligand binding. However, these sensors have poor membrane localization and a small change in fluorescence when the ligand is bound. Using protein engineering, we aim to improve the membrane localization and fluorescent response of these sensors. To address the poor membrane localization, we attached localization tags onto sensors based on the μ and κ opioid receptors. These sensors were expressed in HEK cells via lipofection, then visualized under a microscope. We found the addition of trafficking sequences from the inward-rectifying potassium channel Kir2.1 improved membrane localization. Subsequently, we modified the insertion site of the fluorescent protein into the μ and κ opioid receptors. Response to ligand binding was tested by adding receptor-specific agonist and antagonist to HEK cells expressing our sensors. Further testing of our sensors is necessary to characterize the fluorescent response to ligand binding.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Karla Kaun, Neuroscience

Drosophila Group Activity in the Fly Group Activity Monitor (flyGrAM)

Drosophila melanogaster, also known as the common fruit fly, is a popular model organism for the study of neurogenetics and behavior. Due to its conserved response to ethanol, high progeny yield, relatively low cost, and plethora of neurogenetic tools, *Drosophila* are an ideal model to study the circuit mechanisms of underlying alcohol responses. To increase throughput and objectivity in performing behavior experiments, it is critical to develop apparatuses that can efficiently track *Drosophila* behavior after ethanol or light exposure. We present an apparatus that quantifies real-time fly group activity in response to various stimuli, including ethanol administration and optogenetic LED pulses, called the fly Group Activity Monitor (flyGrAM). Importantly, the portability of flyGrAM, as well as its user-friendly software, allow the apparatus to be used effectively in both teaching and research environments. To demonstrate flyGrAM's versatility, we used a modified, classroom-friendly flyGrAM apparatus to determine the effects of alcohol intoxication on *Drosophila* group activity level. With the same classroom set-up, we also used optogenetics to determine the optimal parameters of light exposure to drive behavioral responses in flies expressing the light-gated ion channel *CsChrimson* in neurons implicated in jumping and walking behavior. Our data demonstrate the flyGrAM's accessibility and capacity to quickly and accurately tabulate *Drosophila* group activity in both ethanol and optogenetic assays.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: David Borton, Engineering (Biomedical); Sophie Brown, Engineering (Biomedical)

Investigation of microglia post CSF1R inhibitor treatment in an LPS induced inflammation model in a 3D cortical culture

Microglia, the immune cells of the brain, can be activated by stress, foreign bodies, and other trauma and play a part in mediating neuroimmune pathology across multiple neurodegenerative diseases. Under normal conditions, microglia play a vital role in the brain's innate immune response which helps protect the brain from a multitude of central nervous system (CNS) injuries; however, once activated microglia can produce neurotoxic reactive oxygen species (ROS) and other inflammatory factors which can act as an effector for neurodegenerative diseases. Here we use our 3D cortical culture to model the neuroimmune activation via Lipopolysaccharide (LPS) and the effects of microglial depletion via inhibition of the CSF1 receptor whose signaling is essential for microglia. However, recent studies have shown a microglia repopulation effect after reversal of CSF1R inhibition treatment in an organotypic hippocampal slice culture (OHSC) indicating a possible repopulation of microglia with neuroprotective phenotype changes in our 3D in vitro model. We characterized changes in the population of microglia at DIV14 by staining a common microglia marker, Iba1, following CSF1R inhibition treatment on DIV7. To access the neuroprotective phenotype changes of microglia we stained Iba1 following LPS treatment on DIV5, PLX treatment on DIV7, and fixture at DIV14. After the 3D culture underwent microglia depletion via CSF1R inhibition both within and without LPS treated models, results show blunted proinflammatory responses due to the diminished microglia population in the LPS treated group with distinct changes in active morphology. In summary, microglia are not able to repopulate in our 3D in vitro model post-CSF1R

inhibition. More work needs to be done to see if more than 14 days in vitro is needed to repopulate the microglia.

Jasmine Shum

Poster #C11

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Erica Larschan, Molecular Biology, Cellular Biology, and Biochemistry

Transcription factor CLAMP and its regulation of co-transcriptional splicing via PrLD domain-mediated phase separation

Gene regulation is crucial to cellular function, driving cell fate decisions through transcription and RNA processing. Both transcription and splicing occur on chromatin and are coordinately regulated in a process known as co-transcriptional splicing. However, little is understood about its underlying mechanism. To investigate this mechanism, I studied a DNA/RNA binding protein Chromatin-Linked Adaptor for Male-Specific Lethal (MSL) proteins (CLAMP). CLAMP is known to contribute to male dosage compensation and sex-specific splicing, which involves ribonucleoprotein complexes called spliceosomes. The glycine-rich Prion-Like Domain (PrLD) within CLAMP, is essential for viability and contributes to sex-specific splicing. CLAMP also interacts with the Male Sex Lethal protein 2 (MSL2), an essential component of the MSL complex that coordinates dosage compensation in male *Drosophila* via MSL2 binding domain (MSL2BD).

Biomolecular condensates are membraneless organelles that are formed by liquid-liquid phase separation, usually through RNA-protein interactions. Spliceosome complexes are reported to function as splicing condensates, but the mechanisms underlying their function are unclear. This project explores how RNA-protein complexes may drive spliceosome function via phase separation, and thus how different CLAMP domains contribute to context-specific function. It was hypothesized that the PrLD domain, known to facilitate phase separation properties, is essential for phase separation and thus splicing condensate formation while the MSL2 domain is essential only for dosage compensation. While previous individual-nucleotide resolution UV crosslinking and immunoprecipitation (iCLIP) data identified specific CLAMP-binding RNA motifs in male and female *Drosophila*, it is necessary to validate these motifs and understand whether the PrLD is essential for this binding. I generated CLAMP mutant plasmids with deletions of PrLD and MSL2BD (Δ MSL2BD) using PCR-based mutagenesis. Using electrophoretic mobility shift assays (EMSA), I will assess the RNA-protein interactions between CLAMP and RNA with these sex-specific motifs in vitro. In observing how different CLAMP mutants bind to RNA in cytoplasmic, chromatin, and nuclear fractions in male and female *Drosophila*, I will elucidate the specific domains and RNA motifs that are important for CLAMP's regulation of co-transcriptional splicing through the biophysical properties of the relevant RNA-protein complexes

Jelynn Tatad

Poster #C12

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Edith Mathiowitz, Department of Pathology

Characterizing Mesophases in Biodegradable Polymers

When designing a polymer-based drug delivery system, it is essential that the correct amount of medication is being released to the body's tissues. This is controlled by the polymer's morphology, where an ordered, crystalline structure would restrict delivery whilst a disordered, amorphous structure would promote it. During recent work in the Mathiowitz Lab, the mesophase was discovered as an intermediate between the amorphous and crystalline phases. The objective of this study is to characterize and evaluate the different forms of mesophases as precise and efficient drug delivery systems. Various polymers, such as polylactic acid and polycaprolactone, were film-casted using Dichloromethane (DCM) and pressure and heat processed with a hydraulic press. Next, the samples were analyzed using Polarized Light Microscopy (PLM), Differential Scanning Calorimetry (DSC), and X-Ray Diffraction (XRD). Colorful regions on the samples' PLM reading show birefringence, indicating mesophase formation. XRD further provides evidence of mesophases based on profile peaks, and the photos show signs of different types of mesophases. These findings can serve as a foundation for future research in discovery of biodegradable polymers with induced mesophases as possible vehicles for drug delivery systems.

Jennifer Chen; Melany Veliz

Poster #C13

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Stephanie Parade, Department of Psychiatry and Human Behavior; Laura Stroud, Department of Psychiatry and Human Behavior

Maternal Marijuana Use in Pregnancy and Infant Temperament at 6-Month of Age

What are the consequences of maternal marijuana use during pregnancy for infant behavior in the postpartum period? Using data collected in an ongoing study funded by the National Institutes of Health (R01DA044504; L. Stroud, PI), our UTRA collaboration has focused on understanding links between maternal marijuana use during pregnancy and infant temperament at 6 months of age. Infant temperament is associated with health and development in later childhood and into adulthood, as well as parenting behavior and the parent-child relationship. Thus, understanding factors that contribute to the development of temperament during infancy is important.

Data is currently being collected from two-hundred and fifty one mothers and their infants. More than half of the mothers in the sample used marijuana during pregnancy and nearly half of the mothers are living in poverty. Mothers were recruited prenatally from Women and Infants Hospital and are interviewed about their substance use including marijuana use throughout pregnancy. At 6 months postpartum, mothers and their infants participate in a laboratory observation which includes a standardized observational assessment designed to elicit a mild stress response among infants.

Throughout the summer, Jennifer Chen and Melany Veliz were trained and participated in coding infant temperament during the tasks from videotapes of the observational assessment. Infant temperament was coded in 10-second epochs on a 9-point scale from "(1) extremely high positive response" to "(9) extremely high negative response". 61 videotapes have been coded to date. Upon completion of video coding, coded data will be summarized to generate several variables including the mean temperament rating across the entire observational assessment, the maximum temperament rating across the entire observational assessment, and the variability in temperament ratings across the assessment. These variables will then be used in data analysis to determine if there are observed differences in infant temperament among those infants exposed or unexposed to marijuana during pregnancy. Our long-term goal is to prepare a manuscript for publication based upon this work. Understanding the role of maternal marijuana use in pregnancy for the development of infant temperament is critical for the progress of targeted interventions to enhance development among infants at risk.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Mamiko Yajima, Molecular Biology, Cell Biology and Biochemistry

The Role of the Hippo Signaling Pathway in Sea Urchin Embryos

Asymmetric cell division (ACD) is a crucial cellular process where a parent cell divides into two daughter cells of distinct cell fate and may induce tumor-like phenotypes when misregulated. Recent studies suggest ACD is linked with the Hippo signaling pathway, a regulator of organ growth, cell proliferation, and tumorigenesis. However, these studies have been limited to a few model systems, such as *Drosophila* and mice. Investigating the role of this connection in various model systems is critical to uncovering the evolutionarily conserved mechanisms and unique mechanics of ACD that contribute to the diversity of the developmental program in each species. Here, we use sea urchin embryos as a model system to uncover how polarity factors are regulated in conjunction with the Hippo pathway to control ACD. The first apparent ACD in this embryo occurs at the 16-cell stage, forming smaller daughter cells, the micromeres, that have different cell fates than the larger daughter cells, the macromeres. These micromeres also have a unique function as organizers to control embryonic patterning.

To characterize the expression and localization dynamics of Hippo pathway components in sea urchin embryos, we performed immunoblot and immunofluorescence for the major components, such as YAP/Yorkie, MST/Hippo, and LATS/Warts. We found that YAP expression is consistent from eggs to Day 1 embryos and increases in Day 2 embryos. Immunofluorescence suggests YAP is on the spindle, while MST is consistently at the cell cortex. Both proteins are enriched in the micromeres at the 16-cell stage, yet then mostly in the cortex in the later embryonic stages. Similar localization patterns of each factor were also observed by GFP-tagged constructs. Additionally, GFP-YAP overexpression induced abnormal phenotype, yet not GFP-MST at Day 1 stage, suggesting differential regulation or function of each factor in the embryo.

These observations suggest that the Hippo Pathway components are indeed enriched in the micromeres with ACD factors and may play a role in embryogenesis. Future directions include identifying the functional contributions of the Hippo pathway and its relationship to ACD factors, such as AGS and Gai, in micromere formation and/or function.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Eunyoung Cho, Department of Dermatology, Warren Alpert Medical School of Brown University

Vitiligo Among Adults in the United States: A Cross-Sectional Study Using the All of Us Research Program

Vitiligo is a depigmentation skin disease with varying worldwide prevalence estimates ranging from 0.004 to 2.28%. However, there are only a few studies studying vitiligo in racially and ethnically diverse adult cohorts. We performed a cross-sectional analysis using the All of Us Research Program, a U.S. national database that aims to increase the recruitment of historically underrepresented biomedical research participants over the age of 18. Vitiligo cases were identified through electronic health record (EHR) data

using ICD-10-CM L80 and ICD-9-CM 709.01. Of 369,280 total participants in the All of Us database, 240,634 participants had available EHR data, and 922 vitiligo cases were identified. Using data from EHRs, surveys, and physical measurements at the time of enrollment, we estimated the prevalence of vitiligo by age, race, ethnicity, gender, sexual orientation, education, income, health insurance status, smoking history, and body mass index (BMI). Odds ratios (OR) and 95% confidence intervals (CI) were calculated with multivariate logistic regression adjusted for the aforementioned variables, and a value of $p < 0.05$ was considered statistically significant.

Among the All of Us cohort, we found that the risk of vitiligo varied by race and ethnicity: most notably, participants who identified as Black/African American had a 64% increase in odds of having vitiligo (OR 1.64 [95% CI 1.34-1.99]) compared to those who identified as White. Moreover, data indicated that current smokers had a decreased risk of vitiligo; the odds ratio of vitiligo in current smokers was 0.57 (95% CI 0.44-0.73) with a reference of never-smokers. In addition, we identified lower risk of vitiligo among underserved populations, particularly among participants with lower household income levels and no health insurance. This may reflect vitiligo underdiagnosis among these populations, a possible result of limited access to dermatologic care. Future studies are needed to study the potential disparities in diagnosis and care of vitiligo among underserved communities and develop appropriate interventions for those more heavily affected by this dermatological condition.

Joanne Lee

Poster #C16

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Kate O'Connor-Giles, Department of Neuroscience

Functional analysis of TRAPP complexes at the *Drosophila* nervous system

Transport Protein Particles (TRAPP) are a multisubunit protein complex that influences the formation of neural connections and, we hypothesize, the maintenance of normal behaviors and cognitive functions.

The transfer of information across synapses in neural networks controls coordination of movement and cognitive functions such as thought, learning, and memory. At synapses, synaptic vesicles docked near calcium channels at the presynaptic membrane release their neurotransmitter content in response to signals (action potentials) from other neurons. While it has been established that the proximity of synaptic vesicles to calcium channels is essential to calcium-regulated synaptic communication, the mechanism by which synaptic vesicles are recruited and organized at synapses in relation to calcium channels for neurotransmitter release is not yet fully understood. Structural analysis of synapses shows the presence of tethers which connect synaptic vesicles to each other and to the synaptic membrane. However, despite being recognized for decades, the composition of these tethers is completely unknown.

The evolutionarily conserved TRAPP complex has been identified as a vesicle-tethering protein in other cellular contexts. Disruptive variants in TRAPP subunits have been implicated in motor dysfunction, intellectual disability, and developmental delay. However, no studies have linked TRAPP complexes to the tethering of synaptic vesicles. Work done in the O'Connor-Giles Laboratory has shown that core TRAPP subunits are expressed in the *Drosophila* nervous system and at synapses. Functionally, knocking down individual TRAPP subunits leads to decreases in synaptic vesicles. These results suggest that TRAPP complexes play an important role in synaptic vesicles' recruitment and transmission.

Thus, the following questions were addressed: 1) Do TRAPP complexes regulate synaptic transmission?

and 2) What is their role in learning and memory formation?

The research was conducted at the *Drosophila* neuromuscular junction – the synapse between a motor neuron and a muscle cell and is necessary for muscle activity. It can be genetically manipulated, imaged at multiple levels, electrophysiologically analyzed, and behaviorally studied. Neuron specific knockdown or mutants were used to analyze the function of TRAPP complexes.

John Maragakis

Poster #C17

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Anne Hart, Neuroscience

Identifying Suppressors of Motor Neuron Degeneration in *Caenorhabditis elegans* ALS-mutants

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease characterized by motor neuron degeneration resulting in loss of strength in voluntary movement, and eventually death by respiratory failure. While a large proportion of ALS cases appear to be sporadic, several genes have been causally linked to the disease. Of these genes, a G4C2 hexanucleotide repeat expansion in C9orf72 is responsible for approximately 40% of the observed cases of genetic ALS. To uncover potential genetic modifiers that might be relevant to patients with the C9orf72 expansion, we utilized a *C. elegans* model expressing a 30x G4C2 construct that causes neurodegeneration. These animals display significant neuronal death in the phasmid tail neurons, which are easily counted as a quantifiable marker of degeneration. This project aims to identify modifier genes whose perturbation suppresses neurodegeneration in the G4C2 model. To accomplish this, we exposed these G4C2 animals to EMS (ethyl methane sulfonate) mutagenesis and identified mutant lines with less neurodegeneration. Now, we are working to identify and isolate the causal mutations via whole-genome sequencing. We have identified several genes as candidates. This identification of novel neurodegeneration suppressors has potential to uncover new therapeutic targets that could one day improve the outcomes for people with ALS and other neurodegenerative diseases.

José Candelaria Marrero

Poster #D1

Home Institution: Inter American University of Puerto Rico

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Thomas Bartnikas, Pathology and Laboratory Medicine

The potential significance of manganese in colorectal cancer

Colorectal cancer is a deadly disease; finding new treatments that can help patients is crucial. Recent studies have suggested that manganese levels are increased in colorectal cancer. Other studies have also shown that increased levels of a manganese-dependent antioxidant protein, superoxide dismutase 2 (SOD2), are required for colorectal cancer growth. Manganese is a metal that is present in the liver, kidneys, pancreas and bones; it is important in our body because we need it to make essential proteins. In this study, we wanted to know if changes in manganese levels are required for colorectal cancer growth. To investigate the connection between manganese levels and colorectal cancer, we used azoxymethane (AOM)/dextran sodium sulfate (DSS) treatment to induce colorectal cancer in mice raised on different manganese diets. Three-week-old C57BL6/NJ mice were placed on manganese-deficient,

-sufficient, or –rich diets, then treated with or without AOM/DSS. Mice were observed for signs of disease such as weight loss, inactivity, diarrhea, and survival; with that said, studies are in progress. Relative to the mice on the manganese-sufficient diet and treated with AOM/DSS, we predict that the mice on the manganese-deficient diet and treated with AOM/DSS will lose more weight, have smaller and fewer tumors because SOD2 activity will be decreased. We also predict that the mice on the manganese-rich diet and treated with AOM/DSS will have more and larger tumors. In conclusion, we expect that manganese has relevance to colorectal cancer yet, further investigation is needed to test this hypothesis.

Joshua Acosta Gonzalez

Poster #D2

Home Institution: University of Puerto Rico - Mayagüez

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Anita Shukla, Biomedical Engineering; Akram Abbasi, Biomedical Engineering

Synthesis and Characterization of Poly-L-Lysine Coated Gold Nanoparticles for the Treatment of Bacterial Infections

Microbial threats are becoming an imminent global public health problem, causing over 2.8 million antibiotic-resistant infections and more than 35,000 deaths annually in the US alone (CDC and Prevention, 2019). The development of novel treatments is crucial to overcome the rising antibiotic resistance crisis. Antibacterial nanoparticles have recently emerged as an effective alternative to antibiotics to combat drug-resistant bacterial infections. Gold nanoparticles (Au NPs), in particular, have demonstrated great antimicrobial potential due to their unique physicochemical properties such as surface chemistry, photothermal activity, and charge tunability. In this study, we have synthesized Au NPs with different surface charge and morphology for optimal antibacterial efficacy. We have tuned their surface plasmon resonance (SPR) to the near infrared region (NIR) as NIR light (780 - 25000 nm wavelength) can penetrate biological tissues with minimal attenuation, enabling localized photothermal activity. Poly-L-Lysine (PLL), a positively charged polyelectrolyte, was used to tune the shape and charge of the Au NPs. We expect that the antibacterial properties of the cationic PLL will enhance the antibacterial efficacy of the Au NPs developed here. The adsorption of PLL on the surface of the Au NPs was confirmed by measuring the zeta-potential of Au NPs and PLL-coated Au NPs, which were ~-23 mV and +33 mV, respectively. Transmission electron microscopy (TEM) images of PLL-coated Au NP exhibited a three-dimensional flower-like hierarchical nanostructure whereas uncoated AuNPs exhibited a spherical morphology. Future work will build on these promising initial results to further analysis of the antibacterial properties of PLL-coated Au NPs.

Jude Adelman

Poster #D3

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Matthew Fuxjager, Ecology, Evolutionary, and Organismal Biology (EEOB)

Overlapping Drums: Aggressive or Not? Exploring the Significance of Overlapping Drums in the Downy Woodpecker

The *Dryobates pubescens* (downy woodpecker) is the native species of woodpecker to Rhode Island. One of the defining signals of the downy woodpecker is their drum. Woodpecker drumming is speculated

to be a form of territorial communication. Woodpeckers have been observed to participate specifically in overlapping drumming with each other. Overlapping drums are defined as when one individual starts drumming before another individual has finished its own drum. There are many studies on the significance of the overlapping songs of songbirds as an aggressive signal, but there is no research on the significance of overlapping drums. In addition to testing the reason for the overlapping drums, it is also important to test the possibility of overlapping drums occurring by chance. To determine its significance, a combination of a novel R package and the traditional Duty Cycle method were used on recordings taken from March to May 2021 of 1-3 woodpeckers responding to playback woodpecker drums. We ran both analyses to show that the downy woodpecker is avoiding overlap of the drums of playback birds. Subsequently, the significance of the playback drum and the woodpecker “call”, also known as a whinny, was statistically studied whether to occur by chance or not. This analysis determined that downy woodpecker whinnies are avoiding overlap of the playback woodpecker drums. The avoidance of overlap in these signals supports the auditory interference hypothesis which states that woodpeckers avoid trying to signal over one another in order to avoid conflict. This would be further supported by analyzing how much the woodpeckers are avoiding overlap based on their proximity to each other.

Julian Ramprashad; Onyx Richards; Aseel Rafat Poster #D4 & #D5
Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Sunil Shaw, Pediatrics

Using CRISPR-HDR to explore cell wall protein interactions and adhesion in *Candida parapsilosis*

Candida species are a major cause of invasive fungal infections, often affecting vulnerable patients—including immunocompromised individuals, underdeveloped neonates, and patients recovering from invasive medical procedures—whose compromised skin, GI tracts, or mucosal membranes allow the pathogen to invade internal organs and the bloodstream. *Candida* species’ resistance to current antifungals has been on the rise and is rated an urgent threat by the CDC. New methods of treating *Candida*—including *C. parapsilosis*, the focus of our lab—may lie in the yeast’s mechanisms of adhesion, a crucial step in establishing infection. The uniquely-fungal cell wall is a good target for new therapies since it is critical for maintaining the cell’s shape, keeping external threats out, and housing various virulence factors.

This study investigates four proteins linked to the *C. parapsilosis* cell wall: the adhesin Als7, cell wall glucan remodeling proteins Phr1 and Phr2, and iron sequestration protein CFEM2. The Shaw lab has previously found Als7 and Phr1, though not CFEM2, are necessary for adhesion in *C. parapsilosis*. Our goal is to characterize the distribution of these proteins and identify the proteins they interact with using fluorescence microscopy and proximity labeling. To do this, mNeonGreen, mScarlet, and a modified ascorbate peroxidase (CAPEX3) were inserted into CpAls7, Phr1, Phr2, and CFEM2 using CRISPR-HDR. So far, we have constructed the necessary repair templates and Cas9/sgRNA expression plasmids and have begun transforming them into yeast. We hope to identify positive clones and have preliminary fluorescent microscopy and proximity labeling data to present in time for the 2022 Summer Symposium.

Our findings could reveal other proteins that influence the activity of our proteins of interest, thereby informing future research seeking to manipulate adhesion, cell wall remodeling, or iron sequestration with novel antifungals. Because the proteins we are studying have homologues in other *Candida* and (for Phr1, Phr2, and CFEM2) non-*Candida* fungal pathogens, this knowledge and future therapeutics based

upon it could extend beyond *C. parapsilosis*. Furthermore, proteins we find to be associated with CpAls7, Phr1, Phr2, and CFEM2 could be the focus of further research characterizing the mechanics of fungal adhesion and the cell wall.

Kathryn Lee

Poster #D6

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Sean Monaghan, Division of Surgical Research; Alger Fredericks, Division of Surgical Research

Detection of e.coli infections in sepsis patients by optimizing RNA sequencing alignment software

Bacterial infections have a large contribution to mortality and morbidity rates in sepsis patients worldwide. The management of these bacterial infections increases in complexity as the global burden of antimicrobial resistance (AMR) in bacteria also grows. Fast and accurate diagnostic strategies for these infections and their AMR characteristics are essential for early and effective treatment. Although technologically advanced approaches such as RNAseq are not used in clinical settings due to their costly and time-consuming nature, they are becoming a key element in developing novel diagnostics and therapeutics that can be utilized in such contexts. With extensive computational resources to store and process sepsis patient data at hand, our lab has developed a novel RNAseq analysis pipeline in detecting the presence of bacterial infections and associated antimicrobial resistance that consists of two main steps. In the initial assessment, RNA reads from sepsis patients are aligned to a reference human genome to obtain unmapped reads. The second portion of the analysis entails mapping the resulting unmapped reads to reference pathogenic genomes and AMR genes, which enables the detection of infection and whether or not that infection exhibits AMR. The latter stage involves the issues of long mapping runtime and strict mapping criteria against the AMR genes, which greatly impacts the rate of and threshold for AMR detection. Here, we propose creating custom parameters in advanced RNAseq alignment software such as STAR and Bowtie2 to allow for more generous alignments and significantly decrease mapping runtime in detecting bacterial infections.

Kayleen Vicente

Poster #D7

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Amanda Jamieson, Molecular Microbiology and Immunology

Influence of SARS-COV-2 on F3 Expression in BEAS-2B Cells

The SARS-COV-2 virus, can, in severe clinical cases, lead to coagulation or formation of blood clots as well as obstruction of veins and arteries, which can have deleterious long-term effects. Among the most important players in coagulation are Tissue Factor (TF). TF is the initiator of the coagulation pathway and activates several key coagulation factors. We have previously shown that TF has been shown to be upregulated in SARS-Cov-2 infected epithelial cells.

The goal of the project is to determine how SARS-Cov-2 leads to TF expression. In the first part of the experiment, qPCR will be used to compare levels of F3 (gene that encodes tissue factor) in flu-infected, SARS-Cov-2 infected, and uninfected normal human bronchial epithelial cells (NHBECS). Secondly, we will use the lipofection method to transfect BEAS-2B cells, a bronchial epithelial cell line, with each of the

27 SARS-Cov-2 genes, analyzing the levels of F3 using qPCR.

At the current preparatory stage, the goal is to determine the optimum conditions for lipofection by conducting titration experiments in BEAS-2B cells with eGFP (Green Fluorescent Protein) followed by a flow cytometry assay. We are also creating a library of DNA plasmids of each SARS-Cov-2 protein using their corresponding glycerol stocks. Future directions include troubleshooting of titration experiments and lipofection of cells with individual proteins, followed by qPCR analysis focused on levels of F3 as well as the housekeeping control genes, GAPDH, and HPRT.

Kealyn Bowie

Poster #D8

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jess Plavicki, Department of Pathology and Laboratory Medicine; Michelle Kossack, Department of Pathology and Laboratory Medicine

Understanding the Impact of Juvenile Exposure to 2,3,7,8 Tetrachlorodibenzo-p-dioxin on Adult Heart Health

Humans are continuously exposed to environmental contamination through the air they breathe, the water they drink, and food they eat. Prior research demonstrates that exposure to environmental contaminants can adversely impact cardiac development and contribute to cardiovascular disease, the number one cause of death worldwide. Our lab is using the zebrafish model to study how exposure to the global contaminant 2, 3, 7, 8 tetrachlorodibenzo-p-dioxin (TCDD) during critical periods of development shapes heart health. TCDD activates the aryl hydrocarbon receptor (AHR), a ligand-activated transcription factor that has important roles in cellular detoxification and development. Previous research using multiple model systems as well as cell culture systems have demonstrated that exposure to AHR agonists during embryonic development disrupts cardiac development and function. Although there is significant growth and development during juvenile stages, few studies have examined how juvenile exposure to contaminants impacts adult heart health. To measure the impact of juvenile exposure to TCDD on cardiac health, we exposed zebrafish to environmentally relevant concentrations of TCDD for one hour at twenty and fifty days post-fertilization. We used a combination of electrocardiograms, echocardiograms, and histology to examine heart health at three, six, nine, and twelve months post-fertilization in TCDD-exposed and control fish. Electrocardiograms were used to assess if electrical conduction in the heart was disrupted after early exposure to TCDD. The electrocardiograms allowed us to measure P Duration (duration of atrial depolarization), the PR interval (interval of atrial filling), QRS interval (interval of ventricular depolarization), and RR interval (interval of time between heart beats). Our electrocardiogram data suggests that there is a significant sex-specific association between exposure and RR interval with age. We used echocardiograms to measure the A-Wave (flow of blood across the atrioventricular valve during atrial contraction), the Aortic Ejection Time (time taken for blood to flow through the aortic valve), and the E-Wave (volume filling the ventricle before atrial contraction). Our echocardiogram data indicates that exposure to TCDD reduced heart function and produced cardiovascular stiffening. Our results show that the juvenile heart is sensitive to environmental exposure and that exposure to TCDD during this stage affects adult heart health.

Kyle Lam

Poster #D9

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Anita Shukla, Biomedical Engineering

Characterization of gelatin nanoparticles in biological matrices

Biofilm infections are a rising concern due to their tendency of growing on medical implants and increased antibiotic resistance. Biofilms are a complex three-dimensional structure consisting of bacteria embedded within a matrix of self-secreted extracellular polymeric substances (EPS), such as extracellular DNA, proteins, and polysaccharides. This complex structure decreases the efficacy of antimicrobial treatment by many mechanisms, including hindering the diffusion of antibiotics throughout the biofilm. Biopolymer nanoparticles like gelatin nanoparticles (GNPs) are a promising candidate for the treatment of biofilms due to their biocompatibility, biodegradability, and low toxicity. GNPs can encapsulate antimicrobial therapeutic agents and penetrate the biofilm matrix, allowing treatments to diffuse further into the EPS. While nanoparticles are a promising antimicrobial agent delivery system, the mechanisms behind nanoparticle-biofilm interactions are not fully understood. This work aims to better understand and characterize the interaction of GNPs in biofilms by studying how GNPs degrade in biofilms over time. We accomplish this through two main steps: GNP synthesis and in vitro experiments. GNPs were synthesized through a two-step desolvation process and crosslinked with glutaraldehyde, and its physical properties were measured through dynamic light scattering (DLS) and zeta potential. In vitro experiments consisted of characterizing the growth kinetics of *S. aureus* and *S. epidermidis* with optical density measurement at 600nm (OD600) and colony enumeration and of testing their ability to produce gelatinases through gelatin hydrolysis assays. *S. aureus* is known to be a gelatinase-positive bacteria, while *S. epidermidis* is a gelatinase-negative bacteria, thereby allowing a comparison of GNP degradation in these two species. Biofilms were formed from both strains in glass and plastic wells, identified via crystal violet assays, and imaged using confocal microscopy. Preliminary results show that the synthesized GNPs have average diameters of 170.0 ± 1.7 nm with a mean polydispersion index of 0.2 ± 0.01 and zeta potential of 30.4 ± 0.9 mV. The gelatinase hydrolysis tests confirmed that *S. aureus* 25923 produces gelatinase. Growth kinetics for both strains were analyzed by measuring OD600 and counting cell forming units (CFU). Future work includes characterization of GNP-biofilm interactions through confocal microscopy imaging.

Kyoko Leaman

Poster #D10

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Theresa Desrochers, Department of Neuroscience, Robert J. and Nancy D. Carney Institute for Brain Science, Psychiatry and Human Behavior; Brown University

Testing the effect of experience on abstract sequential processing in nonhuman primates

To complete everyday tasks, humans must process complex sequences of information, which requires tracking their progress through a series of steps towards a goal. These sequences may range from unfamiliar (e.g., observing the landmarks one passes on a new bus route) to highly familiar (e.g., tracking the buildings one passes on their daily commute). Research in both human and nonhuman primates shows that the lateral prefrontal cortex is an essential brain region for tracking position within a sequence. Preliminary data from the Desrochers Lab finds that activation in the dorsolateral prefrontal cortex (dlPFC) in monkeys is affected by unexpected deviations from a known sequence of images. It is unclear, however, whether the level of prior experience with these visual sequences modulates the neural activity associated with sequence processing.

We investigated the effect of prior experience on neural activity elicited by sequence viewing using

functional magnetic resonance imaging (fMRI) data from awake, behaving macaque monkeys. In two tasks, macaques viewed four-item sequences composed of either high or low familiarity stimuli. In two additional tasks, the same sets of sequence-associated stimuli were presented in a random order, along with high or low familiarity images that had never appeared in a sequence (sequence-unassociated). We hypothesize that the dlPFC will show higher activation in response to sequences containing highly familiar stimuli than less familiar stimuli. Additionally, we hypothesize higher dlPFC activation in response to sequence-associated stimuli than sequence-unassociated stimuli when both are presented in a random order.

Preliminary results show that dlPFC activity is significantly higher when viewing highly familiar sequence-associated stimuli than -unassociated stimuli. In contrast, stimuli with low familiarity do not show significant differences in activity between sequence associated and -unassociated in the dlPFC. This pattern suggests a possible interaction between stimulus familiarity and association to sequences. In future studies, we will use region of interest (ROI) analyses to compare dlPFC activation levels more precisely between tasks to better understand these differences in activation.

Leanna Bai

Poster #D11

Home Institution: Brown University

Summer Research Program: NSF-funded undergraduate summer research experience

Faculty Mentor: Nicolas Fawzi, Molecular Biology, Cell Biology, and Biochemistry

Assessing the Impact of ALS-Associated Mutations on TDP-43 CTD Aggregation Capacity and Interactions

Throughout the world, neurodegenerative diseases affect millions and are one of the leading causes of death and disability. It is known that these conditions, namely amyotrophic lateral sclerosis (ALS), Alzheimer's disease related dementias (frontotemporal dementia (FTD); limbic-predominant age-related TDP-43 encephalopathy (LATE)), as well as some forms of Alzheimer's disease, can be characterized by intracellular protein aggregation, specifically that of the human TAR DNA-binding protein of 43 kDa (or TDP-43), which is involved in alternative splicing, transcriptional control, mRNA stability, and other aspects of RNA regulation. A variety of mutations in the aggregation-prone domain of this protein have been implicated in both familial and sporadic forms of ALS and frontotemporal dementia (FTD), and as a result, TDP-43 has garnered substantial interest for its consequential role in the development of Alzheimer's disease related dementias and other forms of neurodegeneration. This protein has additionally been thoroughly examined as an important target for the development of therapeutics combating these diseases, specifically its C-terminal domain, in which ninety percent of ALS-associated mutations in TDP-43 are located. Although the significance of TDP-43 has been widely regarded, little is known about its dynamic self-interactions; the development of strategies to treat ALS has been hindered by insufficient understanding of TDP-43's atomic structure, as well as the difficulty of observing its aggregation-prone complexes. I hypothesize that the disease mutations that lie in a "hotspot" from residues 378-390 in the C-terminal domain of TDP-43 — N390D, W385G, D378-390, G384R, S379C, N378D, and S379P — alter the protein's propensity for aggregation and phase separation. In particular, the well-known familial ALS mutations G384R, N378D, and S379P are more likely to induce aggregation than the other mutations, which may be found in sporadic cases of ALS and are more likely to be associative than causative. I will determine the impact of these seven ALS-associated mutations on the 378-390 region as well as the C-terminal domain's interactions and dynamics. Elucidating the effect of these mutations on the protein's structure and dynamics will contribute to a further mechanistic understanding of its function and applicability in therapeutics for neurodegenerative diseases.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Justin Fallon, Neuroscience

Characterization of Spatial Memory in a Mouse Model of Increased Hippocampal Neurogenesis

Adult hippocampal neurogenesis (AHN) is an important mechanism for normal learning and memory. AHN is impaired in Alzheimer's Disease and other neurological diseases, including major depression, suggesting that boosting neurogenesis could be a treatment for these disorders. BMP (bone morphogenetic proteins) signaling is known to inhibit AHN, thus interventions that reduce BMP signaling could promote AHN. In previous studies, our lab identified MuSK (muscle-specific kinase) as a BMP co-receptor that augments BMP signaling. The Ig3 domain of MuSK is required for its high-affinity binding to BMP and the activity of the MuSK-BMP pathway. Using CRISPR-Cas9, we created a mouse model that constitutively lacks the MuSK Ig3 domain and exhibits increased hippocampal neurogenesis. In my project, I am performing a series of behavioral experiments to assess whether the down-regulation of the MuSK-BMP pathway, and the subsequent increase in neurogenesis, results in improved spatial learning and memory. Our long-term goal is to better understand the behavioral implications of MuSK-BMP pathway manipulation and shed light on its potential application for the treatment of Alzheimer's, as well as other neurodegenerative and neuropsychiatric disorders.

Home Institution: Rutgers University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Sonia Mayoral, Department of Neuroscience, Carney Institute for Brain Science, Brown University

Investigating myelin's effects on Wallerian degeneration in the CNS.

Myelin is an insulating sheath that wraps axons and allows for quick and efficient electrical communication between neurons. Made by specialized glial cells known as oligodendrocytes, it is critical to proper nervous system function. Myelin has also been implicated in being neuroprotective since its loss can lead to neurodegeneration in demyelinating diseases such as Multiple Sclerosis (MS). How this protection is conveyed remains unknown. In order to better understand myelin's neuroprotective actions, we have developed a mouse model of partial optic nerve myelination using Cre-lox technology in which myelin fails to develop along the distal nerve regions. Using this model, we tested whether myelin is protective against Wallerian Degeneration (WD), a well-characterized form of degeneration that affects transected axons. First, we crossed partially myelinated optic nerve mutants to Thy-1.1-YFP^h transgenic mice, whose optic nerve axons are sparsely labeled with a fluorescent protein. Next, we performed monocular enucleations on adult mutants and fully myelinated littermate controls. Six days later, transected and intact optic nerves were collected and processed for immunohistochemical analysis and fluorescence imaging. FIJI was used to measure each nerve's corrected total fluorescence (CTF) and axon fragment lengths. Quantifying CTF indicated no significant differences among experimental groups, although differences were apparent. Measurements of fragment length revealed significantly shorter fragments in enucleated mutant nerves versus enucleated controls, indicating that WD progresses faster in partially myelinated nerves, thus supporting a neuroprotective role for myelin. Additional analyses and

subsequent experiments will clarify how myelin may protect from axon degeneration.

Madison Liesching; Jacob `Eberson; William Connolly

Poster #D14 & #D15

Home Institution: Vassar

Summer Research Program: Summer Research Program, Weiss Lab

Faculty Mentor: Dioscaris Garcia, Department of Orthopedic Surgery; Christopher Born, Department of Orthopedic Surgery

Antimicrobial Efficacy of Silver-Carboxylate against Drug-Resistant Pathogens in the Context of Prevention of Lower Spinal Infections by Enterococcus Faecalis

Introduction

Post-operative surgical site infections (SSI) are an increasingly common complication and a serious threat to patients¹. SSIs can lead to life-threatening health issues and are becoming more difficult to treat due to antibiotic resistance.² One main cause of SSIs is the Vancomycin-resistant pathogen *Enterococcus Faecalis* (*E. Faecalis*) which frequently occurs in the lower spine.³ Previous studies have indicated that silver carboxylate has the potential to combat drug-resistant pathogens.⁴ In this study, we aim to determine the efficacy of silver carboxylate released via a titanium dioxide-polydimethyl siloxane (TiO₂-PDMS) matrix against *E. Faecalis* while maintaining cell viability in keratinocytes and osteoblasts.

Materials and Methods

E. faecalis was grown overnight to a concentration of 1e7 CFU/mL. Dose response curves (DRCs) and Kirby Bauer (KB) assays were used to assess bactericidal efficacy of various conditions including Vancomycin, Linezolid, Tobramycin and Polymyxin in both 1x and 10x concentrations, and silver in the forms of silver carboxylate, 100% silver and nanosilver in the amounts of 10nM and 30nM against *E. faecalis*.

Keratinocytes and osteoblasts were cultured on 96-well plates at 1e5 cells per well. MTT and LDH assays were utilized using the same conditions as the bacterial assays to assess cell viability and cytotoxicity.

Results

The DRCs showed that a 10X concentration of silver carboxylate was the most effective of the silver treatments against *E. Faecalis*, (OD = 0.083 ± 0.028). Linezolid 10X (OD = 0.056 ± 0.001) was the only condition that was more effective.

The MTT assays indicated that in both osteoblast and keratinocytes, 1X silver carboxylate exhibits the largest cell viability results of all of the silver conditions, which is lower than our tested antibiotics

Conclusion

Although the silver carboxylate is effective, our results indicated that it does not kill *E. Faecalis* as well as current antibiotics. Further, it poses a greater risk to nearby cells and therefore does not represent a perfect replacement for antibiotics. However, our results indicated a potential for silver carboxylate to be used should antibiotic resistance increase.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Mamiko Yajima, Molecular Biology, Cell Biology and Biochemistry

Functional Contributions of Phase Separation in Sea Urchin Embryogenesis

Liquid-Liquid Phase separation (LLPS) is the biochemical process that allows molecules to form granules when the interactions between each other are more thermodynamically favorable than between them and the solvent. Recently, phase separation is proposed to contribute to various intracellular events such as the organization of cellular organelles involved in asymmetric cell division (ACD) and the localization of cell fate determinants during ACD. However, the mechanistic detail for LLPS function and direct contributions to ACD is still limited. Here, to uncover how LLPS may occur and contribute to ACD of embryonic cells, we used the sea urchin embryo as a model system. The sea urchin embryo undergoes its first apparent ACD at the 8-16-cell stage, through which the smaller cells called micromeres are formed at the vegetal pole. In this vegetal pole, various polarity factors such as AGS and Gai, fate determinants such as Vasa become enriched during ACD, which is known to be critical for successful micromere formation. Importantly, many of these factors at the vegetal pole have intrinsically disordered regions within their protein structures, which is one of the proposed elements that cause LLPS. Indeed, AGS and Vasa form granules, the major indication of LLPS. We, therefore, hypothesize that the asymmetric enrichment of these proteins is aided by phase separation. To test this hypothesis, we treated embryos with various chemicals that are reported to inhibit or enhance LLPS and stress granule formation in various model systems. These chemicals include glycerol and sodium azide, inducers of the formation of stress granules, 1,6-hexanediol, an inhibitor of LLPS, and emetine, a reducer of stress granules. Using immunofluorescence, confocal microscopy, and FIJI software, we quantitatively analyzed the distributions and granule formation of Vasa and AGS proteins in the treated embryos to determine the effects of each inhibitor treatment.

Future directions include identifying how the granule formation is regulated through the interactions with other proteins such as Tudor-domain-containing proteins and PIWI proteins that are reported to function with Vasa through the functional assays, and how that contributes to ACD regulation and overall embryonic development.

Home Institution: Florida State University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Stephanie Jones, Robert J. & Nancy D. Carney Institute for Brain Science

Simulating the cellular and circuit dynamics of current source density measurements using the Human Neocortical Neurosolver

Magneto- and electro-encephalography (M/EEG) are powerful imaging modalities for studying fast timescale human brain activity. Yet, the microscale cell and circuit origin of M/EEG signals remains difficult to infer and interpret. Bridging this divide, the Human Neocortical Neurosolver (HNN) is a neural modeling software that simulates the current sources underlying M/EEG with a neocortical column model that includes multiple cortical layers. HNN serves as a simulation toolbox, allowing researchers to test novel hypotheses on the neural dynamics underlying healthy and pathological brain processing. However,

to do this effectively, HNN must be able to compare simulated data types to empirical data types including M/EEG current dipole inverse solutions, local field potential (LFP) and current source density (CSD). Here, we incorporated new functionality into HNN for the simulation and visualization of LFP and CSD signals alongside each other. Specifically, we developed a collection of functions that translate an array of simulated laminar voltage potential measurements into CSD, which allows for the determination of the originating sources and sinks that contribute to the extracellular field. This functionality can be used to further interpret, test, and validate the neural dynamics of extracellular events simulated in neural networks, particularly as they relate to empirically measured brain dynamics.

Meghan Gormley

Poster #E1

Home Institution: Brown University

Summer Research Program: Medical University of South Carolina - Summer Undergraduate Research Program

Faculty Mentor: Nancy DeMore, Surgical Oncology

Secreted frizzled-related protein 2 is involved in pancreatic cancer and regulated by KRAS

Secreted frizzled-related protein 2 (SFRP2) is associated with tumor growth. SFRP2 induces angiogenesis, inhibits tumor cell apoptosis, and induces T-cell exhaustion. Pancreatic cancer has one of the highest associations with the SFRP2 protein and the high levels of SFRP2 are associated with a significant decrease in the chances of disease free survival. The most prominent mutation in human pancreatic cancer is the KRAS gene, a mutation that occurs in more than 90% of tumors. Through the inhibition of key proteins in the KRAS mutation pathway, we measured SFRP2 expression in relation to known downstream proteins. The goal was to determine the role and relationship of SFRP2 in the KRAS pathway and thus the role of SFRP2 in pancreatic cancer. The levels of expression of SFRP2 and downstream proteins were analyzed by western blot analysis in PANC-1 and MIA-PaCa cells. In PANC-1 cells treated with KRAS inhibitor MRTX1133 for various time points, SFRP2 expression followed the trend of downstream proteins ERK and Phospho-ERK indicating that SFRP2 regulation is related to the pathway. When KRAS was inhibited SFRP2 levels decreased by 50% at 4 hours. SFRP2 levels also decreased with the inhibition of other key downstream proteins in the KRAS pathway, such as ERK, MEK, and RAF, further proving the relationship. The regulation of SFRP2 is closely related to that of KRAS which is the primary mutation in pancreatic cancer patients, indicating that SFRP2 plays a key role in the development and progression of human pancreatic cancer.

Melissa Aldana: Claire Gray

Poster #E2

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Erica Larschan, MCB

Identifying key drivers of gene regulatory networks in male *Drosophila*

Precise and coordinated regulation of gene expression during growth and development is essential for the viability of all organisms and to prevent diverse diseases ranging from cancer to neurodegeneration.

Chromatin domains coordinate gene expression by concentrating key factors at specific genomic locations in a context-specific way to concordantly activate or repress groups of genes. Before zygotic

genome activation (ZGA), chromatin domains have not yet formed and only a few key transcription factors (TFs) are bound which are called **pioneer TFs**. Pioneer TFs have the ability to bind to closed chromatin, recruit chromatin remodelers to open chromatin, and target additional transcription complexes. Furthermore, pioneer TFs are critical for cellular reprogramming and are often reactivated in cancer. Pioneer TFs can regulate the formation of active and repressive chromatin domains which form after ZGA. *However, the fundamental mechanisms by which chromatin domains are formed at the correct genomic locations across time and space remain unknown.* One example of a conserved active chromatin domain is the hyperactivated single male X-chromosome in *Drosophila*, which coordinately upregulates thousands of genes two-fold to equalize transcript levels with the two autosomes. My preliminary data suggest that the interaction between an essential pioneer TF and a large transcription complex is important to target this active chromatin domain specifically to the X-chromosome. Therefore, I will use the Cleavage Under Targets and Release Using Nuclease (CUT and RUN) approach to define new mechanisms by which a pioneer TF nucleates the formation of an active chromatin domain that upregulates the male X-chromosome over time and space.

Michael Jia: Joyce Gao

Poster #E3

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: David Sheinberg, Neuroscience

Visual integration of shape and motion

Shape and motion are two of the most important factors that are combined in the perception and recognition of visual objects. With our project we aim to study the relationship between the ventral “what” and dorsal “where” pathways. Are the two pathways inherently interconnected, or can they be consciously separated? If they are interconnected, what are their relative weights in object recognition, and how are these weights modulated by attention? In this project, we use a modified Stroop task that pits equally salient motion and shape stimuli against each other. To do this, we overlay an arrow shape on a random dot motion task. By controlling the congruency between the directions signaled by the arrow and random dot motion, as well as the participants’ attention to either stimulus, we hope to better understand the relationship between shape and motion. Together, we hope these experiments can shed light on how the brain integrates information from multiple pathways to create a coherent representation of objects in the world.

Miyoly Alvarado Álvarez

Poster #E4

Home Institution: University of Puerto Rico at Cayey

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Alexey V. Fedulov, Department of Surgery

Epigenetic Editing: DNA Demethylation in the Promoter of Cxcl11 Gene

DNA methylation plays a critical role in epigenetic silencing of transcription and de-methylation of key regions leads to transcriptional enhancement. Because any cell in an organism contains all genes of that organism’s genome, the ability to specifically demethylate key regulatory sequences of silenced genes

could be therapeutically beneficial for numerous disorders. Many environmental exposures cause harm through epigenetic effects, but a challenge in the field has been to prove the causative/mechanistic importance of such exposure-related methylation changes. The problem stems from lack of molecular tools to specifically demethylate an epigenetic target sequence. Here we designed and generated recombinant zinc finger -fused demethylases selectively targeting a single gene promoter and tested their effect on a sample target Cxcl11 by evaluating methylation change and modified transcriptional responsiveness to IFN stimulus. The demethylation effect on epigenetic target sequence was confirmed in vitro using NIH-3T3 and MLE-12 cells. During in vivo experiments in mice, low epithelial cell yield and 'preciousness' of the epigenetically acting proteins posed a challenge for accurate detection of CXCL11 at the mRNA level. Through a series of real-time PCR experiments, to optimize thermal cycling conditions for low-abundance target detection, we comparatively tested 3 PCR chemistries: SYBR Green approach, single- and multi-plex TaqMan probes. We found the SYBR Green design provided the most reliable and accurate detection of CXCL11, template amount and annealing temperature being critical variables. Zinc finger -fused demethylases can effectively edit the epigenetic status of Cxcl11 promoter leading to substantial transcriptional enhancement in response to IFN stimulus.

Muneet Gill

Poster #E5

Home Institution: Brown University

Summer Research Program: Undergraduate Research Assistant

Faculty Mentor: Anne Hart, Neuroscience

Investigation of a genetic suppressor of ALS-associated neurodegeneration in a sod-1 *C. elegans* ALS model

Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative disease that is characterized by the loss of cholinergic spinal and glutamatergic cortical neurons. Mutations in over 25 genes can cause this disease, but approximately 20% of genetic ALS cases are linked to mutations in the superoxide dismutase 1(SOD1) gene. My goal is to explore genetic mutations that decrease motor neuron degeneration, which will help reveal the mechanisms underlying ALS. These genes are known as genetic suppressors. In this project, I will examine a recently identified suppressor gene in the nematode *C.elegans*.

Thus far, researchers in Dr. Hart's laboratory have created single-copy models of ALS in *C. elegans*—including a patient allele, G85R, found in the SOD1 gene in ALS patients. They carried out a forward genetic screen for suppressors of glutamatergic neuron degeneration in the sod-1G85R model. This screen identified a gene whose loss of function suppressed both glutamatergic and cholinergic neuron degeneration, called geneX herein. However, we are unsure if geneX loss of function (geneX(lf)) suppresses cholinergic neuron degeneration in other sod-1 models. The A4V mutation is a common SOD1 mutation causing ALS. The *C. elegans* sod-1A4V model shows cholinergic neuron degeneration. I will create a double mutant strain by crossing geneX(lf) onto the sod-1A4V background and will make the corresponding control strains. By creating this double mutant strain, I will be able to explore and potentially answer my research question: "Does geneX(lf) suppress cholinergic neuron degeneration in the sod-1A4V model?"

Since geneX(lf) suppresses cholinergic neuron degeneration in the sod-1G85R model, I hypothesized the same suppression would be observed in the sod-1A4V model. However, my results indicate that geneX(lf) may not suppress cholinergic neuron degeneration in the sod-1A4V model. While the sod-1A4V strain was not statistically significantly different than the sod-1A4V;geneX(lf) strain, the sod-1WT;geneX(lf) strain

was also not statistically different than the sod-1A4V;geneX(lf). These contradictory results imply that my experiment's power was not strong enough to elucidate a conclusion. By reevaluating my experiment strategy and methods, I will be able to achieve my goal of better understanding the mechanisms underlying ALS spinal motor neuron degeneration. Promising results open up opportunities to explore potential treatments for this disease.

Mylena Corona

Poster #E6

Home Institution: University of California, Davis

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Emine Yalcin, Pathology and Laboratory

Effects of Chronic Cigarette Smoke and/or Alcohol Exposures on Lung Pathology

Chronic heavy alcohol consumption and daily cigarette smoking are the most prevalent addictive substance abuse disorders in veterans. Long-term cigarette smoking causes chronic obstructive pulmonary disease (COPD), which is characterized by chronic inflammatory condition, alveolar damage and destruction (emphysema), and obstruction of the small airways. Despite concurrent dependence, interactions between tobacco and alcohol on lung damage remain understudied. This study investigates how individual and combined exposures to these substances affect lung structure using the mean linear intercept (MLI), a measure of the mean free distance between gas exchange surfaces in the acinar airway complex. A 4-way, 9 week-long experimental model chronic cigarette smoke and alcohol exposure was generated using rats that were pair-fed with isocaloric liquid diets containing 0 or 24% ethanol. Half of the rats in the control and ethanol groups were exposed to CS for 4 days/week. After treatment, rats were sacrificed and lungs were fixed via instillation of formalin. Lungs were paraffin-embedded, sectioned, and stained for histological assessment. For MLI quantification, 10 fields were laid over the lung section. Fields were cropped at 20x and overlaid with horizontal and vertical test lines 45 μm apart. Chords intersecting alveolar septa were measured using FIJI-Image J software. The analysis is still ongoing. Once the data is collected, the average MLI of each group will be calculated to determine whether there is a significant difference in the MLI between rats in each exposure and/ or control group. The conclusions drawn from this study will build upon the well-known link between lung damage and cigarette smoke and will shed a light on the combined effect of alcohol and cigarette smoke on lung pathology.

Neal Yin

Poster #E7

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Daniel Weinreich, Ecology, Evolution, and Organismal Biology

Simulating bet hedging strategies of native and exotic annual plants

Environmental instabilities call for organisms to develop various adaptation strategies in order to maintain long term survival. Bet hedging is one such strategy aiming at reducing risks of extinction under a rapidly changing environment, occurring when a population sacrifices its short term mean fitness in order to minimize variance in fitness in the long run. For example, some annual plant bet hedgers may leave a portion of new seeds dormant each year, so that those dormant seeds can still germinate after a drought wipes out all adult population. In Rhode Island, native annual plants need to adapt to the varying climate

as well as face competition from invasive species. Insight into the extent to which both native and invasive annual plants hedge their bets through delayed seed germination can be important to better understand the preservation of native species in the face of climate change. However, due to variation in collection methods as well as non-exhaustive coverage on New England plant species, seed germination data are hard to estimate on a consistent scale. In order to address this gap, we use stochastic modeling to estimate the optimal bet hedging behavior—that is, seed germination rate—of typical native and invasive annual plants. The results show differentiating patterns in optimal seed germination rates of native and invasive annual plants, which may shed light on the relationship between climate change and the local topology of biodiversity as well as policy making in regards to native species preservation.

Nicole Dennis Talley

Poster #E8

Home Institution: Brown University

Summer Research Program: Summer Undergraduate Research Assistant

Faculty Mentor: Anne Hart, Neuroscience; Alexander Lin-Moore, Neuroscience

Developing New Degeneration Assays in the sod-1G85R Model for Amyotrophic Lateral Sclerosis

Amyotrophic Lateral Sclerosis (ALS) is a devastating motor neuron disease that results in the progressive degeneration and loss of both upper and lower motor neurons. The Superoxide Dismutase 1 G85R (SOD1 G85R) mutation primarily affects cholinergic and glutamatergic neurons in humans, and the sod-1 G85R model in *C. elegans*, also shows selective degeneration of cholinergic and glutamatergic neurons (Baskoylou et al, 2018). Current degeneration assessment protocols used in this system cannot readily detect changes in neuronal processes. The goal of this project is to develop alternative methods to assess degeneration in the *C. elegans* model for glutamatergic and cholinergic neurons. The mutant sod-1 G85R mutation will be crossed into strains that express fluorescence in previously unexamined glutamatergic and cholinergic neurons. Animals without the sod-1 G85R mutation will be compared to animals with the sod-1 G85R mutation using a high-powered imaging microscope. If a difference exists between mutant and wild-type sod-1 worms, then the alternative assay developed here can be used in future studies to accelerate studies of ALS in this model system.

Nina Li

Poster #E9

Home Institution: Brown University

Summer Research Program: Research Engineer working in the Tripathi Lab

Faculty Mentor: Anubhav Tripathi, Professor of Engineering & Professor of Biology and Medical Sciences

Development of an electrokinetic microfluidic platform for the detection and characterization of dsRNA contaminants in mRNA vaccines

The importance of messenger RNA (mRNA) vaccines can be seen with its role in reducing morbidity and mortality during the COVID-19 pandemic. However, one of the persisting challenges facing large-scale production of mRNA vaccines is formation of contaminants, including double-stranded RNA (dsRNA). dsRNA is produced as a byproduct of use of T7 RNA polymerase during in vitro transcription of mRNA. The detection of dsRNA in the body can trigger pro-inflammatory immune response as well enhance mRNA degradation, which would reduce vaccine effectiveness. There also appears to be a positive correlation between dsRNA fragment length and associated negative effects. Current purification platforms and detection platforms fail to be up-scaled or are costly when done so.

This project aims to develop a fast, high throughput, low-cost quality control system using a microfluidic device. The GX Touch II LabChip system was chosen, and a protocol calling for no heating and the testing of each sample by one RNA dye and one DNA dye was developed. Various dye concentrations were tested to find the optimal dye conditions for differentiation based on a single-stranded RNA (ssRNA) and dsRNA ladder. Then the hypothesis of dsRNA being identified by the ratio (Peak Area by DNA: Peak Area by RNA Dye) > 1 and mRNA/ssRNA being identified by the ratio (Peak Area by DNA: Peak Area by RNA Dye) < 1 was tested using custom long mRNA and dsRNA fragments. Results demonstrated that we were able to differentiate the dsRNA contaminant based on this method. dsRNA was also found to travel much faster than mRNA of the same length. Migration time was plotted against fragment size, creating a potential method to approximate the size of the detected contaminant.

The mobilities of genetic materials under electric fields were studied as well as their interactions with different dye materials. A potential method of mRNA vaccine quality control was tested in a scalable, efficient, and effective way requiring only tiny samples amounts.

Nina Magid

Poster #E10

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jessica Plavicki, Pathology and Laboratory Medicine

Understanding the function of sox9b in the development of the cardiac conduction system

SOX9 is a transcription factor dynamically expressed during development with pleiotropic functions during organogenesis. Mutations in SOX9 cause a rare genetic disorder called campomelic dysplasia (CD) which is usually embryonically lethal. Individuals with CD who survive postnatally have serious congenital defects affecting the heart, skeleton, brain, and gonads. The role of mammalian Sox9 in gonadal and skeletal development has been well studied; however, comparatively little is known about how Sox9/SOX9 function shapes cardiac development. Understanding SOX9 function in cardiac development is essential for diagnosing and treating congenital defects. Our lab uses the zebrafish model to understand the roles of sox9b, an ortholog of human SOX9, in cardiac development. We previously found that sox9b is expressed in the developing heart, the mature heart, and the vagal nerve which innervates the heart. Loss of sox9b function caused by a dominant negative construct (dnsox9b) disrupts cardiac morphogenesis and function, specifically resulting in an abnormal heart rhythm and impaired cardiac output. We hypothesize that observed changes in cardiac rhythm and contractility result from disrupted development of pacemaker cells, an essential component of the cardiac conduction system. Relatively little is known about transcriptional hierarchies that regulate development of pacemaker cells. We further hypothesize that loss of sox9b function disrupts planar cell polarity, leading to abnormal heart contraction and reduced cardiac output. Here, we performed fluorescent immunohistochemistry and confocal microscopy to image the organization of cardiomyocytes in the hearts of zebrafish embryos with dnsox9b expressed specifically in cardiomyocytes, and age matched sibling controls with unaltered sox9b function. Preliminary results show marked differences between dnsox9b embryos and controls in cardiomyocyte organization, size, shape and orientation at 3 days old. We are exploring methods to quantitatively describe the difference in cardiomyocyte phenotypes caused by dnsox9b expression. In addition, we are performing fluorescent in situ hybridization to examine whether the pacemaker node develops properly when sox9b function is lost in cardiomyocytes. We find that sox9b affects arrangement of cardiomyocytes, furthering our understanding of the role of sox9b in the cardiac conduction system, and contributing to understanding the etiology of CD and other congenital defects.

Home Institution: Tougaloo College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Dioscaris Garcia, Department of Orthopaedics; Christopher Born, Department of Orthopaedic Surgery

The Efficacy of Silver Carboxylate on Multidrug Resistant *Acinetobacter baumannii* Infections Common in Military Wounds and its Safety in Human Skeletal Muscle Cells

According to the World Health Organization, the increased presence of pan-resistant strains of bacteria are rendering antibiotics ineffective.[1] The inappropriate and excessive use of antibiotics amplified the rapid evolution of resistance, contributing to the need for antibiotic-independent therapeutics. Recent studies have shown that new antibiotic-independent antimicrobials, like antimicrobial peptides and zinc oxide, may not be optimal for human use.[2] Thus, silver has been the focus of renewed interest in combating antibiotic resistance due to its multimodal antimicrobial mechanisms. Our lab has developed a novel antimicrobial coating, utilizing titanium dioxide (TiO₂) and polydimethylsiloxane (PDMS) hybrid matrix to diminish silver toxicity through the controlled elution of silver carboxylate. This coating has successfully eliminated biofilm formation and certain multidrug-resistant (MDR) bacteria.[3,4] The current study aims to find the effectiveness of silver carboxylate against MDR *Acinetobacter baumannii* and the safety of the coating on human skeletal muscle cells (SkMC). *A. baumannii* is the leading cause of wound infections amongst injured service members.[5] Further, we hypothesize that silver carboxylate will combat *A. baumannii* growth while eliciting minimal harm to SkMC. SkMC were cultured on 96-well plates at 1e5 cells per well. Cell viability and cytotoxicity were assessed using the MTT and LDH assays, using increasing concentrations of silver carboxylate, antibiotics (Vancomycin, Linezolid, Tobramycin, and Polymyxin E), and crude nanoparticle and colloidal silver formulations. The negative controls (media blank and TiO₂/PDMS matrix-only) and positive controls (1% Triton X and 100% silver carboxylate with no matrix) were also utilized. The Kirby Bauer assays at 1e7 CFU/mL assessed bacterial susceptibility to the same conditions and controls by analyzing the zones of inhibition (ZOI) via ImageJ. Dose-response curves were produced. The data shows similar or higher cell viability for 1X silver carboxylate-eluting 95% TiO₂/PDMS coating compared to antibiotic and pure silver conditions. ZOIs of *A. baumannii* were significantly larger for 1X and 10X silver carboxylate than the antibiotics and crude silver formulations. Ultimately, these data suggest that silver carboxylate in lower concentrations is effective against *A. baumannii* infections and safe for human SkMC.

Home Institution: State University of New York at Fredonia

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Sheldon Holder, Department of Pathology and Laboratory Medicine, Warren Alpert Medical School of Brown University; Ali Amin, Department of Pathology and Laboratory Medicine, Warren Alpert Medical School of Brown University

The Effect of Androgen Signaling on Cisplatin/Gemcitabine Chemotherapy Resistance in Bladder Cancer

The American Cancer Society estimates that in 2022 over 81,000 cases of bladder cancer (BC) will be

diagnosed, and over 17,000 deaths related to BC will occur. In addition, studies have shown that men have an increased risk of developing BC compared to females, even when smoking and environmental exposure are considered. In prostate cancer, androgen receptor (AR) plays a vital role in the progression of tumors. AR binds to its ligands to become active before migrating to the nucleus to regulate the transcription of target genes. These genes include growth stimulators, transcription factors, cell cycle regulators, and metabolic enzymes. Additionally, it seems AR contributes to the epithelial to mesenchymal transition and cisplatin-based chemotherapy resistance.

Three different cell lines were generated using the BC cell line UMUC3. The parental cell line was grown in media containing charcoal-stripped FBS. UMUC3-FBS was a second cell line grown in media containing standard FBS. Finally, UMUC3-R1881 was generated by growing the cells in media containing ~2nM R1881 (synthetic androgen). Immunohistochemistry was performed on the three cell lines to determine the expression of AR and Ki-67. The cell lines were also challenged with chemotherapy drugs (cisplatin and gemcitabine) and R1881 in a scratch assay to determine the effect of androgen on chemosensitivity and cell migration. Tissue samples collected from patients with muscle-invasive bladder cancer pre and post-chemotherapy treatment were analyzed using IHC to determine the degree to which AR positivity affects response to chemotherapy.

Peter Gonzalez

Poster #E13

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Anita Shukla, Engineering; Ronnie LaMastro, Engineering

Synthesis and Characterization of Voriconazole Encapsulated PLGA Nanoparticles for Treatment of *Aspergillus* Infections

Fungal infections are a growing health concern due to limited available treatments and an increase of at-risk patients, including the elderly, immunocompromised, and transplant recipients. One such opportunistic pathogen, *Aspergillus fumigatus*, takes advantage of reduced immune function in order to colonize the alveolar region of the lungs. Furthermore, the virulence and mortality of *Aspergillus*-related infections worsen in patients with pulmonary illnesses such as cystic fibrosis, chronic obstructive pulmonary disorder (COPD), and pneumonia. Existing antifungal treatments pose several concerns such as cytotoxicity, high dose requirements due to hydrophobicity, and emerging resistance. Polymeric nanoparticles offer a means of entrapping hydrophobic therapies to reduce the amount of administered therapeutic required to clear fungal burden by reducing off-site delivery. In addition, the size and mass of these particles are highly tunable which allows for effective deposition of therapeutics into the alveoli and prevention of rapid immune clearance. In the present study, voriconazole, a first-line defense antifungal therapeutic utilized in treating *Aspergillus*-related infections, was encapsulated in poly lactic-co-glycolic acid nanoparticles (PLGA NPs). These NPs exhibited a spherical morphology as confirmed through scanning electron microscopy (SEM). A mean hydrodynamic diameter determined via dynamic light scattering (DLS) of 127.7 ± 2.7 nm and zeta potential of -31.4 ± 2.7 mV were measured for blank particles. When voriconazole was incorporated into the NPs, the mean hydrodynamic diameter increased to 337.8 ± 29.4 nm and zeta potential was comparable at -25.8 ± 5.39 mV, respectively. Future studies will aim to determine the encapsulation efficiency and improve it if needed by optimizing the organic solvent and the initial concentration of the drug in said organic solvent, in addition to comparing the MIC of this voriconazole, encapsulated nanoparticles to that of free voriconazole. We expect that the concentration of nanoparticles required to eradicate fungal growth will be comparable to that of free voriconazole, but with reduced cytotoxicity to mammalian cells due to the decreased off-site delivery provided by the PLGA NPs.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Erica Larschan, Molecular Cellular Biology and Biochemistry; Mukulika Ray, Molecular Cellular Biology and Biochemistry

Transcription Factor CLAMP Regulates Sex-Specific Splicing

Chromatin-linked adaptor for male-specific lethal (MSL) proteins (CLAMP) is a maternally deposited transcription factor which is a DNA/RNA binding protein that regulates dosage compensation in males and early embryonic sex-specific splicing in both males and females. However, the question remains if CLAMP also regulates sex-specific splicing during later development. In the brain, extensive alternate splicing results in sex-specific variations, reported in a wide range of organisms from flies to humans. Although earlier studies in the lab showed CLAMP binds to spliceosome components, the role CLAMP plays in the function of the splicing complex remains unclear. Since understanding the role of a TF like CLAMP in post-transcriptional RNA processing in splicing would help reveal mechanisms of co-transcriptional splicing - an important component of gene regulation - I investigated the role of CLAMP in sex-specific splicing throughout development, especially in the brain.

I computationally analyzed RNA-seq data from cell lines, whole third instar larvae (L3), and brain of L3 and adult flies. I compared control samples down-regulating CLAMP using the RNAi technique as well as different CLAMP mutants in these sample groups. To understand the context specific role of CLAMP, mutants with different deletions of CLAMP domains were created. In this study, I have focused on the Q-Rich Prime Like Domain (PRLD) which is reported to be essential for RNA binding proteins (RBD). I also validated my computational results using qRT-PCR and RT-PCR.

I found that CLAMP played a significant role in sex-specific splicing in later development in both Males and Females from all samples. Specifically, mutants gave rise to new sex specific splicing events when compared to Control samples which supports CLAMPs role of inhibiting aberrant splicing. Similarly, the PRLD domain was found to be important in CLAMPs splicing functionality.

Interestingly, CLAMP regulates female sex-specific splicing of spliceosome component Hrp38, seen in different isoform expression. The human homolog hnRNPA2B1 is known to be involved in neurodegenerative diseases.

My analysis additionally identified a number of new sex-specific splicing events in genes that are involved in important biological processes that could be interesting to study in the future.

Home Institution: Emory University

Summer Research Program: NSF Research Experience for Undergraduates (REU)

Faculty Mentor: Michael Caiola, Food and Drug Administration

Mathematical Modeling of Healthy and Parkinsonian Neuronal Firing Patterns in Primate Thalamocortical Motor Circuit

The basal ganglia, along with the motor thalamus and cortex, are involved in movement planning and execution. Dysfunction in these structures leads to movement abnormalities, such as the bradykinesia, akinesia and rigidity seen in Parkinson's disease (PD). Our study used mathematical modeling to

examine the movement disruption in the cortex and thalamus. Since the sheer number of neurons makes the task of modeling at network level difficult, instead of modeling each individual neuron, we approximated the system using a series of coupled ordinary differential equations. Using bifurcation theory, we manipulated this approximate system to mimic neuronal level changes that lead to neuronal dysfunction, disease states, and, ultimately, possible trajectories in parameter space that lead back to a healthy neuronal state. These types of models help add to the understanding of neuronal dysfunction but are pretty useless without data to validate the model. Fortunately, a rich dataset of in-vivo primate neuronal data recorded throughout various movement-related brain areas helped validate and corroborate findings for this project.

Rebecca Kim; Ange Zelig Karondo
Home Institution: Brown University

Poster #E16

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Alexandra Deaconescu, Molecular Biology, Cell Biology and Biochemistry; Christiane Brugger, Molecular Biology, Cell Biology and Biochemistry

The Role of Phosphorylation and Protein Plasticity in the Regulation of the E. coli General Stress Response

The rapid development of antibiotic resistance is a serious and global threat. Antimicrobial resistance relies on multiple pathways, including mechanisms that involve persistence (phenotypic changes with no genetic modifications) or mutation. A key player in the ability of gammaproteobacteria to develop phenotypic and genetic diversity in response to stressors is RpoS (37.8 kDa), the stationary phase promoter specificity subunit of RNA polymerase. RpoS is principally regulated by proteolysis dependent on a ClpXP adaptor called RssB (37.3 kDa). RssB itself is regulated bidirectionally by aspartate phosphorylation and by multiple dissimilar proteins called anti adaptors. Our goal is to reveal atomic resolution features of the activation and inhibition mechanisms of RssB using x-ray crystallography and complementary functional studies.

Max Ulibarri

Poster #E17

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Lalit Beura, Molecular Microbiology & Immunology

Resident Memory T Cell Differentiation In Vaginal Organoids

The female reproductive tract is an important yet often overlooked organ system to study adaptive immune responses. With over a million STDs acquired every day worldwide, understanding the immune responses here is crucial. To help advance this area of research, I have been developing an organoid model system of the vaginal epithelium lining. An organoid model is a method of 3-dimensional cell culture system where the epithelial cells are suspended in an artificial extracellular matrix. This matrix allows adult stem cells to grow in every direction into many distinct layers. Importantly, this leads to the differentiation of the epithelial cells into specialized cell types such as basal, suprabasal, and a cornified apical layer of epithelial cells. This diverse cell population recapitulates the in vivo environment far better than traditional 2D cell culture, which only allows for growth of a single layer of cells and limited—if any—cell type specialization. However, organoids still retain a highly reductionist approach compared to live mice models. This allows for controlled experiments with little risk of confounding biological processes. I have co-cultured T cells with these organoids with the goal of creating chemical library screens to identify cytokines and molecules that are essential to resident memory T cell development. In

the future, this model will be used for CRISPR screens and to further build upon the chemical library screen.

Rebecca Blum

Poster #F1

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Elizabeth Harrington, Division of Biology and Medicine; Brianna Guarino, Vascular Research Laboratory

Do Extracellular Vesicles from ARDS Models Cause Pulmonary Endothelial Cell Dysfunction?

Acute lung injury (ALI) can lead to acute respiratory distress syndrome (ARDS), a rapidly progressing and deadly lung condition affecting the ability of the alveoli to perform gas exchange. Past evidence has shown that extracellular vesicles (EVs) play an important role in the progression of ALI/ARDS. EVs are membranous sacs released by most cell types and are integral in cell signaling and communication. The contents of EVs include lipids, proteins, and nucleic acids, although specific content is often influenced by factors such as cell type and environment. Diseased cells shed EVs that can cause dysfunction in recipient cells once they are absorbed, creating large medical implications. This project investigates how circulating EVs from distressed cells cause dysfunction within the cells that line the blood vessels of the body, known as endothelial cells (ECs). In ALI/ARDS, pulmonary ECs become hyperpermeable, causing fluid and protein accumulation in the lungs and eventually pulmonary edema. We hypothesize that EVs play a significant role in EC permeability via specific EV cargo, such as miRNAs.

Specifically, our project investigates how EVs from mice with bacterial ALI (ALI-EVs) influence rat EC permeability, migration, and tube formation ability, all important hallmarks of EC function. To induce ALI in the mice, *P. aeruginosa* strain 103 (PA103) was intratracheally instilled into their lungs, while the healthy control mice were given saline. Next, ALI-EVs and healthy saline control EVs (sEVs) were isolated from mouse blood plasma via ultracentrifugation. After isolation and further characterization of EVs, we have begun to treat healthy rat lung microvascular endothelial cells (RLMVECs) with ALI EVs and plan to compare their function to sEV treated cells. We predict the ECs treated with ALI EVs will exhibit dysfunction, which will be measured through electric cell-substrate impedance sensing (ECIS), migration, and tube formation assays, with the eventual goal of investigating EV cargo. By studying how pathogenic EVs compromise pulmonary ECs, better health predictions and therapeutics could be created for patients with lung infections or damage.

Rohan Freedman; Miauaxochitl Haskie

Poster #F2

Home Institution: Brown University

Summer Research Program: Kaun Lab Summer Research (Grant)

Faculty Mentor: Karla Kaun, Neuroscience

Drosophila as a model system to study opioid use disorder

Opioid use disorder (OUD) affects more than 2.1 million Americans and is responsible for 47,000 deaths every year.¹ From 2002 to 2017 there was a 22 fold increase in opioid-related deaths.² Opioids are a class of drugs that stimulate opioid receptors to bring about analgesic properties for pain management. By binding to opioid receptors, opioid drugs hijack the complex endogenous opioid system which results

in dysregulation of the reward system. Although invertebrate models have been developed to study the effects of opioids on behavior and neural circuits, a *Drosophila* model has not yet been developed. The powerful genetic tools uniquely available to *Drosophila* make it an ideal model system to study the neural and molecular mechanisms underlying opioid use. The aim of this study is to characterize *Drosophila* drug seeking behavior in response to an opioid paired odor. Since an ortholog to the mammalian μ OR has yet to be identified in flies, we used a transgenic line of flies to induce expression of the human OPRM1 gene in all neurons. We expected to observe that expression of OPRM1 will increase time spent with a cue paired with the synthetic opioid fentanyl. This work will help establish *Drosophila* as a useful model to further investigate the neuromolecular mechanisms responsible for OUD.

Ryan Henry

Poster #F3

Home Institution: CUNY Hunter College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Alexander Fleischmann, Neuroscience

Odor Identity Coding Within Specific Neural Projections in Olfactory Cortex

The sensory cortex comprises several neuron types that project to distinct target regions. It is crucial to determine their individual functional features in order to comprehend how sensory information is conveyed between brain regions. Piriform cortex (PCx), the primary receiver of sensory information from the olfactory bulb, has neurons that project to a variety of regions, including the olfactory bulb (PCxOB) and the medial Prefrontal Cortex (PCxmPFC). It is known that PCxOB and PCxmPFC cells are both deep-layer pyramidal cells, but it is unclear if they receive separate information preferentially. In this study, we use GRIN lens technology and two-photon calcium imaging microscopy to capture neuronal activity in the PCx of awake, freely behaving male and female mice (4-6 months). We label PCxOB and PCxmPFC subpopulations with a retrogradely transported Adeno-associated virus and assess their response properties to odor response profiles. Our findings imply that PCx cell types encode odor information differently, shedding fresh light on how olfactory information is transmitted throughout brain regions. Odor identity is shown to encode more effectively in PCxmPFC neurons than in PCxOB neurons.

Samara Cummings

Poster #F4

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Nicolas Fawzi, Molecular Biology, Cell Biology and Biochemistry

Investigation of FUS LC in RNA-Mediated Liquid-Liquid Phase Separation

Fused in Sarcoma (FUS) is an RNA-binding protein that forms liquid-like puncta to facilitate RNA transcription and splicing events in the nucleus. Upon mutation, this protein undergoes cytoplasmic mislocalization and the formation of fibrillar aggregates, both of which are observed in patients with the neurodegenerative disease amyotrophic lateral sclerosis. FUS contains a low complexity, SYQG-rich domain (FUS LC) at its N-terminus that plays a critical role in phase separation and self-assembly. Here, we elucidate FUS LC-RNA interactions, the ability of FUS LC to phase separate in the presence of RNA, and the disruption of self-assembly by a familial ALS-associated mutation G156E. Through centrifugation assays that respectively measure the partitioning of FUS LC wild-type, G156E, and FUS-RNA mixture into the condensed phase, NMR spectroscopy that identifies which amino acids in FUS LC are most

perturbed in the presence of RNA, and microscopy experiments that visualize FUS LC liquid droplets, we found that FUS LC-RNA interactions are governed by electrostatic repulsion between negatively charged RNA and the negatively charged amino acids in FUS LC. As a result, these interactions increase the extent of FUS LC phase separation. Overall, this study provides molecular details underlying FUS LC-RNA interactions in the context of phase separation and how the familial ALS mutation G156E disrupts these dynamics.

Silvia Blanco

Poster #F5

Home Institution: University of Puerto Rico, Rio Piedras Campus

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Peter Belenky, Molecular Microbiology and Immunology

Applying long read sequencing to genotype evolved bacterial strains

Whole genome sequencing is a powerful tool that produces complete genomes for bacterial identification and comparative genomic studies. Long-read sequencing technologies can overcome the limitations of short read (next-generation) sequencing by improving genome contiguity and creating accurate genome assemblies with minimal gaps. Our work focuses on utilizing Oxford Nanopore MinION long-read sequencing to prepare an assembly of bacterial strains. We sequenced four differentially swarming *Enterobacter* family members: SM1, SM3, SM1_HS2B, and SM3S. The *Enterobacter sp.* SM1 is a weak- or non-swarmers isolate from feces of normal mice, while *Enterobacter sp.* SM3, is a hyper-swarming clinical isolate from feces of mice exposed to dextran sulfate sodium that causes acute colonic inflammation. SM1_HS2B, whose genome was newly annotated in this study, is a laboratory generated hyperswarming mutant strain of SM1. Similarly, SM3S is a newly sequenced mutant strain of SM3. Additionally, as a control, we sequenced an *Escherichia coli* strain. Data obtained from long-read sequencing was analyzed on the bacterial bioinformatics programs PATRIC and Anvi'o. This work demonstrates the potential of long-read sequencing in the identification and comparison of bacterial strains of potential clinical interest.

Sira Morales

Poster #F6

Home Institution: University of Puerto Rico - Mayagüez

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Mauro Rodríguez, Jr, Mechanical Engineering

A numerical model of coupled arterial blood flow and cerebrospinal fluid transport

The transport of cerebrospinal fluid (CSF) through the perivascular system (PVS) is hypothesized to be caused by blood flow in arteries. The CSF transports waste from the brain in the form of proteins through the PVS. We investigate the validity of hypothesis by considering that the transport of CSF in the PVS due to the pulsating blood flow in the artery as the primary mechanism. A scaling analysis is used to identify the non-dimensional parameters that govern the fluid motion across any scale. We construct a theoretical model for blood flow and CSF transport based on first principles (conservation of mass and momentum). A system of ordinary differential equations describing the 1D flow is solved numerically using central finite differences. We determine the scaling relationship for CSF flow rate in relation to the blood

flow rate. We also present the possible blood flow conditions under which CFS is transported into the PVS.

Keywords: cerebrospinal fluid transport 1; pulsating blood flow 2; fluid dynamics 3

Sydney Tucker

Poster #F7

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Amitai Shenhav, Cognitive, Linguistic, and Psychological Sciences

Learning about task difficulty to determine exertion of mental effort

To decide whether to exert mental effort, people consider its costs and benefits. Prior work examined how individuals' expectations of difficulty affect their motivation to exert mental effort. To maximize benefits and minimize costs of mental effort, individuals consider the difficulty of their environments and adjust their mental effort accordingly. For example, if a person encounters a task they expect to be too difficult (e.g., a child receives a book beyond their reading level), they might engage in little or no mental effort because they expect poor performance no matter their effort level. Alternatively, another person who encounters a difficult task might believe there is a possibility of performing well and instead intensify their mental effort. We designed a study to examine how people form expectations of difficulty, how they dynamically adjust these expectations within a changing environment, and how these expectations inform their motivation to engage in mental effort. We created a novel, incentivized, picture–word interference task in which participants must exert mental effort to respond correctly. Participants will earn monetary rewards by correctly responding to a certain number of stimuli in each 10s interval. The thresholds that participants must reach change gradually over the course of the experiment and vary from easy (e.g., 6 trials) to difficult (e.g., 15 trials). Participants will not know the threshold for each interval until the interval is over. Thus, they must predict whether each threshold is likely to be high or low based on their learning of previous thresholds. We will examine whether participants track past thresholds by periodically asking them to predict future thresholds. If learning occurs, participants' answers should reflect their environment's changes in difficulty. Additionally, if participants' learning influences their motivation to exert mental effort, we expect differences in accuracy levels and response times in high-and low-difficulty areas of the task (e.g., faster reaction times and greater accuracy, which indicate more mental effort, in high-difficulty areas). We encounter tasks of varying difficulty daily, and this research will demonstrate how we learn about and respond to difficulty. Piloting of participants online will begin shortly.

Talia Fernandez; Hannah Park

Poster #F8

Home Institution: Brown University

Summer Research Program: Caleel Fellowship

Faculty Mentor: Carlos Aizenman, Neuroscience; Adrian Thompson, Neuroscience

Understanding the role of acute and chronic stress on developing brain circuits

Preliminary work shows that acute stress causes behavioral deficits in developing *Xenopus* tadpoles. Here we study the role of stress and exposure to the stress hormone, corticotropin releasing factor (CRF), on *Xenopus* optic tectal circuits. Due to the optic tectum's role in processing sensory information, we hypothesized that CRF would alter sensory integration and decrease foraging behavior. To test this hypothesis, we used a schooling behavioral assay. To test whether CRF mediates the effect of stress on schooling, we used CRF antagonist, NBI, to block CRF receptors in the tectum. Our experimental groups

included: CRF-treated, stressed, and NBI-treated tadpoles. During schooling, stressed tadpoles had smaller intertadpole angles than controls, suggesting increased schooling. NBI appeared to rescue this effect. This data suggests that stress causes an increase in schooling behavior. However, this conflicts with our findings that CRF-treated tadpoles had larger intertadpole angles, indicating decreased schooling. These results may indicate the presence of another stress hormone. By characterizing the behavioral effects of stress and CRF exposure during development, we will be able to gain understanding of important sensory integration circuits.

Tej Tummala

Poster #F9

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Wafik El-Deiry, Pathology and Laboratory Medicine

Synergistic Combination of Lurbinectedin with Irinotecan in Pancreatic Cancer Cell Lines

Pancreatic cancer is a devastating disease with a five-year survival rate below 10% according to the American Cancer Society. Novel chemotherapeutics and targeted therapies in pancreatic cancer have shown limited success, illustrating the urgent need for novel treatments. Lurbinectedin is a chemotherapeutic synthetic tetrahydroisoquinoline alkaloid that inhibits active transcription by binding to guanine rich sequences in the minor groove of DNA. Lurbinectedin has been shown to reduce oncogenic transcription by stalling and degrading RNA Polymerase II while also inducing single- and double-stranded breaks to DNA, causing subsequent apoptosis. Lurbinectedin received accelerated FDA approval in 2020 for metastatic small cell lung cancer on or after platinum-based chemotherapy and is currently undergoing clinical trials in a variety of tumor types. We recently described a synergistic interaction between Lurbinectedin and ONC201/TIC10, a compound that induces the TRAIL pathway, in killing SCLC cell lines associated with activation of p-Chk1 and the integrated stress response. We now demonstrate Lurbinectedin's efficient killing of pancreatic tumor cells as a single agent in PANC-1, BxPC-3, and HPAF-II cell lines, with IC-50s corresponding to sub-nanomolar concentrations. We also demonstrate that a combination of Lurbinectedin and Irinotecan, a topoisomerase I inhibitor with FDA approval for advanced pancreatic cancer, results in synergistic killing of pancreatic tumor cells in vitro. Cell viability was measured using the CellTiter-Glo assay at varying drug concentrations. We hypothesize a combination therapy of Lurbinectedin and Irinotecan can enhance immune cell killing of pancreatic tumor cells. This is being explored by co-culturing TALL-104 CD8+ T lymphoblast cells with pancreatic tumor cells treated with Lurbinectedin, Irinotecan, and combination. Our results are developing insights regarding molecular mechanisms underlying therapeutic efficacy of a novel combination drug treatment for pancreatic cancer.

Theodore LaBonte-Clark

Poster #F10

Home Institution: Brown University

Summer Research Program: Summer Research Assistant in The Carney Institute for Brain Science

Faculty Mentor: Matthew Nassar, Neuroscience

A Sequence Learning Model Demonstrates High Predictive Accuracy and Generalizability

Sequences are integral to human and animal learning and behavior. Animals rely on sequences to organize their behavior and reduce the cognitive load necessary for completing complex tasks. Sequence learning likely requires that animals have the capacity to access and cross-reference information about

sequence structure and sequence history, but the exact neural mechanisms that underlie the process of sequence learning are poorly understood. Here, I propose a machine learning (ML) model that demonstrates the ability to learn abstract sequence patterns as conditional mappings from memory to predictions of the next item in a sequence.

An ML model that combines reinforcement learning and multiple single-layer perceptrons successfully learns to predict the next item in a trained sequence. Each perceptron has access to a different amount of memory and develops a mapping from memory to predictions of the next item in the sequence. For each prediction, the reinforcement learning model uses contextual information to choose which perceptron to employ and train.

The model is trained on repeating sequences that share a transition structure but have differing elements. For instance, one training session could include the sequences ABBA and CDDC, because both share an underlying transition structure, despite not sharing any elements. The proposed ML model learns to correctly predict reoccurrences of an element within a given sequence, given that it is trained on sequences with the same transition structure. Further, it performs well at generalizing to predict the recurrence of new elements after only one exposure, given that the element has a similar structure to the elements in the training set.

Future work will compare the model to neural data to determine if the activity observed in the model is consistent with activity observed within prefrontal brain regions that are implicated in sequence learning.

Valentin Kirilenko

Poster #F11

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Nicolas Fawzi, Molecular Biology, Cell Biology and Biochemistry

Contributions of FUS LC and RGG Domains to Phase Separation of FUS

The heterogeneous ribonucleoprotein Fused in Sarcoma (FUS) participates in the formation of functional biomolecular condensates through the process of liquid-liquid phase separation (LLPS). The molecular level details driving phase separation are poorly understood. However, mutations in the low-complexity (LC) domain have been causally linked to neurodegenerative diseases including frontotemporal dementia and ALS. Thus, studying of LLPS of FUS deepens not only the understanding of LLPS as a mechanism of self-assembly, but also advances our understanding of these neurodegenerative diseases. The LC domain of FUS has been extensively studied for its contribution to phase separation. Here, we use FUS LC mutants to investigate the importance of various molecular interactions to LLPS and determine how the arginine-glycine-glycine (RGG) motif domains alter these interactions. Together with previous studies on the LC domain, our findings provide much needed nuances to the “stickers and spacers” model, which suggests that aromatic-based interactions are essentially the only important molecular interaction that drives LLPS. We found that the presence of the RGG3 domain does not significantly disrupt the trends in phase separation observed with the LC domain. These results provide us a better understanding of how the LC and RGG domains drive phase separation of FUS.

Valeria Brown

Poster #F12

Home Institution: Tougaloo College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Dr. Patrycja Dubielecka-Szczerba, Hematology/Oncology of Pathobiology Department

Transcriptomic Validation of Markers for Stromal Cell Detection in Acute Myeloid Leukemia Bone Marrow Aspirates and Core Bone Marrow Biopsies

Acute myeloid Leukemia (AML) is a genetically heterogeneous malignancy with an overall 5-year survival rate of approximately 26% due to poor treatment responses. Recent studies have shown possible involvement of the non-hematopoietic compartment in AML development and AML-specific remodeling of the bone marrow (BM) microenvironment. However, our understanding of these BM microenvironmental changes, specifically upon chemotherapeutic treatment, are limited. Thus, we comparatively examined differential gene expression within the core BM biopsies of patients classified as responders or non-responders to standard of care treatment with cytarabine and daunorubicin. We found that patients that respond to chemotherapy showed significant reactivation of mesenchymal stromal cells within the BM microenvironment, whereas patients that showed sub-optimal response showed significant reactivation of osteo-committed subfraction of mesenchymal cells. We identified surface markers specific to mesenchymal reactivation in the stroma including PVR (Poliovirus Receptor Cell Adhesion Molecule), CD271 (Nerve Growth Factor Receptor), and PDGFR β (Platelet Derived Growth Factor Receptor Beta). The following markers were found to be upregulated in osteo-committed subfraction of mesenchymal cells in non-responders: SDC4 (Syndecan 4), CDH2 (Cadherin 2), and CADM1 (Cell Adhesion Molecule 1). We are now further validating these markers using fibroblasts, human mesenchymal stem cells, and osteoblasts with RT-PCR and flow cytometry as well as immunohistochemistry. Identifying markers specific to response to chemotherapy may potentially aid in identification of new therapeutic targets within the AML BM microenvironment.

Vanny DaFonseca

Poster #F13

Home Institution: Arizona State University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Jessica Plavicki, Pathology and Laboratory Medicine; Shannon Paquette, Pathology and Laboratory Medicine

Using zebrafish as a model to understand if macrophage are necessary for normal heart health and function

Cardiac macrophages are largely embryonic, they comprise 5-10% of all non-cardiomyocytes in the heart and are spread throughout the heart's chambers. They function as immune cells, as well as aid in vascular development and conduction of the AV nodes. While embryonic macrophages are in abundance, very little is known about their homeostatic functions and potential to alter heart rhythm and electrical conduction of the pacemaker node. This experiment is the first to describe the presence of macrophages at the pacemaker node in zebrafish, in which macrophages are also electrically coupled to cardiomyocytes, suggesting they could have roles in heart function. We hypothesize that the *irf8* gene, which is responsible for the production of embryonic macrophages, will adversely affect heart health leading to an irregular heartbeat by affecting the electrical conduction of the pacemaker node. To better understand the role of embryonic macrophages in the heart, zebrafish were chosen as the experimental model. Genotyping was performed on the fish to determine if they were wildtype, heterozygous, or mutant. To identify differences between the groups, echocardiograms measured blood flow into the heart, ECGs measured electrical conduction, and a tissue analysis pinpointed inflammation, fibrosis, and hypertrophy. It is expected to see differences in blood flow to the hearts, irregular electrical conduction, and inflammation. With success, this would confirm macrophages as a functionally relevant and important

cell type for maintaining heart health. This may serve as an aid in diagnosing and/or treating heart arrhythmias in the future.

William Pelit

Poster #F14

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Emine Yalcin, Pathology and Laboratory Medicine; Suzanne de la Monte, Pathology and Laboratory Medicine

Brain White Matter Phospholipid Dysregulation in Chronic Cigarette Smoke and Ethanol Rat Model

Chronic alcohol consumption and daily cigarette smoking are the most prevalent substance abuse disorders worldwide. Alcohol and tobacco abuse can lead to deficits in learning, memory, executive, and behavioral functions. Neuroimaging, postmortem, and experimental studies have correlated alcohol-induced cognitive impairment to white matter atrophy and myelin degeneration. Previous studies have largely focused on understanding the effects of heavy drinking on brain structure and function, less is known about the long-term neurodegenerative deficits of chronic smoking. Since most heavy drinkers also smoke tobacco, a better understanding of the nature and mechanisms of brain injury is necessary to develop more effective preventive and therapeutic strategies. Our previous studies using experimental models of chronic alcohol and cigarette smoke exposures suggest the neurodegenerative effects associated with drinking and smoking can be correlated with altered lipid expression within brain white matter (WM). Our work focuses on the shifts in phospholipid expression within WM, as these lipid species affect cell membrane integrity, intracellular signaling, and membrane-protein interactions. An 8-week Long-Evans rat model was generated to explore the effects of cigarette smoke and alcohol on phospholipid expression in WM, and matrix assisted laser desorption ionization-imaging mass spectrometry (MALDI-IMS) measured these changes in situ utilizing fresh frozen brain sections harvested from the animal model. Herein, the data catalog these lipid profile changes and demonstrate the sexually dimorphic outcomes of cigarette smoking and ethanol consumption.

Yongkuan Zhang

Poster #F15

Home Institution: Brown University

Summer Research Program: Undergraduate Research Assistantship in MCB

Faculty Mentor: Nicola Neretti, Molecular Biology, Cell Biology, and Biochemistry; Miiko Sokka, Molecular Biology, Cell Biology and Biochemistry

Multi-round Immunofluorescence imaging combined with Fluorescence in-situ hybridization allows multiplexed characterization of senescent cells

Cellular senescence is a state of permanent cell cycle arrest that plays a major role in damage response, tumor suppression, and aging. Although many prominent phenotypes of senescent cells have already been identified, compiling a comprehensive list of biomarkers that characterize and define the senescent state is still an ongoing challenge. By analyzing chromosomal architecture, damage signaling, and nuclear structure, the Neretti lab seeks to explore how alterations of these biomarkers in senescence cells can aid in their distinction from regular cells.

By combining two techniques: Iterative Indirect Immunofluorescence Imaging (4i) and Fluorescence in-situ hybridization (FISH), antibody staining and hybridization of DNA probes were achieved in the same cells. To characterize biomarkers in senescent cells, we compared etoposide-treated and untreated human fibroblast (BJ and BJ-hTERT) cells, with etoposide acting as a DNA damaging agent used to induce senescence. Our selection of biomarkers includes DNA damage, nucleolar morphology, and genomic markers. The innovative imaging buffer used in 4i allowed for gentle elution of antibodies without damaging the overall cellular structure, therefore making multi-round antibody staining as well as combination with FISH possible. Repeated rounds of imaging using fluorescent microscopy were performed and the samples were eluded and re-stained after each round. The probes selected for FISH targeted the alpha satellite, LINE1, as well as the telomeric regions to investigate whether changes in repetitive segments of DNA can be used as markers to identify senescent cells. In addition, beta-galactosidase staining, a well-known characteristic of senescent cells, was also performed on both samples as a confirmation of senescence induction.

This novel merging of existing techniques allows for the targeting of genetic and antigenic biomarkers within the same cells. Analysis on the subcellular, single-cell, and population-level using this technique can not only improve the identification of senescence cells but also further our understanding of their unique role in aging and disease.

Zander Hary

Poster #F16

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Alexander Jaworski, Neuroscience

Mapping transcriptomically identified commissural neuron subtypes in the embryonic spinal cord.

Commissural neurons are a type of neuron that bridges the left and right hemispheres of the nervous system. In order for commissural neurons to project axons across the nervous system midline and into the contralateral hemisphere, the axonal growth cones of these neurons must encounter specific extracellular compounds and morphogens that direct their wiring patterns. New transcriptomic data obtained through single-cell RNA sequencing has revealed immense molecular diversity among commissural neurons, indicating that the current grouping of commissural neuron subtypes (domains) requires further refinement. Based on the RNA sequencing data, my project characterizes newly discovered commissural neuron subtypes by labeling these neuronal populations via immunohistochemistry (IHC) on mouse embryonic spinal cord tissue sections. This reveals the spatial distribution of these subclasses at multiple stages of spinal cord development with the potential for creating a new "map" of transcriptomically defined commissural subtypes within the embryonic spinal cord.

Zenovia Gonzalez

Poster #F17

Home Institution: St. Francis College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Wafik El-Deiry, Professor of Pathology and Laboratory Medicine

MGMT status as a predictor of response to immunotherapy and temozolomide in MSS CRC and GBM

Colorectal cancer (CRC) is the third most frequently diagnosed cancer and third-deadliest cancer globally. The 2022 MAYA trial found that the DNA-damaging agent temozolomide (TMZ), which is usually used to treat glioblastoma (GBM), sensitizes CRC patients with microsatellite stability (MSS), MGMT-silenced tumors to immunotherapy (IT). The mechanism driving sensitization and whether IT provided benefits is unclear. We hypothesize that MGMT expression will predict sensitivity to TMZ and TMZ-mediated enhancement of T cell killing of GBM and CRC cell lines +/- IT. MGMT expression was measured with a western blot with CRC (n=4) and GBM (n=4) cell lines. IC50 values of GBM cells treated with TMZ were determined using cell viability assays. Using IC50 values of GBM cells + TMZ, co-cultures were performed to measure TMZ-mediated enhancement of T cell killing. Western blot analysis revealed that GBM cell lines didn't express MGMT, likely due to hypermethylation. Comparatively, CRC cell lines had significantly elevated MGMT expression. GBM cell lines were resistant to TMZ up to 80 μ M after three days, but sensitive (IC50=10-90 μ M) after five days. T cells were resistant to TMZ up to 400 μ M after 24 hours. Under the experimental conditions tested to date, results from the co-culture of TMZ-treated GBM and CRC cells with T cells revealed that TMZ may enhance T cell killing of GBM cells but not the killing of CRC cells. Future experiments include measuring IC50 values of CRC cells treated with TMZ and TMZ-mediated enhancement of T cell killing of tumor cells +/- IT.

DAY #2:

2022 SUMMER RESEARCH SYMPOSIUM

SUMMER RESEARCH SYMPOSIUM POSTERS

Friday, August 5

Physical Sciences and Social Sciences

Physical Science

Advay Mansingka

Poster #A1

Home Institution: Brown University

Summer Research Program: Sriram Jayakumar '13 Award, Brown School of Engineering

Faculty Mentor: Roberto Zenit, School of Engineering

Demonstrating targeted navigation and emergent behaviour in turbulent flows via deep reinforcement learning.

Understanding navigation in the presence of a turbulent flow has many applications including designing autonomous drones, creating targeted drug delivery technologies, and modelling weather patterns. Given the unpredictable nature of turbulence, it is challenging to build control schemes for efficient navigation. This paper aims to study autonomous navigation in turbulent flows by training deep reinforcement learning algorithms in computer simulations of turbulent flows. Our swimmers learn to navigate a two dimensional flow, and to exploit vortices in the fluid field to traverse their environments. We demonstrate that the RL based swimmers outperform simpler control theory based approaches. Further, we demonstrate emergent multi-agent behaviour in independently trained swimmers, and showcase their ability to 'slipstream' each other in the flows to further optimise their movements.

Aicha Sama

Poster #A2

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Robert Hurt, Engineering

Barrier Properties of Graphene Oxide and Its Applications in Personal Protective Equipment

Graphene oxide films have exceptional barrier properties, having the ability to block almost all chemicals except for water vapor. The main drawbacks of using these films in broader applications include the brittleness and lack of water stability seen in pure graphene oxide films. Fortunately, graphene oxide films can be modified to create tough, lightweight, water-stable protective barriers. To create composite films that are breathable and flexible enough to be used in fabric, several combinations of polymers and

crosslinkers can be mixed homogeneously with graphene oxide to maximize the above-stated features. Alternatively, polymers and crosslinkers can be painted onto plain graphene oxide sheets to make them tougher and water stable. Carboxymethyl cellulose, hydroxyethyl cellulose, methylcellulose, aqueous polyurethanes, polyethyleneimine, and bis(2-aminopropyl) ether are some of the polymers that were

tested in combination with carbodiimide crosslinkers and glutaraldehyde to maximize the toughness and water stability of the graphene oxide films. By creating and using these high-performance graphene oxide films in personal protective equipment, we can create lab equipment strong enough to withstand chemical warfare agents while remaining breathable. To accomplish this, we use polymers that bind strongly to graphene oxide sheets while using crosslinkers to ensure that aqueous polymers become water-stable. After creating these films, we conduct qualitative tests for toughness and water stability. We found that adding carboxymethyl cellulose to graphene oxide created one of the toughest films we have made to date, though it was not water stable. The toughest and most water-stable film we have created so far consisted of methyl cellulose crosslinked with glutaraldehyde. Though we are still working to find the best polymer-crosslinker combination to produce the toughest and most water-stable graphene oxide film, we have made significant progress in this area.

Alexa Schultz

Poster #A3

Home Institution: Yale University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Colleen Dalton, Department of Earth, Environmental and Planetary Sciences

Cascadia's Crust: Imaging the Crust and Upper Mantle of the Pacific Northwest Using Rayleigh Wave Phase Velocities

The Pacific Northwest is a diverse geologic region that contains the Cascadia Subduction Zone and several episodes of extensive magmatism since 17 Ma, including the Snake River Plain and the Columbia Plateau. Rayleigh wave phase velocity tomography can provide insight into the lithospheric structure that affects tectonics and magmatism in the region. The relatively recent discovery of the megathrust fault at the Cascadia Subduction Zone and its capability for producing a magnitude 9.0 earthquake highlights the importance of creating a thorough picture of the region and explaining how the local geologic features impact seismic activity and hazard. Here, we determine Rayleigh wave phase velocity maps of the Pacific Northwest at periods from 20s to 100s. We measure the phase times from 294 teleseismic earthquakes at 149 broadband stations and calculate phase velocity using the Helmholtz tomography method. We find that the cold subducting Juan de Fuca plate is characterized by high seismic velocities along the coast, while the Cascades range is characterized by low seismic velocities at shorter periods that are sensitive to the crust and fast velocities at longer periods. Generally, we find that regions with higher elevations, such as the Northern Basin, are marked with low seismic velocities. Ongoing work is developing a fully 3-D model of shear-wave speed from these data. Our findings constrain seismic velocities with higher lateral resolution in Cascadia than most prior studies, which has implications for seismic hazard and geophysical earthquake models.

Alexander Wilk

Poster #A4

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: James Russell, Earth, Environmental, and Planetary Sciences

Super-interglacial Climate Dynamics in the Tropical Indo-Pacific Warm Pool

Given the ongoing climate crisis and the ever-growing unpredictability of climate dynamics, research into Earth's climate history is a necessary action for understanding and addressing our modern world. Tropical

precipitation belts, areas of major atmospheric convection and global heat transport, are changing rapidly today, expanding and moving poleward, but the exact teleconnections and dynamics of tropical rainfall are not fully understood. The Indo-Pacific Warm Pool (IPWP) is the region centered over Indonesia characterized by its maximal atmospheric convection and high local precipitation, and thus it additionally is the maximal source of heat and moisture for global climate. Recent pre-anthropogenic climate cycles on Earth have been dominated by orbital configurations and varying amounts of insolation, but these cycles are not uniform between each glacial and interglacial stage. At present, Earth is in a period of low-amplitude, low-variability insolation, an orbital configuration similar to that of a few interglacial periods during the recent Pleistocene Epoch: Marine Isotope Stages 5e, 11, and 19. Based on paleoclimate research focused in high latitudes, however, these three periods differ in global climate. The Holocene and MIS11 are considered “super-interglacials”, in which global ice volume reaches an anomalous minimum, while MIS19 is not. This project’s analyses of various geochemical paleoclimate proxies found within high-resolution lake sediments cored from Lake Towuti (in Sulawesi, Indonesia) will reveal the similarities and differences between interglacials within the IPWP. These proxy methods include using branched glycerol dialkyl glycerol tetraethers to reconstruct past temperatures, and the δD isotopic composition of leaf waxes to reconstruct past precipitation regimes in the region. Finding similar temperature and hydroclimates across different interglacial periods of the Pleistocene will suggest that insolation is truly the dominant control on tropical hydroclimate and temperatures, while finding differing results across each interglacial would suggest that high-latitude ice volume is a much stronger control on tropical precipitation than is low-amplitude changes in insolation. Such comparison provides critical insight into the teleconnections of tropical hydroclimate for the IPWP throughout history and into the modern day.

Anjali Srinivasan; Alberto Lopez Resendiz

Poster #A5

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Brenda Rubenstein, Chemistry

Analyzing the Dynamics of the ABL1 Protein Kinase

Protein kinases, enzymes which modify proteins through phosphorylation, are important for the regulation of cell growth, proliferation, and immune response. One such kinase is ABL1, which is often involved in the spread of certain cancers when it is present in a hyperactive state. It has previously been discovered that ABL1 inhibitors are an effective treatment for cancers like myeloid leukemia. Thus, understanding ABL1 conformations can lead to the design of more effective inhibitors. Like most kinases, ABL1 transitions between active and inactive states through conformational changes. Previous experiments have used NMR spectroscopy to show that the ABL1 kinase can interconvert between a first and second inactive state, in addition to its active state. More recently, molecular dynamics simulations have been useful to analyze these changes at the nanosecond scale, allowing for a more detailed understanding of conformational transitions. However, there has yet to be work done modeling the change from the first to the second inactive state, which could reveal more “hidden” conformations. These hidden conformations could expose new ways in which an inhibitor can bind to the protein, allowing for the development of more effective drugging. In this project, we have elucidated the mechanism by which the first and second inactive states of the ABL1 kinase interconvert through molecular dynamics and metadynamics. After using Schrodinger's Desmond to analyze longer-time ABL1 conformational changes, we were able to reveal the dynamics into and out of the second inactive state for the first time. These findings will hopefully serve as a catalyst for future work on more effective kinase-inhibiting drugs.

Home Institution: California State Polytechnic University, San Luis Obispo

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Tim Herbert, Department of Earth, Environmental and Planetary Sciences

Deep Sea Time Machine: Marine Sediment Cores as Indicators of Ancient Upwelling

Upwelling is a process which transports cold, nutrient-rich water to the sea surface, resulting in increased biodiversity and productivity. Coastal upwelling regions generate fertile ecosystems and sustain the global fishing industry. However, potential changes to coastal upwelling systems in response to surface warming induced by climate change are unknown. Studying how these systems were affected by past climatic changes has potential to minimize this knowledge gap. Here we provide an analysis of marine sediment core samples as a means to observe how the Benguela Upwelling System was impacted by climate change in the Pliocene, an epoch 5.3 to 2.6 mya whose climate conditions serve as an analog for Earth's climate in the near future. Our results demonstrate the use of percent calcium carbonate (CaCO₃) in marine sediment core samples as a proxy for ancient biological productivity. Our findings provide insight on how the productivity of coastal upwelling regions may change in response to a changing climate, which has the potential to impact local biodiversity and coastal economies. Furthermore, this information can be utilized by policy makers to make informed decisions concerning the management and protection of coastal regions.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jacob Rosenstein, Engineering

Digital Systems for a New Nanopore DNA Sequencing Device

Nanopore sensors present new opportunities for sequencing DNA in a portable device. The portability of nanopore sequencers allows a user to analyze DNA samples on-site, allowing more effective work in ecology, epidemiology, and a variety of other fields. The focus of this project lies in developing a new type of nanopore sequencer called an Ion Fountain Nanopore Reader (IFNR) that uses a 2-dimensional MXene layer to improve the device's sensitivity. The project is in early stages, and my work has largely focused on writing software and digital logic that facilitates electronic signal acquisition from the device. This software includes Verilog hardware description code that builds digital control logic on an FPGA, and Python code for an interface that allows the user to interact with the device through a computer. This project is a collaboration between groups at Brown and Northeastern University and is funded by the NIH.

Home Institution: Princeton University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP), SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Stefanie Tellex, Computer Science

Autonomous Agents Executing Generalized Sequential Constrained Tasks

Natural language instructions (NLI) given to robots often exhibit sequential constraints rather than simply being goal-oriented (e.g., "first go around the lake and then travel north to the intersection"). Prior approaches mapped NLI to Linear Temporal Logic (LTL), a structure that enables a robot to understand commands with sequential constraints. A large dataset of NLI-LTL pairs is needed to learn to translate NLI to LTL, but such a dataset is expensive to create, and existing datasets are not large enough. Furthermore, these approaches lack generalizability, because during deployment, the robot can only operate in the domain that it was trained in. To address these two issues, we first implement a model that learns to translate NLI to LTL using NLI-Trajectory pairs where trajectories are used to verify the correctness of the LTL generated by the model. Then, we integrate COPYNET, a model with a copying mechanism, into our model. It allows the model to output words not in its target vocabulary by copying words from each NLI instance. The model can then generate tokens not seen during training. With our method, a robot trained in one environment can execute natural language instructions with sequential constraints in novel environments without the need for retraining or finetuning in these different domains. Consequently, this makes the deployment of robots faster, cheaper, and more feasible.

Brian Freedman

Poster #A10

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jay Tang, Physics

At the Frontier of Biology and Physics: Determining the Swimming Behavior of a New Bacterial Species

During the past ten weeks, my research has been focused on analyzing the motion of *Enterobacter* sp. SM3., a newly-discovered bacterial species whose swimming behavior and chemotaxis is largely unknown. Each week, under the guidance of Professor Jay Tang and with the help of Brown graduate student Silverio Johnson, I followed a standard procedure that involved observing SM3 under a microscope, recreating its trajectories using ImageJ software, and analyzing the trajectories. Specifically, we analyzed tracks for the presence of "runs," or periods of smooth, constant motion, and "tumbles," or periods of erratic motion in which the bacterium stays in place and rapidly changes direction until it begins another run in a new direction. Other forms of motility that did not align with this particular model were recorded to gain a more complete description of the different modes of motility of SM3.

After multiple weeks, we began to focus our attention on developing a computer program that would automate the data collection process, as we were unable to discover any freely-available existing software designed for this purpose. During the last weeks of this project, we independently designed several algorithms to make our data collection process more rigorous, standardized, and accurate. Creating the resulting program, which we intend to make freely-available following thorough review, and gathering preliminary data on the swimming behavior of SM3 have been the two primary objectives of my research during these past ten weeks.

Due to early findings indicating potential beneficial roles of SM3 in reducing intestinal inflammation, determining foundational knowledge of the swimming motility of this bacterial species has great potential for making further advances in biomedicine and biophysics alike. I expect to continue this project into the coming months in order to gain sufficient data to thoroughly describe the motion of SM3 and help to contribute to these important scientific advances.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Kareen Coulombe, Engineering

Modulating the mechanics and structure of wet-spun collagen fiber scaffolds for engineering cardiac tissues

Myocardial infarction results in a loss of functional cardiomyocytes, and therefore loss of overall cardiac function. One emerging therapy is to remuscularize the injured heart through implantation of an engineered cardiac tissue (ECT) on the epicardial surface of the heart. One limitation of this therapy, however, is the mechanical integrity of the engineered tissues, both during surgery and once implanted onto the heart. ECTs must be robust and provide mechanical and structural reinforcement to the native heart tissue. Wet-spun collagen fibers can be used to create scaffolds for the engineered tissues to improve their strength while tuning the mechanical and structural support delivered to the heart. To this end, we developed an improved method for capturing wet-spun collagen fibers into scaffolds to increase the fidelity of fiber geometry (0, 30 degrees). Additionally, we quantified single fiber and acellular scaffold mechanics through tensile testing. Finally, we created ECTs containing the collagen fibers, resulting in compaction on the scaffold and a beating phenotype. These studies provide the groundwork that will be leveraged to engineer a robust cardiac tissue.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: James Russell, DEEPS

Charcoal as Fire Frequency Proxy in Lake Kopello

The impact that fire has on tropical ecosystems is poorly studied as compared to more arid landscapes. Through analysis of charcoal abundance in sediments from lake cores, we can develop an understanding of both fire frequency, and the specific vegetation which was burned by fires. My research focused on cores from Lake Kopello in east Africa, which were chemically treated to isolate for charcoal.

Home Institution: Pomona College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Daniel Ibarra, Department of Earth, Environmental, and Planetary Sciences; Institute at Brown for Environment & Society; Natasha Sekhon, Department of Earth, Planetary, and Environmental Science; Institute at Brown for Environment & Society

Late Holocene hydroclimate changes recorded in $\delta^{18}\text{O}$ of a stalagmite from Cueva De La Fabrica, Colombia

Speleothems, calcium carbonate (CaCO_3) cave deposits, are an important archive used to reconstruct past terrestrial hydroclimate variability. Cave drip water chemistry (i.e., trace elements and stable

isotopes) influences speleothem growth layers as it precipitates, which makes speleothems great archives for changes in the hydroclimate. Speleothems that grew before the availability of instrumental data provide an understanding of changes in rainfall by recording the response of past climate to changes in internal and external climate forcings.

In this study, we analyze the stable isotope variability of a speleothem, C2A-1, that grew between $3,206 \pm 63$ (2σ) and $3,750 \pm 110$ yrs B.P in Cueva De La Fábrica, Colombia. In Colombia, there are no published stable isotope measurements of speleothems, although insights from such analyses would benefit the interpretations of several regional isotope-based paleoclimate records. In this region, $\delta^{18}\text{O}$ values are sensitive to changes in rainfall. The cave lies near the boundary of wet and dry El Niño and may provide crucial insight into El Niño trends during Pre-Muisca cultures. We micro-milled C2A-1 at a 500 μm resolution to yield 283 samples. $\delta^{18}\text{O}$ values fall between -7.07 and -8.33 ‰ (V-PDB) and $\delta^{13}\text{C}$ values are between 1.37 and 3.40 ‰ (V-PDB). The carbon isotope values are high compared to existing speleothem isotope data from surrounding countries, which might suggest a C4 vegetation. Both isotope proxies indicate systematic changes in rainfall and vegetation. Our data suggests sub-decadal hydroclimate variability (~ 1.5 ‰ in $\delta^{18}\text{O}$) over a 600-year period. We compare our new terrestrial paleoclimate record against coral records from the central and eastern Pacific to discern the similarities and differences in the hydroclimate response during the late Holocene. In combination with observations of modern hydroclimate, trends in stable isotope variation could provide insight into how hydroclimate in Colombia and the eastern tropical Pacific may look in the future.

Christopher Shin

Poster #A14

Home Institution: Brown University

Summer Research Program: Research at The Shukla Laboratory for Designer Biomaterials

Faculty Mentor: Anita Shukla, School of Engineering

Development towards a 3D Bioprinted Near-Infrared (NIR) Light Responsive Core-Shell Hydrogel Patch as a Topical Wound Infection Therapy

In the United States, over 2.8 million antibiotic-resistant wound infections occurred in 2019 leading to over 35,000 deaths, posing a significant clinical challenge. Current treatments include hydrogels, which are highly hydrophilic polymers that can encapsulate cargo (e.g., antibiotics) and provide an aqueous environment to reduce swelling and inflammation at infection sites, making them suitable for wound treatments in healthcare settings. However, their inability to control the release of antibiotics gives rise to skin toxicity and more resistant strains of bacteria; therefore, more work is needed to prevent the exacerbation of open wound infections. In this study, a three-dimensional (3D) bioprinted photoresponsive hydrogel patch with a core-shell architecture is proposed, and methods of its printing and simulating its drug release are investigated. The hypothesized mechanism involves NIR irradiation of the hydrogels, which triggers the localized surface plasmon resonance (LSPR) activity of the NIR-tuned gold nanorods (Au NRs) encapsulated in the shell, locally increasing the heat and therefore the solubility of ciprofloxacin encapsulated within the core, thermally controlling its on-demand release. Hydrogel substrate and bioprinting parameter optimization led to the clearest delineation between core and shell using a hybrid shell (calcium-crosslinked 3% (w/v) alginate and 10% (v/v) poly (ethylene glycol) diacrylate (PEGDA)) and a core (10% (v/v) PEGDA) printed at 50 and 20 kPa respectively, with an extrusion feed rate of 1.3 mm/s and a minute-long exposure to UV light. Image analysis is conducted to quantify diameters to obtain spreading ratios for the shell (1.063 ± 0.052) and core (1.756 ± 0.110) on all straight edges of the hydrogels. During printer parameter optimization, a macroscopic, cylindrical version of the core-shell

construct using 10% (v/v) PEGDA (core) and 3% (w/v) alginate (shell) is developed via separate template molding. The cumulative release behavior of ciprofloxacin is investigated at either 23°C or 40°C, mimicking a heat profile of encapsulated Au NRs upon NIR irradiation. Ciprofloxacin release is manipulated with an on/off heat cycle after an initial burst release from the core-shell system, exhibiting user control of ciprofloxacin release over time.

Clara Tandar

Poster #A15

Home Institution: Brown University

Summer Research Program: Draper Bioengineering Internship Program

Faculty Mentor: Eric Darling, Center for Biomedical Engineering; Ryan Dubay, Center for Biomedical Engineering

Dethroning Polystyrene: Cell-Like Particles with Tunable Acoustic Properties for Improved Calibration

The mechanophenotype of biological cells has been shown to correlate with biomolecular states and cell function. Hence, new methods to measure mechanophenotype at high throughput are of growing interest. Acoustophoresis, a method commonly used for contactless, label-free isolation of target cell types within complex samples, has recently been used to characterize cell mechanical features. To make accurate measurements of cell mechanical features, calibration particles with physiologically relevant properties are needed to quantify and optimize acoustophoretic device performance. Currently, conventional polymer microspheres are rigid and do not replicate cell deformation and compressibility. To address this, we expanded on our previous work on monodisperse, tunable, cell-like microparticles (MPs) from polyacrylamide hydrogel, fabricated with a flow focusing microfluidic droplet generator. MP size was controlled during droplet formation by modifying the continuous-to-dispersed phase flow rate ratios, while the compressibility and density were controlled by the monomer-to-crosslinker ratio and incorporation of nanoparticles (NPs) in the polyacrylamide precursor solution, respectively. Here, we present for the first time microparticles of reduced density and acoustic contrast (lower than unloaded MPs) achieved by loading MPs with low molecular weight NPs of tert-butyl acrylate and 1-octadecanethiol. The NPs were produced by bulk emulsion sonication and photopolymerization before addition to the MP precursor. Densities of MPs suspended in deionized water with known volume fractions were quantified using a U-shaped resonator densitometer. NP-loaded MPs were found to be statistically lower than unloaded MPs at 1005.9 and 1013.6 kg/m³, respectively ($p \ll 0.01$). Lastly, NP-loaded and unloaded MPs were suspended in aqueous media and infused into a glass flow cell mounted to a piezoelectric transducer. When a half-wavelength pressure standing wave was generated in the fluid cavity, the loaded MPs of negative acoustic contrast and unloaded MPs of positive acoustic contrast migrated away and toward the pressure node located along the channel centerline, respectively. These new particles extend the tunable range of acoustic contrast, mimicking and exceeding that of most biological cells and may also aid cell separation through conjugation to cells.

Connor Macken; Timothé Desbordes

Poster #A16

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Arto Nurmikko, Department of Engineering

Modeling the Brain and Studying Traumatic Brain Injury

We are working to take advantage of the coupling of optical fibers to simulate neuron-neuron interactions.

With a 3D array of these fibers, we can create a model for the neural system. We can then send energy pulsations into the system to simulate traumatic brain injury and study the neuron-neuron interactions during and after the energy pulse is received.

Dani Romero Mejia; Alex Green; Lucca Paris

Poster #B1 & #B2

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ian Dell'Antonio, Physics

Dark Matter and Galaxy Evolution in Observations of Galaxy Clusters

Our research uses gravitational lensing and analysis of optical multi-band, X-ray, and radio images to map out the dark matter in galaxy clusters in the local Universe and compare it with the properties of the galaxies and gas. Through combining our analysis (and those of other past undergraduate and graduate students), we measure the properties of the dark matter and the evolution of galaxies from the center to the outskirts of the cluster. This work involves using the computational resources at CCV to run and modify scripts to take raw telescope data into images, catalogs of galaxy positions, shapes, and brightnesses.

Daniel Wexler; Lorenzo Davidson

Poster #B3

Home Institution: Brown University

Summer Research Program: Experimental Program to Stimulate Competitive Research (EPSCoR-NSF)

Faculty Mentor: Baylor Fox-Kemper, Earth, Environmental, and Planetary Sciences

Using Satellites to Analyze Temperature, Chlorophyll and Salinity in Narragansett Bay

Narragansett Bay is the largest estuary in New England and is therefore of great environmental and economic importance. Not only does it support a biologically diverse ecosystem, but it also helps to filter the air we breathe and the water we drink. Since the start of the 20th century, Narragansett Bay has experienced above average increases in water temperature and significant pollution. Quantifying how different components of the Bay have changed over time in response to climate change, regionally specific anthropogenic actions, and natural processes, is critical to understanding the future of the Bay. There are several buoys in the region that collect data at a high temporal resolution, but this data is limited to only certain months of the year and to the specific locations of the buoys. In this study, we use remotely sensed data from the Landsat 5, 7, and 8 satellites to expand the record of sea-surface temperature (SST) to the entirety of the Bay over a 38-year period (1984-2022), and we make progress towards being able to measure chlorophyll (Chl) and sea-surface salinity (SSS) from satellite imagery. For SST, we calibrate the thermal bands of the three satellites against the in-situ buoy measurements using two different methods of bias corrections, one that uses the entire dataset and another that splits the data at different temperature thresholds and calculates a different bias for each side of this split. For Chl, we use two different multi-band algorithms to extract chlorophyll readings from the blue and green bands of the satellites and compare their respective accuracies. For SSS, we test for correlations between individual Landsat bands and buoy measurements to see if salinity is connected to color. In the future, we will use our record of SST to quantify how different parts of the Bay have changed over time and measure the amount of warming that has taken place over the past 38 years. We also plan to use a pattern recognition technique to improve our calibrations for Chl and SSS.

Home Institution: Brown University

Summer Research Program: Space Grant/NASA

Faculty Mentor: Yan Liang, Earth, Environmental and Planetary Sciences

Estimating Martian Mantle Temperatures with Al-in-Olivine Thermometry

In this project, I am investigating and developing a modified aluminum-in-olivine geothermometer that can be used to estimate the temperatures of crystallization of Martian meteorites. Olivine and spinel are among the first minerals to crystallize from basalts, tracking magmatic evolution and recording the parental magma's liquidus temperature. The Al-in-olivine thermometer is a model that uses the partitioning of Al between olivine and spinel and the atomic proportions of Cr to Al in spinel (Cr#) to estimate the temperature of olivine crystallization. Previous Al-in-olivine thermometers were calibrated to the terrestrial mantle composition. Without direct access to samples of the Martian mantle, applying a geothermometer to the Martian composition would have important implications for the study of the igneous evolution and differentiation of rocky planetary bodies like Mars. However, the original Al-in-olivine thermometer does not predict parental melt temperatures well when applied to the Martian shergottite samples, as Martian basalts are much more Cr-enriched than terrestrial basalts - so much so that instead of spinel, chromite is prevalent in the Martian basalts. Because spinel Cr# was used to calibrate the Al-in-olivine thermometer to the terrestrial mantle composition, I instead investigated the potential of using partitioning of Al and Cr between olivine and the melt composition in tandem with olivine geochemistry to develop a thermometer calibrated to the Martian composition. My research thus far has yielded a promising model utilizing Al partitioning between olivine and the parental melt and olivine forsterite, Ca, and Cr content that when applied to shergottite meteorite data yielded a positive correlation between estimated temperature and olivine forsterite content. My future research will apply this model to experimentally-created compositions of shergottite meteorites to further test its applicability to the Martian composition.

Dayna Jackson; Caylan Hagood; Gabriella Orfanides; Evrim Ozcan; Jared Ramirez; Raul Ayala Poster #B5 & #B6

Home Institution: Howard University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Kenny Breuer, Engineering; Ty Hedrick, Biology

To Surf or Not to Surf: Experimental Kinematic Methodology for Bird Wind Tunnel Flight

A key aspect of expanding our knowledge of biological flight is learning how flying animals, such as birds, alter their flight behavior in response to turbulent flight conditions. By observing the flight of European starlings (*Sturnus vulgaris*) in the controlled environment of a wind tunnel, we are able to better understand the potential benefit or cost of adapting to turbulent flight conditions. To investigate the kinematics and dynamics behind avian flight, we measure the birds' interactions with turbulent flows as well as the forces they employ to remain airborne using accelerometers and video analysis. We harness accelerometer "backpacks" to each bird to collect acceleration data along three axes for the duration of their flight. In addition, four wide-angle video cameras placed throughout the wind tunnel record the bird's location in the x, y, and z planes. The data from the accelerometer and cameras is synchronized. Analyzing this synchronized data may reveal patterns in how much a bird flaps its wings at different

locations in the tunnel as it “surfs” between upstream and downstream positions. Using these tracking techniques for multiple-bird experiments, we can identify trends in how the birds position themselves relative to one another.

Ding Ding Wei; Natalie Love

Poster #B7 & #B8

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: John Bradley Marston, Physics; Brenda Rubenstein, Chemistry

Statistics of Nonlinear Dynamics from Quantum Computing

By exploiting the fundamental laws of nature, quantum computers can offer significant speed-up over classical computers, potentially tackling problems that were previously considered difficult or impossible to solve. Some well-known examples include prime factorization and solving linear systems of equations that can be computed exponentially faster than known classical solutions. In our work, we use IonQ's 11-qubit quantum computer to model the statistical behavior of dynamical systems. In particular, we develop quantum algorithms to find the probability density function of the nonlinear Ornstein-Uhlenbeck model. We aim to test whether or not there is a speed-up over known classical approaches. Possible future applications of our work include the study of deterministic chaotic systems and climate modeling.

Jackson Moore

Poster #B9

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Derek Stein, Physics

The influence of temperature on the distribution of solvated ion clusters released by a nanopore ion source.

We studied the effect of temperature on the distribution of ion species emitted from a newly developed nanopore ion source into a mass spectrometer. The emission mechanism from the nanopore appears to be ion evaporation, whereby ions are pulled directly out of solution by strong electric fields that develop at the nanopore. Ion evaporation is a thermally activated process that typically releases ions in clusters with a small but variable number of water molecules. The distribution of such ion clusters is thought to depend on the rate of ion evaporation of each particular species, which has been linked to temperature. We tested that hypothesis by introducing a heating element near the tip of the nanopore ion source. Calibrations show that effective heating at the tip is possible. We find that raising the temperature of the tip from 20°C to 50°C leads to a decrease in the average mass of the emitted ion clusters and an increase in the abundance of bare ions. The ability to detect single ions is a step towards single molecule proteomics and effectively sequencing individual biopolymers.

Gabriella Orfanides; Evrim Ozcan; Jared Ramirez; Caylan Hagood; Dayna Jackson; Raul Ayala; Poster #B10 & #B11

Home Institution: Rochester Institute of Technology

Summer Research Program: NSF Research Experience for Undergraduates (REU)

Faculty Mentor: Alexander Gerson, Biology (UMass Amherst); Cory Elowe, Organismic and Evolutionary

Biology PhD Candidate (UMass Amherst)

So what's the cost? Quantifying avian flight energetics with ^{13}C -labelled sodium bicarbonate

Flight is an energetically expensive form of travel, yet birds have evolved many efficient flight strategies. Quantifying the metabolic cost of flight is essential to researchers attempting to gain insight into adaptive flight behavior and the exact mechanisms by which birds balance flight costs alongside other physiological costs. We used the

^{13}C -labelled sodium bicarbonate method (NaBi) to measure energy expenditure of European starlings (*Sturnus vulgaris*) flying in a wind tunnel. ^{13}C -labelled sodium bicarbonate was administered to starlings, respirometry measurements were taken before and after flights, and isotopic elimination rates were used to determine flight metabolic rates and overall energetic costs. Results provide insight into how flight costs may be impacted by biological processes such as molting or group interactions of birds during flight. Additionally, flight energetics in relation to turbulent flow structures created by a vortex shedding wake generator were preliminarily explored. We present NaBi as a useful methodological tool for addressing further questions at the intersection of biology and engineering, such as what metabolic costs or benefits may be associated with unstable flow patterns present in flight and what behavioral changes may arise.

Giang Thai

Poster #B12

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: James Valles, Physics

"Go with the Flow" or Not: Evidence of Positive Rheotaxis in *Paramecium caudatum* using High-speed Video Microscopy

Paramecium caudatum are single-celled organisms widespread in freshwater environments. Their approximately 200 micron long slipper-shaped bodies are covered with hair-like filaments called cilia that make them an attractive model organism for cilia beating in human organs where similar cilia assembly has been observed. *Paramecium* cells contain an oral groove — a channel near their cell mouth — and cilia attached here (known as oral-groove cilia) facilitate their feeding of other microorganisms such as yeast by sweeping them to their mouths where they are absorbed and digested. Cilia, however, are useful for more than just catching and swallowing their prey whole. Specifically, cilia outside the oral groove (i.e. on the body) beat in a coordinated fashion to propel *Paramecium* cells through the fluid. Some *Paramecium* behavior such as their reported positive rheotaxis — a tendency to orient their swimming against oncoming flows — suggest that their motile cilia may also perform sensory functions. To investigate this possibility, we studied the swimming of *Paramecium* cells from high-speed video at high magnification as they move in a microfluidic chamber that enables the application of precisely controlled fluid flow. However, the rapid movement of the cells makes quantitative measurements very challenging. We also carried out experiments to verify their positive rheotaxis by conducting video analysis of their swimming at low-speed videos. In our efforts to make quantitative our experimental observations, we modeled the velocity distribution of *paramecium* as they are turning and recorded detailed measurements of the frequency of cilia beating over a range of flow rates. How *paramecium* cells achieve their rheotactic behavior and the sensory basis that underpins it remains unclear.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Benjamin McDonald, Chemistry

Polymers As Enzyme Mimetics for the Depolymerization of Polyesters

This project investigates chemical recycling of polyethylene terephthalate, a semicrystalline thermoplastic polyester, which accounts for the majority of global synthetic polyester production. As its production and consequent accumulation in the environment continuously increases, sustainable methods of recycling of these polyesters is a critical issue today. Current efforts in the chemical recycling of plastics involve extreme temperatures and polluting reagents that pose significant danger to the environment and often also result in the deterioration of the quality of the plastic itself. This work investigates a dual-catalytic system for the depolymerization of polyesters, which includes a metal hydroxide base and a urea, the latter being biologically-prevalent in enzymatic reactions. Dual-catalytic systems have been shown to demonstrate a synergistic effect, yielding higher conversion rates than each catalyst alone or their sum. Using a well-known catalyst in the synthesis of polyesters, this project works to modify its reactivity to favor the transesterification reaction to yield the constituent monomers. We trialed four phenyl ureas with six bases under different temperatures and catalyst loading to identify the optimum conditions for the depolymerization reaction. In turn, to enhance the reusability and activity of the catalytic system, they will be incorporated into synthetic polymers to form enzyme mimetic macromolecules. This project aims to expand upon the growing field of chemical recycling by investigating efficient, cost-effective, and sustainable reaction conditions to yield the polyester monomer. These monomeric units can then be utilized in the regeneration of virgin-quality plastic for the closed-loop polyester economy.

Home Institution: Cornell University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Daniel Ritchie, Computer Science

Language-Based Material Manipulation for Transforming Sketches into Images

Image translation, that is, to alter the style and content of a given image to match predefined objectives, is a novel technique for artists to achieve their artistic vision. Recent works in image-to-image translation introduce methods to generate photorealistic imagery from non-realistic domains (e.g. drawings, paintings, etc.). However, recent works in image-to-image translation do not allow the user to select specific region(s) for transformation and control the style of generation through text while simulating a photorealistic style. In this project, we present a language-based image-to-image translation model that allows the user to perform object-level edits via semantic query texts. This model takes a sketched image, an instance segmentation mask of the various objects in the sketch, and their corresponding text descriptors as input to translate a sketched image into the photo-realistic domain through texture generation. We adapt existing image-to-image translation architecture along with a pre-trained text-image embedding model to encode text embeddings within an instance segmentation mask for controlled regional material appearance editing. Our method allows users to edit the object appearance, generating diverse outputs given the same input image. Our work automates architectural and product visualization

by allowing users to control the modes in which the sketches and designs are presented in the photorealistic domain.

Isabella MacNaughton

Poster #B15

Home Institution: UMass Amherst

Summer Research Program: Research Experience for Undergraduates (REU)

Faculty Mentor: Anita Shukla, Biomedical Engineering; Ronnie LaMastro, Biomedical Engineering

Synthesis and Conjugation of Fungal-Targeting Peptides to Nanotherapeutics

Systemic infections caused by the fungal pathogen *Candida albicans* are a major concern due to limited Food and Drug Administration (FDA) approved antifungal treatments. Currently available drugs are hydrophobic and toxic, leading to poor absorption and immune responses to the drug. Liposomal nanotherapeutics currently pose the most promising treatment for systemic fungal infections due to greater increased circulation times compared to free drug, potential fungal-targeting capabilities, and reduced levels of toxicity. Conjugation of fungal-targeting moieties to nanoparticles could improve the nanotherapeutic's interaction with fungal cells, thus improving drug delivery and overall treatment of infections. Peptides with antifungal qualities as these moieties may enhance the fungi-targeting and therapeutic efficacy of liposomal nanoparticles, which could further decrease overall toxicity associated with antifungal drugs. Here, MAP (Cys-KLALKLALKALKALKLA), pVEC (Cys-LLIILRRRIRKQAHASK), P-113 (AKRHHGYKRKFH), and P-113Q2.10 (AQRHHGYKRQFH), peptides known to interact with *C. albicans*, were synthesized using Fluorenylmethoxycarbonyl protecting group (Fmoc) Solid Phase Synthesis. Presently, P-113 and P-113Q2.10 have been conjugated to fluorescent polystyrene nanoparticles using maleimide-thiol click chemistry. We are utilizing polystyrene as a model nanoparticle to investigate conjugation methods to peptide moieties. Fourier Transform Infrared (FTIR) spectroscopy and Nuclear Magnetic Resonance (NMR) were used to determine successful conjugation of the peptide to the nanoparticle. In future studies, the fluorescent peptide conjugates will provide a visualization and qualitative analysis of peptide interactions with mammalian cells. In addition, we will investigate the antifungal properties, cytotoxicity, and fungal targeting efficacy of the peptides to determine the most promising peptides for future incorporation in liposomal antifungal nanotherapeutics.

Jacob Vietorisz

Poster #C1

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Research and Teaching Awards (UTRA)

Faculty Mentor: Derek Stein, Physics

Analysis of peptide photofragmentation for single-molecule protein sequencing

We analyze the feasibility of using light to fragment a peptide into its constituent amino acids before identifying them by mass spectrometry (MS) for the purpose of single-molecule protein sequencing. Laser power considerations strongly favor photofragmenting peptides in solution before they leave the ion source rather than in the gas phase. Ultraviolet (UV) wavelengths near 200 nm are weakly absorbed in water, and a single photon can selectively cleave a peptide bond that links amino acids together. These properties make UV photofragmentation more promising than methods based on infrared or x-ray light. We develop a simple model of the probability of liberating an amino acid intact by cleaving the peptide

bonds on either side of it before the light damages the amino acid itself. We predict 193 nm light can liberate many amino acids with probabilities ranging from 0.65-0.92; however, the aromatic amino acids and histidine, methionine, arginine, and lysine, which are relatively susceptible to photodamage, would be liberated intact with a probability in the range 0.004-0.330. These findings suggest that UV photofragmentation could reveal a significant amount of a single protein's sequence information to a mass spectrometer.

Jessiel Castillo

Poster #C2

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jerome Robinson, Chemistry; Alex Brown, Chemistry

Development of a Multimetallic Framework as a Model for Reactive Metal Oxygen Species

The interactions between metal centers and oxygen are essential to many critical biological systems and artificial processes. It was recently discovered that the addition of strong Lewis acids to copper-oxygen species resulted in completely new and unanticipated reactivity of the metal-oxygen bond. With this recent discovery, questions have emerged about the specific structure and properties of these compounds. In this project, we plan on stabilizing these transient species through a designed framework that enforces multimetallic cooperativity. This increased stability will be used to analyze structure and other properties, which will lead to new applications in renewable energy.

Karen Liu

Poster #C3

Home Institution: Amherst College

Summer Research Program: NSF REU for Artificial Intelligence in Computational Creativity

Faculty Mentor: Jeff Huang, Computer Science

Using Motion Data to Visualize Mobile Device Interaction Experience

Usability research on mobile software remotely has become increasingly important, but current methods often fall short of on-site testing on accuracy, clarity, or efficiency. To perform remote testing, orientation, linear acceleration, and angular velocity data collected from the mobile phone motion sensors are central to making predictions about the user's behavior. As such, time-series plots of the motion data are the intuitive choice for accuracy, but they lose clarity of the emotive experience, as well as efficiency in the researcher's ability to analyze these graphs. This project is prototyping artistic ways of visualizing motion data to provide insights into the user interaction experience that are not possible with traditional plots. The more abstract stills and animations tackle issues of clarity by extracting and emphasizing certain changes in motion, as well as issues of efficiency by compressing the amount of time taken to analyze user motion data. So far, the decreased emphasis on linear representation through visualizations that parallel the effect of water ripples has a positive impact on the intrigue of viewing motion data even as it sacrifices the accuracy of direct-mapping.

Home Institution: Arizona State University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Mauro Rodriguez, Engineering

Ultrasound-Induced Microbubble Perturbations in a Non-Newtonian Fluid

Ultrasound-induced microbubble oscillations are used for non-invasive imaging, diagnostics, and targeted drug delivery. These microbubbles are coated with a stabilizing agent and then injected into the bloodstream. Ultrasound pulses are used to oscillate boundary-attached microbubbles to form non-spherical perturbations and generate a microjet that ejects a payload (drug) to a desired location. The objective of this research is to study the theoretical ultrasound-induced, non-spherical microbubble dynamics and perturbations in a non-Newtonian, viscoelastic fluid. A Rayleigh-Plesset-type theoretical model for wall-attached microbubbles is augmented to include non-Newtonian and viscoelastic (nonlinear elasticity) blood and subjected to ultrasound waveforms used for targeted drug delivery. We determine the evolution of dominant non-spherical modes in biological tissues. The comparisons between the perturbation mode dynamics to spherical, free-field simulations to demonstrate the effect of the wall will also be presented.

Home Institution: Penn State

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: John Mustard, DEEPS

Exploration of Water in the 6 Micron *Wavelength* Region

The presence of water species (OH- / H₂O) is widespread on the Moon, indicated by the presence of an absorption at 3 μm. However, the 3 μm region contains both hydroxyl (OH-) and molecular water (H₂O) signatures which have proven difficult to disentangle. The presence of molecular water has been found in lunar samples and in observations by the SOFIA telescope showing a 6 μm absorption. While the 6 μm fundamental bending vibration of water can confirm the presence of H₂O, fundamental analysis of laboratory data of known samples has not yet been done. Here, we bridge this gap of knowledge by characterizing the 6 μm absorption feature in water-bearing crystalline minerals. Using the RELAB spectral library, we have surveyed the spectral characteristics of 66 hydrated minerals. We find the 6 μm water feature to have a band position between 6.040 - 6.206 μm, with an average band position of 6.136 μm. Seven of the hydrated minerals display a spectral doublet near 6 μm, with the first band position being between 5.803 and 6.024 μm, and the second band position being between 6.047 and 6.289 μm. Two minerals displayed spectral triplets. In minerals with doublets and triplets it is unclear which band positions are a signature of the fundamental bending vibration of water. Our results display a fundamental bending vibration of molecular water band position and range that is consistent with the 6 μm band position reported on the Moon.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jerome Robinson, Chemistry

Influence of Ring Size on pKa and Copper Chelation for a series of Cyclen-based Spirocyclic Polyaminocarboxylates

Imaging of amyloid beta plaques is critical for diagnosing Alzheimer's and following disease progression. Positron emission tomography (PET) is a powerful technique that enables quantification of amyloid beta and tau protein aggregation over time. Previous FDA approved Alzheimer's PET agents are effective but rely on ^{18}F and ^{11}C isotopes which have prohibitively short half-lives ($t_{1/2} = 109.7$ min and $t_{1/2} = 20.3$ min, respectively). ^{64}Cu is a promising agent for PET imaging because it is a positron emitter with a desirable half-life of 12.7 hours. A complication is, reported ^{64}Cu compounds are not lipophilic enough to pass the blood-brain barrier, a primary checkpoint for effective imaging of amyloid beta plaques. In order to improve blood-brain barrier penetration, ^{64}Cu compounds should be stable, neutral, and lipophilic. Here, a series of lipophilic spirocyclic cyclen-based compounds are reported which display favorable thermodynamic stability setting the groundwork for future in vivo studies.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Brenda Rubenstein, Chemistry

Calculating Entanglement in Molecules

Entanglement is the correlation between the state of one particle and the state of another. When two particles are entangled, the transfer of information between them is instantaneous, a surprising result that now serves as the basis for many critical quantum technologies. In quantum computing, for example, entangled quantum bits (qubits), which store probabilities represented by wave functions in a superposition of states, allow for more efficient computations. Quantifying entanglement is essential to utilizing qubits, currently embodied in particles (ions, photons, electrons, etc.), not entire molecules. Our goal was to pioneer a method to calculate entanglement between electrons in molecules using exact diagonalization, which can be used to solve the Schrodinger Equation for molecular Hamiltonians. Using the eigenvalues obtained in this way, we calculated the entanglement of electrons within molecules. These entanglements can ultimately be used to rank molecular qubit candidates.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: James Russell, Earth Environmental and Planetary Sciences (DEEPs)

A 6,000 year record of Holocene hydroclimate and lake water balance from Lake Edward (Uganda - D.R. Congo)

Despite projected precipitation increases over East Africa, climate models suggest that water-availability

in this drought-prone and water-stressed region will decline further in the future, due to changes in the character of rainfall events and warming-induced evaporation increases, highlighting the importance of controls on terrestrial water-availability other than direct changes in precipitation amount. Existing African paleoclimate records indicate that temperatures increased by ~ 2 °C during a Mid-Holocene optimum 5-6 thousand years ago – similar to warming expected in coming decades – while precipitation has declined since Africa's early Holocene Humid Period, primarily in response to variation in radiative forcing. Hence, high-resolution Holocene paleolimnological climate records may present an informative “natural factorial experiment,” through which the combined impacts of warm/cold and wet/dry climate states on East African land hydrology can be assessed. Integrating information on the stable isotopic composition of precipitation and surface paleo-waters from lacustrine sedimentary archives in a hydrologic mass-balance model allows for a quantitative simulation of changes in atmospheric evaporative demand and its influence on terrestrial water-availability. This analysis will employ a new organic geochemical record of the hydrogen isotopic composition (δD) of terrestrial plant leaf waxes (a proxy for precipitation isotopic composition) together with data on the oxygen isotopic composition ($\delta^{18}O$) of authigenic carbonates (a record of lake water composition) from Lake Edward in the Western Rift of Equatorial East Africa in order to better elucidate the evolution of Holocene moisture regimes in the region.

Lily Tran

Poster #C9

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Andrew Westbrook, CLPS; Michael Frank, CLPS

Fractal Scaling in Heart Rate Variability Dynamics with Cognitive Load

Heart Rate Variability (HRV) is examined in studies of exercise physiology and general medicine. It reflects the balance between the parasympathetic and sympathetic systems of the autonomic nervous system. HRV can be summarized using simple statistics (e.g. standard deviation), but has also been quantified by fractal scaling, a mathematical term that describes patterns observable across varying scales along which it is viewed. HRV typically decreases with increasing physical demands which is thought to reflect diminishing adaptability. Here, we test our hypothesis that fractal scaling and HRV correlate systematically with increasing cognitive demands.

Detrended Fluctuation Analysis (DFA) is used to determine the dynamics of fractal scaling in heart rate with increasing cognitive load. DFA is a key statistical method used to analyze scaling behavior in time series. DFA can quantify scaling behavior in physiological systems (e.g. neuronal and cardiovascular), and demonstrate long-range temporal correlations therein. When the variability of inter-beat intervals scales increases linearly (in log-log space) with the number of beats over the window in which variability is measured, HRV exhibits fractal scaling. In contrast, when they become more random or more correlated, fractal scaling breaks down. Physiologically, this may be due to the withdrawal and reallocation of the vagal control (mediated by the vagus nerve) toward other immediate mental or physical demands. Vagal withdrawal may explain why decreasing HRV is associated with diminished adaptability.

To explore the relationship between HRV and cognitive load, we utilize DFA to determine the fractal scaling dynamics in heart rate with increasing cognitive load. We test the prediction that fractal scaling in HRV both varies systematically with cognitive load and also correlates with individual differences in the fractal scaling of reaction times. We also test the prediction that fractal scaling in heart rate correlates with individual differences in subjective cognitive effort during task performance. Finally, because fractal scaling in neuronal oscillations has been shown to correlate with fractal scaling in behavior (both quantified by DFA), on-going work will test the hypothesis that diminished fractal scaling in HRV correlates with reduced fractal scaling in EEG signal and cognitive flexibility in demanding mental tasks.

Home Institution: Williams College

Summer Research Program: REU Artificial Intelligence in Computational Creativity

Faculty Mentor: James Tompkin, Computer Science

Using Topic-Focused Summarization to Understand Generated Abstractive Summaries of Language Models

Natural Language Processing is rapidly advancing from the field of research to industrial applications at a rate that has been outpacing its own regulations. The amount of data and parameters available for the training and fine-tuning of neural network models is increasing too fast to understand how these language prediction models produce output on existing tasks. This research project investigates the task of generating abstractive summaries using topic-focused summarization. Using the third-generation Generative Pre-Trained Transformer model (GPT-3) and the CNN/Dailymail and WikiHow datasets, we input sets of original and perturbed texts and probe the output abstractive summaries for social biases by comparing them against the ground truth summaries. Semantic perturbations in target attributes, such as verb tense, adjective choice, and sentiment variation, can lead to variations in output; by measuring the consistency of meaning across these variations, we will evaluate the susceptibility of GPT-3 to making stereotypical associations for gender, race, and other biases.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jerome Robinson, Chemistry

Bridging the Gap Between Catalyst Structure and Function for N-oxide Amplified Stereoselective Ring-Opening Polymerization of a Series of Beta-lactones

Plastics (polymers) have enabled critical advances in nearly every aspect of modern life. Our society's reliance on enormous amounts of environmentally persistent polymers is contributing to over 400 tons of plastic waste per year and is one of the greatest environmental concerns for current and future generations. Isotactic poly-3-hydroxybutyrate (P3HB) is a naturally occurring material, which can display comparable physical properties to traditional plastics such as polyethylene, can be renewably sourced, and is biodegradable. However, synthetic access to isotactic P3HB has been extremely limited. Our group has developed methods to produce isotactic P3HB with unprecedented levels of activity and selectivity, where system performance can be amplified through the addition of simple Lewis bases. Initial results suggest selectivity and activity can be tuned by substitution of these neutral donors. While electronic studies have shown a volcano-plot type relationship between Hammett parameters and reactivity, structure-function relationships regarding the sterics of the neutral donors and catalyst performance have yet to be established. In this project, our goal is to synthesize a new family of diverse Lewis bases (2,6-disubstituted pyridine-N-oxides) and investigate their effects on the activity and selectivity for the ring-opening polymerization of beta-butyrolactone (BBL). Furthermore, this catalyst represents the first generalizable homogeneous catalyst for the synthesis of isotactic P3HB. We demonstrate this via the polymerization of a variety of lactones, which can then be used for copolymerizations, allowing for tunability of mechanical and thermal properties.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Yan Liang, Earth, Environmental, and Planetary Science

Reading Depth of Magma Crystallization from Aluminum and Titanium Concentrations in Pyroxenes of Martian Meteorites.

Martian meteorites are the only samples on Earth that are available for research into the geology of Mars. There are more than 330 identified martian samples so far, with most of them being basalts or crystallization products of basalts. Compositions of martian meteorites can give us insight on the processes of magmatic evolution and martian mantle processes. An important parameter to the interpretation martian meteorites is pressure or depth at which the magma was formed or stored in the martian crust or mantle. A widely used approach in the martian meteorite community to find these depths is with concentrations of Al and Ti in the mineral pyroxene, however the accuracy of this model has not been assessed critically for martian data. Here we investigate factors that control pyroxene Ti/Al ratios with a combination of thermodynamic models and mineral data. This will be done by comparing the alphaMELTS thermodynamic model for pyroxene growth, against martian and terrestrial experimental data in addition to martian samples. This model has been calibrated with terrestrial data such that its accuracy with martian samples is unknown. Lastly, we are employing lattice strain models for pyroxenes as an attempt to predict the Ti content of the model-generated minerals more accurately.

Home Institution: Harvey Mudd College

Summer Research Program: Scale-Aware Sea Ice Project (SASIP)

Faculty Mentor: Christopher Horvat, Institute at Brown for Environment and Society (IBES)

The Summer Role of Clouds on Arctic Sea Ice in Climate Models

The changing and melting of the Arctic sea ice cover is heavily influenced by the surface radiative budget. The presence of clouds changes this net radiation by decreasing incoming shortwave radiation and increasing incoming longwave radiation. In winter, incoming solar shortwave radiation is negligible over the Arctic, thus the surface of the Arctic is warmed more by clouds than by clear skies. In the Arctic summer, clouds have warmed the surface of the Arctic as well, but as the overall albedo of sea ice declines, this role may change. We use data from the Community Earth System Model Version 2 Large Ensemble (CESM2-LENS) to establish when and where clouds will cool the Arctic surface in the future, both geographically and averaged across the Arctic. We find that clouds will change from warming to cooling the surface of the Arctic in June relative to clear sky conditions by 2050 based on CESM2 predictions. While the clouds in July are already presently and historically predicted to be cooling the Arctic surface, CESM2 also predicts high increases in the relative amount of cooling between cloudy and clear skies to occur in the future.

Home Institution: Washington University in St. Louis

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Timothy Herbert, Earth, Environmental and Planetary Sciences

Under the Sea-diments: Reconstructing Past Climate Using South African Marine Sediment Cores Affected by the Agulhas current

Upwelling systems are a vital part of ocean climate dynamics because cold water, filled with nutrients from the deep ocean, is brought to the surface which leads to an active ecosystem filled with life. West of South Africa there is upwelling and alongside that upwelling, there is the Agulhas current bringing in warm water from the East. Ocean currents have some influence on climate. For the region off the coast of South Africa, this is the same, however, we do not understand just how impactful these currents are for this region. Understanding this is especially important when attempting to reconstruct its past climate. One particular way to reconstruct past climate is by looking at calcium carbonate. This comprises shells and skeletons and is a good indicator of past biologic productivity. Looking at the calcium carbonate percentage of deep-sea marine sediments in this region, one can infer how the region might have looked previously. Marine sediment cores were taken from this region and contained sediment from the Pliocene. The sediment was found to have a high percentage of calcium carbonate indicating a lively region. The remaining composition of the sediments is terrigenous because little to no biogenic silica was found. Looking at how sediment changes through time can help us formulate a cycle and add to mapping global climate changes. This can further our understanding of ocean circulation currents' impact on climate and how climate could likely be at the end of the 21st century.

Willis Bilderback

Poster #C15

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Robert Hurt, Engineering

Kinetics of the Release of Intercalants from Graphene Oxide Nanosheets

I have been investigating the effects of pH and ionic strength on the elution of Rhodamine B, a common tracer molecule, from graphene oxide nanosheets it is intercalated within. Previous literature from the group I am working with has demonstrated that few-layer stacks of graphene oxide nanosheets intercalated with small molecules, including Rhodamine B, can be useful for releasing these molecules in a controlled manner. This work showed that most of the molecules released from nanosheets moved primarily perpendicular to the plane of the nanosheets through small gaps between sheets, rather than through the edges of the films. It is theorized the reason this is the dominant mechanism of release is that functional groups on the surface of graphene oxide provide significant hindrance to the lateral motion of molecules between the sheets, making it faster for them to move a small lateral distance to a new randomly located gap than to move laterally all the way to the edge of the film. An interesting follow-up to this is to determine how various factors that affect the interlayer spacing of graphene oxide films affect the rate of release for intercalated molecules, as a greater interlayer spacing would be expected to reduce the resistance to lateral motion of molecules, thus increasing the rate of their release by both aforementioned mechanisms. This is what I am investigating, as it is known that strongly acidic conditions reprotonate the carboxylate groups on graphene oxide's surface, removing the negative charge on graphene oxide's surface and ameliorating their electrostatic repulsion, decreasing the interlayer spacing. It is for this reason predicted that decreased pH will slow the release of any intercalant from graphene oxide. It is believed that at higher ionic strengths positive cations will insert themselves between the negative charges of graphene oxide surfaces, also reducing the electrostatic repulsion between sheets, meaning it will significantly increase the release of molecules at high pH, but have little effect at low pH. I am investigating how both of these factors interact with one another to allow for fine tailoring of the release

rate of molecules from graphene oxide nanosheets.

Yungeun Kim

Poster #C16

Home Institution: Brown University

Summer Research Program: Undergraduate Researcher

Faculty Mentor: Brenda Rubenstein, Chemistry

Correlating Factors in the Kumamoto Oscillation of Coupled Biofilm

Often called Biofilm, these collectives of microorganisms can collaborate to organize their behaviors. With recent research noting that biofilm communities undergoing individual metabolic oscillations become coupled through electrical signaling to synchronize growth between in-phase and anti-phase oscillations, the extent to which variables largely impact these phase transitions are yet to be fully understood. By implementing a simpler Kumamoto model and other computational techniques, the degree to which each variable can impact phase transitions becomes clearer.

Madelyn Stewart

Poster #D1

Home Institution: Yale University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Chris Horvat, Institute at Brown for Environment and Society

Emulating ICESat-2 Laser Altimetry to Measure Sea Ice Concentration

Sea ice is an important indicator of global warming as well as a significant parameter in climate models. Passive microwave satellites, the standard choice for sea ice concentration (SIC) measurements, potentially overestimate SIC because they fail to recognize long, thin cracks in the sea ice. SIC retrieved from ICESat-2, a laser altimeter that produces highly accurate measurements in straight-line paths over sea ice, may be a more accurate alternative. However, the error of relying on binary straight-line transect data over a large region to find an overall measurement is unknown. In this study, we emulated the sea ice measurement technique of ICESat-2 to quantify and characterize associated errors in SIC. We then studied the emulator's results on randomized binary surfaces, computer generated pancake ice, and groundtruth sea ice data from NASA's Operation IceBridge. We found the absolute error of emulated IS-2 SIC measurements decreases as a function of the distance covered by ICESat-2. We anticipate the model results to reach less than 3% error, below the standard deviation for passive microwave satellites over similar conditions, within 20 transects for all types of surfaces. This work helps authenticate the satellite's ability to provide better SIC data than passive microwave satellites.

Maria Clara Rapoza

Poster #D2

Home Institution: Colgate University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Stephen Parman, Earth and Planetary; Joseph Boesenberg, Earth and Planetary

Early Inner Solar System Conditions Recorded in New Meteorite NWA 14756

The building blocks of our modern day solar system, from the Sun to our very planet Earth, were meteorites. Some meteorites are unaltered and still preserve and record the conditions present during early solar system formation. One category of such meteorites, ordinary chondrites, are derived from the inner solar system. By looking at the bulk mineral composition of the new meteorite sample North West Africa (NWA) 14756 on an electron microprobe and comparing it to similarly classified meteorites (FeO poor LL ordinary chondrites), we can determine the temperatures, pressures, and other variable conditions that persisted at the time and place of NWA 14756's formation in the early solar system. Here we show that the NWA 14756 meteorite fits the generally accepted compositional trends for low petrologically altered LL3 ordinary chondrites. Our results reveal this meteorite is primarily abundant in olivines, pyroxenes, spinels, and glass, with Type I and II chondrules with varying mineral abundances, and highlights what the primitive solar system was composed of. We anticipate our research to add to current ordinary chondrite data and provide more evidence as to what the inner solar system was like in the beginning of planetary formation. Furthermore, learning about meteorites adds to our understanding of how celestial bodies like asteroids and planets formed, as well as how impacts have changed and influenced life and evolution of planets like Earth.

Maya Gong

Poster #D3

Home Institution: Haverford College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Baylor Fox-Kemper, Earth, Environmental, and Planetary Sciences

Modeling River Runoff Using Precipitation Data in the Narragansett Bay

In this study, we model river runoff into Narragansett Bay and nearby waterways from gridded weather model precipitation data from the North American Mesoscale Model from 2006-2022. This model would allow us to approximate river flow projections based on precipitation projections, based on approximating the present day hydrological relationship between both. We approximate each major river basin emptying into the bay as a collection of grid cells of precipitation discretization and sum the precipitation into each river basin. The precipitation data within each basin was compared against the respective river gauge data from the United States Geological Survey (USGS), using a simple cumulative time-lagged correlation approach. This comparison results in a simple model of river runoff in the bay that approximates runoff as the sum of precipitation data that exponentially decreases with respect to time. This model explains a large fraction of the rivers' flow and variability.

Mia Hines

Poster #D4

Home Institution: Grinnell College

Summer Research Program: NSF REU Site: Artificial Intelligence for Computational Creativity

Faculty Mentor: Jeff Huang, Computer Science; James Tompkin, Computer Science

TeachHandi: Artificial Intelligence System and Interactive Program to Teach Handwriting

Analyzing handwriting in the Artificial Intelligence community has become increasingly popular. Computer Scientists have focused on creating programs to generate handwriting from text input, recognize

handwritten characters, and improve the methodology of compression and capture of handwriting data. The development of a program to teach or improve a human's handwriting style has yet to be explored by the AI handwriting community. Our project focuses on the development of a Machine Learning model and interactive interface that contributes to the overall improvement of an individual's handwriting. We implement a stroke-based model that separates style and content from handwriting, which allows the user's flexibility of their own style. Furthermore, the interface teaches handwriting through fun and meaningful exercises. Schools and outreach organizations across the country can use the program in their teaching English language initiatives. Additionally, the program can be used by millions of individuals to easily and efficiently improve their handwriting.

Morgan Jones

Poster #D5

Home Institution: Howard University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Mauro Rodriguez, Engineering

Theoretical microbubble growth dynamics from a liquid-solid interface

There is a critical societal need to focus on non-fossil fuel energy technologies, particularly those that use electrochemical interactions. These electrochemical reactions produce gasses (e.g., ammonia and hydrogen) that serve as intermediates to the production of energy (e.g., batteries) and chemicals. These technologies can become solutions for energy needs in automobile and aviation industries. A critical challenge from this sector involves the scalable production of gasses from the electrochemical reactions from a liquid that is in direct contact with an electrified surface. The reaction produces gas molecules (e.g., hydrogen) that then slowly forms a gas bubble. The bubble grows, reaches a critical volume, becomes buoyant, and eventually detaches from the solid-liquid interface. Our aim is to understand the growth mechanics of the bubble attached to an electrified surface. We first consider a bubble that grows due to a sinusoidal injection of gas modeling the electrochemical reaction. Second, we consider the strategy to detach the bubble from the surface via a sinusoidal input-pressure waveform. For both cases, we conduct theoretical bubble dynamic calculations solving a Rayleigh-Plesset-type equation with varying amplitude, initial radius, and frequency. We compare the computed maximum bubble radius and compare the results to the theoretical maximum radius for a spherically growing bubble.

Muhammad Shafiq

Poster #D6

Home Institution: Mercer University

Summer Research Program: (REU)

Faculty Mentor: Ian Gonsler, Department of Engineering

Elderly Healthcare Technology 2032

How can we integrate new healthcare technology into our living environment so that the next generation of human-computer interface is seamless and easy to use? How can we mitigate the disconnect between elderly and healthcare providers? Advances in home healthcare for the elderly have seen a drastic increase due to the pandemic. However, the application of home healthcare is challenging because such systems are difficult to integrate into the living environment to be used effectively. For this problem, we have developed tbo 2.0, a smart robotic table that blends into the environment. This paper describes the

smart table prototype and its application to healthcare technologies integrated within such as telecommunication, emergency call, oximeter, and mobility help. Furthermore, the smart table is accompanied by a user interface developed specifically to simplify user experience for the elderly. Tbo 2.0 is the centerpiece of a living environment allowing the user to have medical care anytime they need. The smart table demonstrates that the human-computer interface can be simplified to make technology effortless to use.

Nadia McGlynn

Poster #D7

Home Institution: Vanderbilt University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Christian Huber, DEEPS

Modeling the Role of Edifice Growth on Eruptions and Magma Chamber Growth and Longevity

As the largest volcano in the solar system, activity of the Martian volcano Olympus Mons has likely persisted for much of the geologic past of Mars. Volcanic activity is the result of feedbacks between different components of the volcanic system and its surroundings. One example of such an interaction is the impact of added mass from a volcanic edifice at the surface on eruption frequency and underlying magma chamber growth and longevity. To better quantify the range of responses of magma chamber behavior to changes at the surface, we utilized analytical calculations based on a two-dimensional cylindrical reservoir to formulate a mathematical model. From this, we explored the effect of hoop stress and maximum tensile stress on chamber geometry and size. We showed that in a relatively deep magma chamber, the edifice will have a lesser effect on eruption history. Edifices with large radii and lesser heights may serve to inhibit eruptions, while an edifice with a small radius and larger height will promote eruptions. Over the history of Olympus Mons, the evolution of edifice growth may have had dramatic effects on the eruption frequency and altitude of the volcano. Changes in altitude, rather than latitude, played an important role in dictating local climate conditions on Mars, especially in regards to ice growth. Uncovering the details of Olympus Mons's eruption history and growth may provide additional constraints that help us piece together the evolution of climate and past environments on the planet.

Natalie Chang

Poster #D8

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Daniel Ibarra, Earth, Environmental, & Planetary Sciences

Late Quaternary climate reconstruction of Silver Lake through oxygen and carbon isotopes in ostracod carbonate

Lake Mojave, a pluvial lake of the Mojave River, existed from the Late Pleistocene to Early Holocene, a period of rapid and extreme climate change. Survived by Soda and Silver Lake playas today, Lake Mojave is suggested to be sensitive to climate and water cycle fluctuations, making it an excellent archive of paleohydrology in the Pacific Southwest. Here, we present qualitative preservational observations paired with carbon and oxygen stable isotopes from ostracod shells from a 9-meter sediment core taken from Silver Lake. Ostracods construct their shells using dissolved carbonate ions from ambient lake water, which are directly affected by climatic parameters and provide insight on the

hydrochemistry and water temperature at the time of calcification. Due to the short lifespan (~2 years) and quick molting rates (~8 stages to reach adulthood), ostracod shells are sensitive to seasonal changes that may be missed through bulk-sediment analysis. We classified ostracods through quantity per depth, shell-to-sediment ratio, degree of pyritization, and degree of color alteration. Both shell size and color alteration increased with depth, while pyritization appeared consistent throughout all depths. Carbonate analyses show general trends of $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ both becoming isotopically lighter with time. This correlates with an increase of temperature and decrease in precipitation entering the early Holocene. Notably, an extraneous point with a high percentage of sand correlates with particularly variable isotopic values of the same depth. This also follows a peak in annual precipitation seen through a recent reconstruction of the paleoclimate of western North America. Given the lack of duplicate ostracod shell analyses within a given depth, more research is needed to adequately support a direct causal link. However, since ostracod shells are potentially capable of detecting more minute changes in hydroclimate, abrupt alterations in paleoenvironment could affect and be seen through ostracod shell chemistry. In sum, these analyses support previous findings of a wet Late Pleistocene and drier Early Holocene while increasing our temporal understanding of the evolution of Silver Lake and the Mojave River system.

Nathan Craig

Poster #D9

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ian Dell'Antonio, Physics

Simulating the Effect of Blending Shear Biases

The Rubin Observatory is a giant telescope project that is just finishing construction in Chile. The observatory will be conducting the "Large Survey of Space and Time" (LSST), which will produce deep maps of 1/2 of the sky. As one of the many projects that the LSST will be used for is to measure the dark matter content of galaxy clusters using the distortion of the shapes of background galaxies (this is weak gravitational lensing). However, the LSST images will be so deep that images of the galaxies will overlap. This will make measuring the shapes hard. The purpose of this project is to construct simulations of LSST images with and without blended objects, to determine the size of the average shape measurement error, and whether the average is shifted from the true value.

Nnenna Nwankwo

Poster #D10

Home Institution: Howard University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Kareen Coulombe, Department of Biomedical Engineering

Engineering a High-Throughput Method to Assess Cardiotoxicity In Vitro

In vitro cardiotoxicity testing using human induced pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs) is an increasingly popular technique for assessing the safety of drugs during pre-clinical studies. hiPSC-CM based models reduce the need for animal models and provide a controlled, human-relevant in vitro platform for experimentation. Previous studies in our lab have demonstrated the use of cardiac microtissues as predictive models to detect pro-arrhythmic cardiotoxicity. However, the process of creating the hydrogel molds in which cells self-assemble is tedious and impractical for large-scale experiments. Using Onshape, we developed a 3D printed device engineered to scale up the

production of hydrogel molds, with features that allow for high-throughput imaging of microtissues. The device has 64 cellular recesses (8x8 array) designed to achieve a structured pattern that simultaneously records the action potential of each microtissue. Polydimethylsiloxane (PDMS) was then cast onto the 3D printed model to fabricate a stamp-like device. Compared to the 35-microwell hydrogel molds used in previous studies, our device has additional recesses that increase the number of microtissues we produce. It also enables us to simultaneously form hydrogel molds across multiple wells of well-plate. Using this device, we successfully generated cardiac fibroblast-only microtissues, demonstrating the feasibility of a high-throughput model for optical imaging. Future work will use a B9 Creator printer to produce smaller microwells suitable for 12-well and 24-well plates. Further development of this device could lead to commercial applications in large-scale drug testing in the pharmaceutical industry.

Patrick McCann

Poster #D11

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Alberto Saal, DEEPS

Southern Patagonia: The connection between magmatism, subduction, the slab window, and the continent

The Patagonia slab window formed ~12 Ma when the actively spreading Chile ridge subducted beneath the South American plate. Subslab asthenosphere upwells through the gap that forms as the subducting oceanic plates separate. This results in decompression melting and slab window volcanism, producing basalts at the surface that preserve a geochemical record of the underlying mantle. Geophysical observations suggest that the mantle flows through the Patagonia slab window from west to east, but geochemical studies of South Patagonian basalts have not shown clear evidence of mixing with a Pacific subslab component. We measured Sr, Nd, Pb, and Hf isotope ratios as well as major and trace element compositions of basalts from Meseta de la Muerte to investigate the mantle flow in this unique tectonic region. The data suggests these basalts were formed by mixing between three compositional endmembers: a mantle wedge component depleted in incompatible elements, a slab component enriched in incompatible elements, and a younger EM1 component that's only present in basalts that formed after the slab window had fully opened beneath the region. The younger EM1 component resembles the composition of the South Atlantic mantle, but it does not resemble the composition of the Pacific subslab mantle. This provides evidence of mixing with Atlantic mantle flowing from the east, but it does not provide evidence of mixing with Pacific mantle flowing from the west.

Pittayuth Yoosiri

Poster #D12

Home Institution: Brown University

Summer Research Program: SASIP

Faculty Mentor: Christopher Horvat, Institute at Brown for the Environment and Society (IBES)

Sea Ice Concentration Calculation with ICESat-2

Sea ice concentration (SIC) is an essential parameter for climate models, informing our understanding of Earth's changing cryosphere. Current SIC data relies on passive microwave (PM) sensors, which struggle to resolve small features like fractures in compacted sea ice. Modern laser altimetry, such as the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2), is capable of decimeter-level elevation accuracy over a much smaller footprint than PM sensors. This allows for better precision in classifying overflown surfaces. This study examines a new SIC product from ICESat-2 based on the ATL07 sea ice height product. The

ICESat-2 SIC estimates are then compared against PM SIC predictions from the National Snow and Ice Data Center and the Ocean and Sea Ice Satellite Application Facility. Idealized SIC calculations along the ICESat-2 tracks are compared with measured SIC data from ICESat-2. Multispectral products from the DigitalGlobe WorldView satellite constellation and the Moderate Resolution Imaging Spectroradiometer are used as ground-truth to assess the accuracy of SIC data from ICESat-2 and PM sensors. Focusing on the spring melt seasons of 2020 and 2021, we find ICESat-2 to be more accurate at measuring SIC for regions with 96-97% SIC than PM sensors. This study validates the viability of ICESat-2 to estimate SIC in regions of compact, but not fully-ice-covered areas.

Rachel Ma; Lyndon Lam; Aditya Ganeshan; Benjamin Spiegel; David Paulius; Roma Patel;
Poster #D13 & #D14

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: George Konidakis, Computer Science; Stefanie Tellex, Computer Science

Goal Understanding Through Verbs

Household robots have to be able to manipulate all sort of objects, including objects they have not seen during training. When given a human-language command and presented with an unseen object, a robot should first see whether it understands the human's intentions before carrying out the command. We have developed a model that transforms the visual representation of seen objects, conditioned on a verb. By performing the correct transformation, the model correctly predicts the termination state of the manipulated object. If the object door was seen during training, then given the visual representation of a closed door and the command "open the door", the model should transform the visual representation of a closed door to one of an opened door. This project demonstrates the use of verbs to transfer manipulation knowledge to unseen objects. We expect utilizing the commonality between language commands (verbs) to help with generalization that can be implemented across a spectrum of objects.

Rachel Rowey; Angelina Schorr

Poster #D15

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA), Neal Mitchell '58 Systems Thinking Project Award

Faculty Mentor: Vikas Srivastava, School of Engineering

Improving Chemotherapeutic Efficacy: Hydrogels for pH Regulation of the Cancer Tumor Microenvironment

The tumor microenvironment (TME) is identified as a critical factor that influences cancer cell proliferation, metastasis and anticancer drug efficacy. The high metabolic activity of cancer cells and inefficient perfusion of the tumor contribute to accumulated metabolic products in the TME leading to cancer cell acidification of the extracellular space. As a consequence, many therapeutics become less effective in the TME. For example, weak base chemotherapeutics such as doxorubicin can be rendered incapable of permeating through a cancer cell's phospholipid membrane due to protonation by acidic ions in the extracellular space. To mitigate this decreased efficacy phenomena, we fabricate injectable hydrogel formulations with chemotherapeutics that could provide alkaline buffering of extracellular acidity in

addition to chemotherapeutic delivery. We investigate the influence of media pH on cell behavior and doxorubicin efficacy in the MDA-MB-231 breast cancer cell line using MTT assays and confocal microscopy. We carried out in vitro release studies of weak base chemotherapeutics and alkaline buffers. We confirmed that hydrogels are non-toxic using an MTT assay on 2D cultures of MCF-10A mammary epithelial cells. Furthermore, we evaluated the activity of chemotherapeutics in the presence of alkaline buffers released from the hydrogel matrix. Our findings demonstrate the potential of combining alkaline buffering with pH dependent chemotherapeutics to improve chemotherapeutic response in solid tumors.

Raul Ayala; Jared Ramirez

Poster #D16

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Kenneth Breuer, School of Engineering

Characterizing forces on a wing 'surfing' due to an upstream wake generator

Birds are highly adaptive to turbulent flow structures; however, it is not fully understood how turbulent flow patterns influence the natural flight patterns of birds. While inspiration for this project stems from the natural flapping flight of European Starlings, an analogous engineering system was chosen in order to better understand the fundamental effects of periodic, turbulent flow structures on a downstream entity. This engineering system consisted of a.) a 3D printed NACA 0012 airfoil mounted to a force/torque transducer and b.) a wake generator pitching an airfoil at various frequencies. Measurements were taken using various wind tunnel speeds and pitching frequencies of the wake generator. The resulting variations in the coefficient of lift shows a highly periodic pattern in time series, which corresponds to the vortex shedding pattern of the wake generator. Comparisons between measurements in the model system and flow field visualization will be discussed.

Riley Flores

Poster #E1

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Anubhav Tripathi, Center for Biomedical Engineering

An Automated Electronic Device With Single-Well Control For Multiplexed Electrical Dissociation of Tissues

Electric fields on the order of 2 V and 1 kHz can be used as an alternative method for isolating cells from tissue samples via "electrical tissue dissociation." This novel technique shows promise when compared to mechanical, enzymatic, and chemical methods, with increased cell yields and viability accompanied by decreases in processing time. This project focuses on developing a low cost, portable device for high-throughput tissue dissociation. In this study, a device was created using the Arduino Mega 2560 to simultaneously output four square waveforms, enabling processing of up to 100 samples simultaneously with 4 different electrical conditions. The presented data depict the successful transmission of these four signals, without interference between the internal timers. In addition, the performance of the multiplexed device was compared to a separate single output device that was created using an Arduino Uno, and found to be a low cost alternative for high-throughput processing of tissue samples for downstream single-cell analysis.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Daniella Teape, Pediatrics

The Role of Autophagy in Hyperoxia-Induced Cilia Disassembly

Supplemental oxygen as a lifesaving measure of bronchopulmonary dysplasia (BPD) causes alveolar simplification and loss of bronchial epithelial cilia. Little is known about the mechanism of hyperoxic ciliary dysfunction in the respiratory tract. We have previously hypothesized that hyperoxia causes intraflagellar transport (IFT) dysfunction with resultant decreased cilia length. We have found in past experiments that exposure to hyperoxia induces cilia disassembly, which was associated with aberrant IFT protein expression and dysregulated metabolism. These findings delineate potential mechanisms underlying abnormal cilia assembly in BPD. We planned to further this investigation by assessing mechanisms of cilia disassembly for this project. Autophagy is one of the known mechanisms of cilia disassembly that involves proteins such as Kif19a and regulators AC6 and AMP kinase (AMPK). Autophagy is a cell recycling mechanism for damaged proteins and organelles to conserve energy/resources. Kif19 is a motor protein that resides at the cilia tip and controls ciliary length via microtubule depolymerization. AMPK activates autophagy and mobilizes Kif19a into autophagosomes for degradation, leading to increased cilia length. AC6 can disrupt AMPK-Kif19a interactions to prevent Kif19a autophagy and maintain proper cilia length. We hypothesize that hyperoxia induces decreased cilia length through Kif19a overexpression. We have currently observed a decrease in expression of LC3B, a common autophagy marker, in human epithelial airway cells with increasing hyperoxia exposure times. This suggests decreased autophagy with increased hyperoxia exposure, which could indicate a decrease in kif19a degradation and a subsequent decrease in cilia length. We have also performed immunohistochemistry co-staining experiments to determine the localization of kif19a and cilia in mouse tracheal cells exposed to both hyperoxic conditions and normal oxygen conditions. We plan to continue investigating the mechanism of cilia disassembly by quantifying AMPK, AC6, and Kif19a expression levels in the presence of increasing hyperoxia exposure times. We also plan to perform gene knockout experiments to determine if Kif19a is the principal component of cilia regulation in hyperoxic conditions as well as how the absence of regulators such as AMPK and AC6 affect cilia disassembly in these conditions.

Home Institution: Brown University

Summer Research Program: Biomedical Engineering Research Assistant

Faculty Mentor: Anubhav Tripathi, Biomedical Engineering

Improved PCR via Liquid Gallium Temperature Zoning

In the context of diagnostics, time is of the utmost importance. Laboratories must produce high quality diagnostic results within hours of sample collection, often using PCR to surpass a limit of detection for target DNA or RNA. The standard length of a PCR amplification is about one hour, cycling through three different temperatures 20 to 40 times to perform denaturation of template DNA, annealing of primers, and extension of the new DNA strand. Longer times spent achieving PCR amplification can result in diagnostic bottlenecks and longer wait times for patients that may be in need of urgent care.

The majority of time in a thermocycler, which uses Peltier heating elements, is not spent incubating at a specified temperature, but ramping up and down between temperatures. Standard thermocyclers have ramp rates of 1-3°C/s, meaning that a simple temperature change from 55°C to 75°C can take up to 20 seconds. In this work, we propose a fast PCR machine that drastically increases ramp rates by employing liquid gallium as a unique method of heat transfer combined with spatial temperature zoning. These innovations allow our machine to accomplish a PCR amplification in less than half of the time of a standard thermocycler. Three wells of gallium are set to predetermined temperatures for denaturation, annealing, and extension, while three step motors control vector motion of the sample between the wells. The gallium-based fast PCR machine bypasses the high degree of thermal resistance that standard Peltier heating elements are known to face, especially when using low heat capacity borosilicate glass sample tubes rather than industry standard polypropylene tubes.

Preliminary results demonstrate that our fast PCR machine achieves ramp rates of up to 13°C/s for heating and up to 7.6°C/s for cooling, making ramp times more than 8 times faster for heating and 3 times faster for cooling compared to a standard thermocycler. Further research will explore BioAnalyzer traces for a pUC-19 plasmid cloning vector amplification on the fast PCR machine.

Safah Tariq

Poster #E4

Home Institution: Brown University

Summer Research Program: Undergraduate Research Assistant (URA)

Faculty Mentor: Vicki Colvin, Chemistry

Testing Nanoparticle-Polymer Conjugates as Crystallization Agents for Multiple Protein Species

Upon functionalized with Thiol-PEG, gold nanoparticles may be good candidates for universal nucleants. They can remain non-aggregating in crystallization buffers, promote protein-protein interactions, and, in some cases, incorporate into protein crystals. To test the effectiveness of our crystallization aid, we selected some commonly used proteins and compared them to the crystallization conditions reported in previous articles. For our experiments, we decided to perform our crystallization experiments on HEWL (hen egg-white lysozyme), proteinase K, and ferritin. These protein species vary significantly in size and crystallize at different pH values, salt concentrations, and buffer solutions. We researched solubility and suitable conditions for crystallizations. Using a 96-well plate to perform a variety of batch crystallization experiments under a range of concentrations of proteins and salt in the presence of buffer solutions, we were able to test the effects of the addition of AuNP 10k-PEG on crystallization of these proteins. Once we created our crystallization screen and let the crystals grow, we could see if crystallization conditions were affected. We found that the super-solubility curve, defined as “the line separating conditions where spontaneous nucleation (or phase separation, precipitation) occurs from those where the crystallization solution remains supersaturated without the formation of a solid phase for an indefinite length of time” did appear to shift. Taking HEWL as an example, we observe that with the addition of AuNP, single lysozyme crystals suitable for XRD can grow at a concentration of .01 mg/mL lysozyme. We also see that at higher concentrations, the addition of AuNP leads to more aggregation and cloudier solutions. We further performed XRD analysis to compare the spatial construction between pure HEWL crystals with the AuNP-assisted HEWL crystals. Despite the larger volume, the addition of gold nanoparticles to lysozyme crystals does not alter either the projection of the characteristic diffraction pattern or the construction of the complete lysozyme 3D structure. These experimental results demonstrate that our system can be a potential aid for large amounts of proteins.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Daniel Ibarra, Earth, Environmental, and Planetary Sciences

Stable Isotopes show millennial-scale variations in lake water balance in Owen's Lake, CA

Reconstructing the past hydrologic balance of the southwestern U.S. guides our understanding of how future climate change will affect this region's water resources. Stable isotope analyses of lake sediment cores provide relatively continuous records of precipitation and evaporation trends over the lifespan of that lake. Owens Lake, located 40 miles west of Death Valley, CA, shows continuous deposition since the middle Pleistocene, and thus contains at least half a million years' worth of climate information. Past work used traditional stable isotopes of oxygen and carbon to reconstruct a long-term lake balance record throughout a 300-meter long core. Here, we supplement the existing records with $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ data from an additional 74 carbonate samples spanning core depths 40-75m. Based on prior chronologies and sedimentation rate calculations, this depth range covers marine isotope stages (MIS) 6, 5, 4, and 3. The $\delta^{18}\text{O}$ values range from -11 to 0 per mil, while $\delta^{13}\text{C}$ falls between 1 and 13 per mil. The general shape of the $\delta^{18}\text{O}$ record aligns with the global benthic foram record at the glacial-interglacial scale, but also contains smaller-scale variability within these larger patterns. Our data largely agree with those published in previous studies for Owen's Lake. In one depth interval, from 46-51m, comparison of our $\delta^{18}\text{O}$ values with previous data reveals changes of up to 7 per mil over 5cm of core. These values suggest that this lake basin can shift between shallow, evaporatively-enriched ("Dry") and overflowing, isotopically depleted ("Wet") states on decadal timescales. Ongoing work for this project will include clumped carbonate isotope analysis, from which we can calculate lake surface temperature through time; this will allow us to correct for temperature effects on $\delta^{18}\text{O}$ values and isolate other potential climate factors such as precipitation amount, source and seasonality influencing $\delta^{18}\text{O}$ variability.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Anita Shukla, Engineering

Drug-Loaded Liposomal Nanoparticles for Eradication of *Candida albicans* Infections

Invasive fungal infections continue to grow dangerously unchecked within the healthcare industry, due largely to limitations of current antifungal drugs ranging from potent toxicity to poor bioavailability. Fungal pathogenesis stems from opportunistic infections by fungi already present in the host's microbiome, elevating infection risk significantly for patients with underlying risk factors (e.g. immunodeficiency, COVID-19). *Candida albicans*, a commensal fungus, results in 70% of worldwide fungal infections and remains the number one cause of life-threatening invasive infections. Invasive *C. albicans* has a mortality rate upwards of 40%, and its growing resistance to existing therapeutics necessitates rapid innovation of novel treatments. Encapsulating antifungal drugs within lipid-based nanoparticles (liposomes) has recently become an attractive means of potentially improving drug delivery by reducing toxicity, increasing solubility and enhancing drug circulation time. Employing drugs from multiple antifungal drug classes, the goal of this project is to demonstrate improved treatment of *C. albicans* infections with drug-loaded liposomes compared to traditional free drug administration. Liposomes were fabricated via thin film rehydration followed by extrusion. All liposomes were fabricated based on v/v% ratios used in AmBisome®, a form of liposomal amphotericin B that is the gold-standard for treatment of various

invasive fungal infections: 59.9% constituent lipid, 23.7% phosphatidylglycerol, 14.6% cholesterol, 1.87% α tocopherol. Three constituent lipids with differing degrees of saturation were tested: hydrogenated soybean L- α -phosphatidylcholine (HSPC), 1-palmitoyl-2-linoleoyl-sn-glycero-3-phosphocholine (PLPC), and 1-palmitoyl-2-oleoyl-glycero-3-phosphocholine (POPC). Following extrusion, all formulations were found to have hydrodynamic diameters of approximately 100-130 nm. Zeta potential measurements of -40 to -65mV verify the liposomes form a highly stable colloid when suspended in HEPES buffer solution. Given this project focused merely on the ability to encapsulate different antifungal drugs, immediate next steps include maximizing encapsulation efficiency for each drug and replicating antifungal efficacy tests with *C. albicans* clinical isolate strains. Long term goals include successful encapsulation of multiple drugs from each antifungal drug class and decorating liposome surfaces with an active-targeting peptide to minimize off-site delivery.

Toluwalope Ogunfowora

Poster #E7

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Karen Coulombe, Engineering

Efficient Differentiation of Human Induced Pluripotent Stem Cells into Cardiac Fibroblasts for use in Donor-Specific Engineered Tissues

A major barrier associated with the use of implanted tissues is the immune response and ultimate rejection of implants that are labeled as foreign by the host immune system. This necessitates working towards a line of hiPSC-derived fibroblasts, which in tandem with hiPSC cardiomyocytes and epithelial cells will allow for source matching between heterotypic cell types, eventually leading to donor-specific engineered tissues. Fibroblasts are a population of cells originating from mesenchymal cells, whose activity promotes cell adhesion, migration and proliferation. As dominant regulators of the extracellular matrix and tissue compaction, fibroblasts will prove to be a vital component of stem cell-based therapies. In this work, an efficient assessment method was developed to determine the purity and function of differentiated fibroblast populations. Flow cytometry analysis of cardiac and fibroblast markers quantified cardiac and dermal fibroblasts present in a given sample. Immunohistochemistry further confirmed the identity of cells by selecting for the expression of cardiac and fibroblast markers. Using normal human dermal fibroblasts (NHDFs) as a negative control for the cardiac lineage and human ventricular cardiac fibroblasts (HvCFs) as a positive control, a broad assessment of the identity of differentiated cells has been defined. Various protocols modulating the use of bFGF and small molecules, such as Chiron, while exploring differentiation pathways will continue to be optimized until an effective, replicable method suitable for the production of cardiac fibroblasts is determined. Brightfield imaging tracking the progress of ongoing differentiations will eventually serve as morphological markers for differentiations from the optimized protocol. We expect that our work will lead to the successful differentiation of hiPSC-cardiac fibroblasts with an increasingly stable phenotype for therapeutic applications in heart regeneration.

Tony Pan

Poster #E8

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ming Xian, Chemistry

Bio-orthogonal Click-and-Release strategy for H₂S and COS generation

Hydrogen sulfide (H₂S) has been known as a gaseous pollutant with the smell of rotten eggs, exhibiting

lethal effects and toxicity which can lead to reversible unconsciousness, eye irritation, and respiratory irritation. However, H₂S naturally occurs in mammalian cells due to enzymatic activity (ex: CBS, CSE, and MST). Research has revealed that H₂S can target different ion channels and modify various physiological functions. In fact, inadequate levels of H₂S are linked to a variety of diseases including Down syndrome, Alzheimer's disease, diabetes, and liver cirrhosis, establishing H₂S as the third endogenous gaseous transmitter. Thus, chemicals that can precisely supply H₂S in biological systems are useful research tools, and potential therapeutics.

While previous discoveries from other groups have also accomplished H₂S delivery, these chemical donors have faced challenges of biocompatibility, such as requiring large quantities of organic solvents to dissolve. Recently, we discovered that pyran-2-thione can react with strained alkynes utilizing a click-and-release strategy, yielding an unstable cycloadduct intermediate to subsequently release COS. In physiological conditions, carbonic anhydrase (CA), an enzyme facilitating the equilibrium between carbonic acid and CO₂ + H₂O, hydrolyzes COS to yield CO₂ and H₂S, thus achieving a potential bio-orthogonal delivery of H₂S.

Using DFT calculations, we predicted potential diene substrates to release the COS payload after a Diels–Alder/retro-Diels-Alder reaction with a strained alkyne dienophile (a bicyclo[6.1.0]nonyne). These predictions were subsequently verified by experimental data to be viable H₂S donors in physiological conditions, with pyran-2-thione and its 5-methyl ester derivative as optimal candidates. Further applications of click-and-release reactions are under investigation.

Troy Conklin: Jim James

Poster #E9 & #E10

Home Institution: Georgia Institute of Technology (Jim James)

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: James Tompkin, Computer Science

Deblurring Long-Exposure Astrophotography via Neural Networks

When capturing photographs of the night sky, long exposure times are necessary to extract detail from low light conditions. Due to the apparent motion of stars across the sky, long exposures result in blurred images. While this can be remedied through the use of a motorized camera mount, these devices are often expensive and are thus inaccessible to casual photographers. This paper describes a visual computing approach to deblurring long exposure astrophotography without the need for additional hardware. We develop coordinate transforms and deblurring techniques using classical deconvolution, encoder-decoder networks, generative adversarial networks, and neural fields and compare them in effectiveness, both visually and quantitatively. Thus far, we have found that a combination of classical deconvolution and encoder-decoder networks performs the best, improving the peak signal-to-noise ratio from 32.4 to 35.8 dB and increases the structured similarity index measure from 0.82 to 0.92. We hope that solving this problem may provide insights towards the general problem of removing motion blur in photographs.

Tyler Gurth

Poster #E11

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: David Laidlaw, Computer Science; Cindy Nguyen,

A Case Study of Tools for Inferring Structure from a Historical Corpus of 4000 Woodblock Prints

and Multilingual Captions

Through this case study, we present findings regarding the efficacy of visual analysis methods for identifying and understanding underlying themes that span a corpus of captioned drawings. The drawings are a set of Vietnamese woodblocks from the early 20th century. For each comparative method, we used a numerical representation of each caption and image that our methods can process. These numerical representations are often called vectors.

We have several contributions to report, spanning methods operating on captions alone and those operating on drawings alone. Clustering based on the similarity of color histograms of the drawings performed poorly, likely due to a monochrome palette. Using feature vectors based on a very large image dataset provided tight and sensible clusters for the drawing-only data. In terms of visualization of our data, the most effective methods were those that used caption vectors to organize the dataset, but displayed each caption alongside its image; visual clues made it easier to fully understand the cultural context of some captions. Dynamic and interactive representations of the data proved to be the most useful, as they tended to be navigable and searchable. Those two traits assisted us in revealing new themes among the data.

One open challenge is displaying the data in a configuration that represents proportional similarity from one image to another, while also avoiding image and caption overlaps. Another is evaluating the value of using both the captions and drawings in identifying relationships. In summary, our results provide some insights about finding new meaning within image corpuses of size a few thousand.

Ula Jones

Poster #E12

Home Institution: Western Washington University

Summer Research Program: Iris Undergraduate Internship Program

Faculty Mentor: Colleen Dalton, Earth Environmental and Planetary Sciences

Rayleigh Wave Tomography of Alaska

This project examined surface wave propagation across Alaska in order to generate a number of tomographic maps of the crust and upper mantle. To do this, seismic data primarily from the EarthScope Transportable Array taken between 2015 and 2021 was analyzed in Matlab for Rayleigh waves of 8 different periods, each of which is sensitive at a different range of depths from 30 to 200 km. Using Eikonal tomography, phase velocity maps were constructed from the travel times of these waves for about 450 events. Final composite maps are averages of these. Wave attenuation (amplitude decay) will also be examined in certain parts of Alaska. This region is tectonically interesting because it contains certain features that are not fully understood, such as the role of the Yakutat Terrain in influencing subduction and the processes responsible for forming the Wrangell Volcanic Field. As these wave characteristics are linked directly to subsurface features such as temperature, composition, and the presence of water or partial melt, they can help relate the interesting surface features to the underlying crust and upper mantle. So far, several probable locations of partial melt include central and southeastern Alaska, the latter of which may influence volcanism. Crustal thickness variations are also clearly visible and correlated with topography.

Social Science

William Yang

Poster #E13

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: David Weil, Economics

The Economics of Climate Change and Land Quality

Human-induced climate change over the next 80 years is expected to change the planet's climate in dramatic ways. Average temperature will rise by approximately 2-5°C, but there will be geographically divergent effects, with some regions heating much more, and also changes in other climate variations such as rainfall. In this research, we assess the economic effect of these changes. To do so, we incorporate fine-scale (quarter degree longitude latitude) projections of several global climate models into an economic model that also includes population, capital, and productivity. Our starting point for this model is an empirical examination of how geographic factors determine the "quality" of land, defined as its suitability for production and human habitation. We estimate the role of these factors using data on current climate and the geographic distribution of population. Feeding in projected climate for the year 2100, we then calculate country-level and world-level changes in land quality. We find that, in general, areas with improvements in land quality are mountainous and/or distant from the equator. The countries with most significant improvements in land quality are Canada and Russia, while China also improves. Land quality in 2100 is lower in almost all of Africa and Australia, while there are heterogeneous outcomes within Europe. Importantly, there is a strong positive relationship between countries' current levels of GDP per capita and projected changes in land quality, suggesting further inequality in economic development.

Furthermore, we seek to understand the economic impacts of climate change. Thus, we utilize an economic growth model to quantitatively measure how changes in land quality affect income per capita in countries in 2100. Once again, we find enormous geographic heterogeneity in climate change impacts. Under the most extreme projections, GDP per capita is 37% below what it would have been in the absence of climate change in Zimbabwe, and 42.3% above baseline in Russia. After analyzing country-level results, we assess the damage from climate change aggregated to the world level and project that the world level GDP would fall by 6.5%.

Zaynab Al-Rashed

Poster #E14

Home Institution: Xavier University of Louisiana

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Whitney Mills, Health Services, Policy and Practice

Engaging Veterans Affairs (VA) Stakeholders to Build a Veteran-Centric Long-Term Services and Supports (LTSS) Research Agenda

Background: As the largest integrated healthcare system in the United States, VA serves as a model for healthcare and long-term services and supports (LTSS) nationally. VA provides LTSS to more than 400,000 Veterans annually through care provided in homes (e.g., home health) and residential settings

(e.g., Community Living Centers). VA prioritizes Veterans' choice in LTSS services provided. VA LTSS researchers support this, seeking to improve quality and access to care; but have not had enough opportunity to collaborate or communicate to establish a shared vision. To address this and lay the groundwork for a shared research agenda, we examined priorities, challenges, and visions for the future of VA LTSS research.

Methods: LTSS stakeholders' (researchers, healthcare providers, and leadership) priorities were examined via qualitative analysis of 27 interviews conducted between December 2019-February 2020. Follow-up was conducted by email in June/July 2021 to confirm research priorities post-pandemic. **Results:** The main research priorities identified include choice, access, integration of care (79%); improvement of quality of care (64%); interventions, best practices & evaluation (50%); home care, aging in place (50%); and care preferences (50%). Follow-up indicated that the pandemic did not change identified research priorities, with the pandemic reinforcing some.

Impact: The resulting research agenda will prioritize a Veteran-centric approach to care while encouraging collaboration across VA and with community partners to improve communication and care outcomes. This presentation will include possible methodologies, such as PhotoVoice, to move forward in developing a person-centered model of care.

Katie Goss

Poster #E15

Home Institution: Mount Holyoke College
Summer Research Program: Leadership Alliance (DEEPS)

Faculty Mentor: Stephen Parman and Joseph Boesenberg

Early Conditions in the outer solar system recorded in meteorite NWA 14999

Over time, we have been able to determine the age of our solar system and the objects that are housed within it, such as the planets. However, the exact processes and conditions the planets formed under in the beginning of our solar system are still being understood. A way we can study those early solar system conditions is by studying meteorites, as they hold a record of the conditions they formed under. By studying the inclusions and mineral assemblages that are found within them, we cannot only determine these early formation conditions, but also use that information to interpret processes in the early solar system, as the planets were starting to form. In this study, we look at a thin section sample of NWA 14999, a type of carbonaceous chondrite, which is a type of meteorite that has not been altered since it first formed in the early outer solar system. We studied this thin section in order to classify it and compare it with other meteoritical data of its kind. Within this thin section we observed inclusions that are considered the oldest material in our solar system, and give insight on some of the very first records of the conditions in our outer solar system.

Annie Liang

Poster #E16

Home Institution: Brown University
Summer Research Program: CFAR

Faculty Mentor: Omar Galarraga, Public Health, Health Services, Policy and Practice; Marta Wilson-Barthes, Public Health, Health Services, Policy and Practice

Cost-effectiveness of differentiated care with economic strengthening for HIV antiretroviral

therapy adherence: a systematic review

Intro: The sustainability of interventions aiming to improve HIV antiretroviral therapy (ART) adherence depends on effective and cost-effective implementation strategies. Differentiated care models provide client centered services that encourage medication adherence and care engagement while maximizing efficiency for health systems. There is some evidence that differentiated care improves clinical outcomes among people living with HIV (PLWH) in Sub-Saharan Africa; yet these interventions have been unable to fully address the persistent economic barriers to sufficient ART adherence. Economic strengthening in conjunction with differentiated care may help address these barriers, especially if doing so is cost saving for health systems with limited resources.

Current evidence: Prior reviews have found that differentiated care models tend to be cost-effective for patients, but minimally or not cost-effective for providers. To the best of our knowledge, robust evidence of the costs and cost-effectiveness of differentiated HIV care models that engage economic strengthening is not currently available.

Methods: This systematic review was conducted from July to August 2022. We searched PubMed, Econlit and Google Scholar and included observational studies and cluster randomized trials in Sub-Saharan Africa published from 2000 to 2022. Studies were required to report costs and/or cost-effectiveness outcomes to be included. We compared the cost of differentiated HIV care models that incorporate economic strengthening to those of conventional facility based care, identifying key cost differences and future cost savings. Due to high levels of outcome heterogeneity, a narrative synthesis was used and results were not pooled.

*As of 7/22/2022, evidence synthesis from this systematic review is ongoing. Findings will be included in the poster presentation.

Ariel Stein

Poster #F1

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Uriel Cohen Priva, Department of Cognitive, Linguistic, and Psychological Sciences

What Makes an Accent Strong? Disentangling the Roles of Functional Load and Confusability in Accent Perception

Why do some accents sound stronger than others? In this study we examine the contributions of functional load and acoustic similarity to perceived accent.

Functional load is a measure of a sound contrast's contribution to word distinctions in a language; for example, in English the /t-/d/ contrast distinguishes between many word pairs (e.g., "tall"/"doll," "tour"/"door," "ten"/"den") and therefore has a high functional load. Conversely, relatively few words are distinguished by the /f-/v/ contrast (e.g., "file"/"vial"), corresponding to a low functional load.

Previous research has suggested that listeners tend to perceive accents with high-functional-load sound substitutions as more accented than accents with the same number of low-functional-load substitutions (Munro & Derwing, 2006). However, this study did not address the confound of acoustic confusability (i.e., how likely it is for a listener to mistake one sound in a pair for the other); one possible alternative explanation is that listeners' judgements were based partially or entirely on whether the sounds involved in the substitution sounded inherently similar to listeners, as the study's low-functional-load pairs tended

to have relatively high acoustic confusability while their high-functional-load pairs tended to have relatively low acoustic confusability.

This study aims to disentangle the respective roles of functional load and acoustic confusability. We created 60 sentences with target words that would receive sound substitutions varying on functional load and acoustic confusability, and we had a speaker with a non-native accent read them; we then spliced in sounds to create these sound substitutions. Participants rated how accented the 60 sentences sounded; for each sentence, a participant either received a sound substitution (e.g., “bakery” surfacing as “pakery”) or no substitution (e.g., “bakery” surfacing as “bakery”). By comparing the ratings of a sentence between participants who received a sound substitution and participants who did not and evaluating the ability of functional load and acoustic confusability to predict these differences, we aim to disentangle the contributions of these two factors to accent perception.

Benjamin Burns

Poster #F2

Home Institution: The Ohio State University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Jennifer Sullivan, Department of Health Services, Policy and Practice

An Environmental Scan of Suicide Prevention Tools for Older Veterans in Primary Care Settings

Background: The suicide rate of U.S. veterans is fifty percent higher than the rate for non-veteran adults. Further, older adults suffer from greater suicide rates than younger adults. Accordingly, suicide prevention is a main priority within the U.S. Department of Veterans Affairs (VA). Previous research has identified the critical role of primary care providers for suicide prevention, with forty-five percent of those dying by suicide having had contact with primary care within one month before their death. Although several suicide prevention resources targeting primary care providers already exist, it is unclear how many of the resources have been created specifically for older U.S. Veterans utilizing primary care. This environmental scan seeks to assemble a compendium of suicide prevention resources which can be utilized by VA primary care providers interacting with older veterans.

Methods: We searched in three academic databases, Google Scholar, and Google to identify the available suicide prevention resources. We then extracted and summarized data about each resource in a matrix.

Results: Our scan identified 49 resources, with 20 targeted towards veterans, 12 targeted towards older adults, 10 targeted towards primary care providers, and 3 specifically targeted older veterans within primary care settings. Fifteen of the identified resources did not target older adults, veterans, or primary care. The identified resources shared several content similarities, including implementation of a safety plan and counseling on reduction of lethal means.

Conclusion: Although few of the identified resources were exclusively primary care focused, most of the resources are relevant to primary care providers. The compendium of resources generated by this environmental scan will inform efforts to create a comprehensive suicide prevention toolkit for primary care providers serving older veterans in the VA.

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: David Badre, Cognitive Linguistic and Psychological Sciences

Investigating the Effect of Cognitive Control Demands on Strategies and Task Performance

Cognitive control is the ability to make flexible decisions given the diverse information in our environments. More specifically, the brain uses task demands, rules, and contexts and selects appropriate actions to achieve its goals. Many psychiatric disorders exhibit dysfunctional control, from underactive (e.g. schizophrenia) to overactive (e.g. obsessive-compulsive disorder) cognitive control. The mind's skill of parsing through different inputs and narrowing down what is essential for effective behavior uses a 'control representation'. However, the neural instantiation of control representations is still poorly understood. Our overall goal is to understand whether control representations are fixed or change with task demands. In this subproject, we test whether the geometry (format) of representations influences or can be influenced by behavior.

We designed two tasks that differ only in their rule structures' complexity, and hypothesize that the more complex task is more demanding on the cognitive control system. For both tasks, participants must correctly categorize a group of images and sounds (stimuli). In the simpler task, there is a hierarchy of importance for the information (some of the stimuli may be ignored depending on the trial), but in the more complex task, all information is necessary for a correct answer. We predict that we will measure differences in behavior (i.e. participant performance) between the tasks as a function of the stimuli switching categories. Different trial types of trial switches will cause performance deficits seen in slower reaction times and more errors across the tasks.

Additionally, we predict this performance difference will correlate with a difference in brain activity (measured through fMRI data collection) in regions known to underlie cognitive control. In this poster, we report behavioral similarities and differences among subjects collected on both tasks (N = 31) and examine the significance of these findings in relation to the overall study's goals. By studying how people structure control representations based on rules in their environment, we can better understand how the human brain can be adaptive and flexible.

Alison Lu; Claire Kim; Orly Richter; Naile Ozpolat

Poster #F4 & #F5

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Ju Nyeong Park, Medicine/Epidemiology

Media Discourse on Supervised Consumption Sites in the United States

Harm reduction centers (HRCs), supervised injection facilities, and overdose prevention sites, are hygienic facilities in which individuals can use previously purchased drugs under supervision. These evidence-based interventions facilitate safer injection practices, access to prevention services, linkage to care, and have never housed a fatal overdose. In 2021, the Governor of Rhode Island signed into law a two-year pilot program for HRCs, allowing for the legal state implementation of an HRC for the first time. This mixed-methods study proposes to evaluate the implementation of these facilities in Rhode Island. Our aims are 1) to analyze the legislative process and changes behind the implementation of harm reduction centers, such as in Rhode Island, New York, and Canada, and to understand the national media

discourse surrounding such legislation and 2) to conduct in-depth interviews and brief surveys with key stakeholders in the community execute secondary data analysis of policies and documents on the topic. Data collection will focus on the perspectives of HRC staff, peers, community members, and regulatory bodies. A summary will be shared with HRC implementors in Rhode Island to inform the development of the HRC. Sub-aims include identifying the legal barriers, facilitators, and strategies for authorizing HRCs that may be relevant to the Rhode Island context, including issues around operations, federal laws, funding, and community support; examining public perspectives on HRC implementation through analyses on published news articles, opinion pieces, as well as political and legal documents; characterizing the implementation process of HRCs in Rhode Island with collective qualitative data from interviews with HRC staff, service providers, peers, community members, and regulators.

Daniela Figueroa

Poster #F6

Home Institution: SUNY Farmingdale State College

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Emily Rauscher, Sociology

Educational Inequities : Are non profit fundings a factors ?

Reforms in school finance over the past 50 years have strengthened funding equity and given low-income districts additional resources. However, there is still a problem with unequal student performances revealing itself through lower academic achievements in students attending lower income districts. Hidden contributions from regional non-profits that assist local schools, such as parent-teacher organizations (PTAs) and booster clubs, could be one reason why disparity persists despite more equitable funding. Non-profit money is a hidden source of inequality since they do not appear in district budgets but can cover expenses that free up district funds for instructional spending. In this project, we analyze (1) how much school-supporting non-profits raise in New York and how those funds differ across districts by student income. We identify, geocode, and connect local school supporting non-profits to Census data on district enrollment and income using non profit tax data from the Internal Revenue Service 1995-2020. Results show that districts in the highest quintile raise over 6 times more per student than districts in the bottom quintile. Such differences in funding hinder the potential for lower-income students to experience a fair education.

Devon Newman

Poster #F7

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Megan Ranney, School of Public Health, Brown-Lifespan Center for Digital Health, Warren Alpert Medical School

Thematic Analysis of a Novel Cognitive Behavioral Therapy-based Adaptive Intervention for Teens: iDOVE2 LiveText

Prior studies evaluating interventions using Cognitive Behavioral Therapy (CBT) foundations have demonstrated promising results in prevention and improvement of depressive symptoms in teens. Antecedent research has strongly supported the efficacy of longitudinal CBT interventions targeting depressive symptoms. Traditional CBT interventions often require significant resources. The implementation of an adaptive text-based intervention could be a viable alternative for increasing mental

health care access for teens. Our research aims to analyze the iDOVE2 LiveText intervention based on a CBT framework. The purpose of LiveText is to assess whether teens may benefit from an adaptive text intervention with a trained interventionist as a supplement to the standardized, automated texting intervention. The data used for this project were collected from an ongoing multifactorial, randomized control trial (RCT) evaluating the efficacy of a digital health intervention aimed at reducing depressive symptoms and peer-conflict in at-risk teens recruited from a large, Northeastern emergency department. The RCT has four randomized intervention groups: brief intervention (BI), brief intervention and text intervention (BI+Txt), text intervention (Txt), and control. Teens in the BI+Txt and Txt groups are eligible to be re-randomized to receive the LiveText Intervention if they report no signal of improvement in mood days 7-14, or do not respond to the automated text days 7-14. Dosage coding is being performed (and will continue until the study's end) according to a coding scheme developed by interventionists. Statements made by interventionists fall into five thematic groups: three evaluating use of CBT intervention principles (Cognitive Reappraisal, Emotion Regulation, Behavioral Activation) and two evaluating use of iDOVE2 content (reference to txt/BI curriculum, or use of on demand automated texts). By coding the interventionists' interactions with the LiveText participants, we are able to measure the usage of particular CBT-based concepts. This thematic analysis will allow us to adapt, adjust, and modify the implementation of LiveText in the future to ensure that the intervention meets the needs of the target population.

Eugena Choi

Poster #F8

Home Institution: Worcester Polytechnic Institute

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Scott Frickel, Sociology and IBES; Jonathan Tollefson (graduate student), Sociology

An Exploration of the Political Ecology of Manufacturing Waste in Rhode Island (1850-1950)

This pilot research project examines the political ecology of manufacturing waste in Rhode Island during the mid-1800s to mid-1900s. Many of the preexisting manufacturing and consequently their waste sites in Rhode Island have since been redeveloped. However, these waste sites are not easily disposable and the remaining waste, composed of hazardous by-products such as coal tars, ammonia, and coke, pose dangerous health and environmental risks. This waste also tends to travel through both natural and intentional processes. Therefore, the likelihood this waste is eliminated from these former industrial sites is low and the sites go unnoticed for decades. During this time period, there were no federal regulations governing waste practices and companies were unrestricted in their disposal methods. This project aims to uncover, document, and characterize the nature of waste practices for one company within a specific industry known as Sayles Bleachery during the mid-1800s to mid-1900s. Using historical data from archives, databases, and primary sources from this time period we recorded and analyzed material, most notably company documents and correspondences. By compiling this data, we not only demonstrate the political ecology of manufacturing waste during this time period, but also the complexities of waste disposal and regulatory science associated with Sayles Bleachery. This project may provide further insight into the spatial distribution of environmental justice communities in Rhode Island and others across the United States as well.

Jahred Rosa-Sullivan

Poster #F9

Home Institution: UCLA

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Rachel Wetts, Ph.D., Sociology; Loredana Loy, MA., Sociology

Meat, Men, and 'Merica: Attitudes Towards Climate Politics When Affirming or Denying Traditional Consumption Practices

Despite the alarming consequences of climate change, many Americans appear opposed to certain mitigative strategies. For instance, one of the greatest contributors to greenhouse gas emissions comes from the production and consumption of meat. The authors follow the theoretical reasoning of an emergent sociological framework which suggests that the continued consumption of meat despite its negative impacts is due to its symbolism of traditional masculinity and male dominance. We conducted a survey that gauged participants attitudes towards statements of social importance, namely climate change policy, before and after a manipulation or control prime. Preliminary results support our hypotheses in that, when exposed to messaging which insisted on the reduction of meat consumption, women's support for climate change policy strengthened relative to those who were not primed with status value, whereas men, when exposed to messaging that denies the widespread adoption of meat reduction, lowered in their support of climate change policy. These findings reinforce the observation that support or denial of climate change policy may be less reflective of the petitioned behavioral changes and more so a representation of whether the policy supports the relative standing of practices associated with a particular demographic. Further sociological research in the domain of climate politics may extend this framework of symbolic worth to other areas of consumption behavior, mitigation strategies, and identity.

Marina Hahn

Poster #F10

Home Institution: Brown University

Summer Research Program: Summer Research Assistantship in Biomedical Sciences

Faculty Mentor: Megan Smith, Medical Education

Analyzing the Challenges Homelessness Poses to the Continuity of Psychiatric Care

The care management and discharge planning of psychiatric patients experiencing homelessness (PPEH) is an area of debate in the field of psychiatry, social services, and politics. Due to the lack of research on best practices and community resources available, there are currently insufficient actionable guidelines in place to properly assist PPEH in their psychiatric care post-discharge, leading to high rates of readmission. Though PPEH would greatly benefit from community placement in supportive long-term care facilities, gaps in funding and resources have led to long waitlists and early discharges from psychiatric wards without proper placement. Corollary to this, other patients are forced to board for longer than medically necessary in inpatient settings while awaiting an appropriate community placement. Longer inpatient stays are often discouraged as they are likely to lead to revenue loss and cause psychological damage to the patient. Though psychiatrists may request that the patient is added to a placement waitlist, once the patient has been discharged, they are dropped lower on the waitlist. Without access to an appropriate level of care post-discharge, PPEH often decompensate, leading to higher rates of readmission. There is currently very little research qualifying or quantifying how homelessness impacts psychiatric care and discharge planning. Without data analyzing the gaps in care experienced by PPEH at discharge, it is hard to support legislation or policy changes designed to improve individual and systems-level outcomes. This project aims to bridge this knowledge gap by generating the necessary data to quantify and qualify problems experienced by PPEH that could be used to create viable discharge plans and support the creation of long-term care facilities for PPEH. In this study, researchers directly engaged with PPEH (n=30) through semi-structured interviews. Initial analysis using immersion/crystallization methods revealed that over 60% of participants reported that they were not asked about their homelessness by the staff, leading to low confidence in their discharge plan. Themes

such as lack of transportation, personalization, and guidance were also prevalent. Initial data suggests the importance of implementing new discharge guidelines that not only connect PPEH to community resources, but also assist them in accessing those resources.

Matthew Campos

Poster #F11

Home Institution: Azusa Pacific University

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Maricruz Rivera-Hernandez, Department of Health Services, Policy and Practice

Telehealth is Here to Stay: Identifying Barriers and Outlining Recommendations for Enhancing Medicare Open Enrollment During the COVID-19 Pandemic

Background: Before the rise of telehealth, Medicare beneficiaries reported the Medicare enrollment process to be overwhelming and complex (Baxter, 2021). The COVID-19 pandemic highlighted high degrees of unreadiness for older adults in the movement to telehealth (Lam et al., 2020). Therefore, the purpose of this qualitative study was to identify barriers Medicare beneficiaries face in navigating open enrollment in a virtual age and then outline recommendations on how to enhance virtual Medicare enrollment services and platforms for older adults. Methods: We interviewed a group of 28 stakeholders in 2021, then conducted an inductive qualitative analysis to identify themes. Results: After coding for specific themes, three specific problems/barriers were identified with the current state of virtual Medicare enrollment: 1) misleading and predatory marketing surrounds the Medicare open enrollment process, 2) Medicare is confusing and overwhelming for people of all ages, and 3) accessibility issues are persistent: telehealth is not yet equitable for all communities. To personalize the enrollment process for older adults, stakeholders outlined three main recommendations to enhance enrollment services: 1) revert to previous platform features (Medicare ID system vs. medicare.gov account), 2) establish updated and accessible provider networks for different plans, and 3) develop a simplified and centralized platform (eg. app) to compare MA plans. Conclusions: While barriers still exist for older adults in utilizing telehealth services, there is great potential with telehealth to support harder to reach communities. However, more research needs to be done to ensure access to telehealth services is equitable across diverse communities.

Mona Malone

Poster #F12

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jasjit S. Ahluwalia, MD, MPH, Department of Behavioral and Social Sciences

Using E-Cigarettes and Nicotine Pouches to Reduce Harm for Low SES Cigarette Smokers: A Randomized Clinical Trial

This study will investigate whether providing Alternative Nicotine Delivery Systems (ANDS), specifically, complimentary electronic cigarettes (EC) or nicotine pouches (NP) to low socioeconomic status (SES) adults who smoke and are unable or unwilling to quit smoking, will increase substitution of electronic cigarettes or nicotine pouches for cigarette smoking and improve biomarkers of exposure and harm relative to a control group smoking their usual brand of cigarettes.

This is a 16-week, 3-arm randomized controlled trial of 8 weeks of EC and NP to adult low SES smokers and assesses substitution to Alternative Nicotine Delivery Systems, smoking reduction, and biomarkers of exposure and harm. The main aims of this study are to 1) Assess the effects of 8-weeks of electronic cigarette or nicotine pouches use on complete substitution, reduction in cigarettes per day (cpd), EC or

NP use, and nicotine dependence in low SES, adult smokers and 2) Examine the effects of EC and NP on biomarkers of exposure (CO, cotinine), toxicity (urinary NNAL and biomarkers of oxidative stress 8-isoprostane). Although overall smoking rates have decreased in recent times, these reductions have not occurred uniformly across different demographics within the United States, leading to large disparities within cigarette smoking. This project is significant due to the relationship between socioeconomic status and tobacco use and the disproportionate tobacco-related disease burden in this population.

Nancy Collie-Beard

Poster #F13

Home Institution: Hunter College CUNY

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: Michael Frank, CLPS; Peter Hitchcock, CLPS

Gender differences in the relationship between perseverative thinking and attentional impulsivity: A network analysis

Externalizing disorders refer to those characterized by impulsive behavior, and internalizing disorders by problematic internal behaviors. While intuitively these behaviors may seem inversely related, in fact, they are positively correlated, suggesting shared core features. Clinically, boys are twice as likely to be diagnosed with attention deficit/hyperactivity disorder (ADHD), and women are more prevalently diagnosed with anxiety disorders. The symptoms of ADHD in girls are less disruptive and more likely to be overlooked, as they present in the attentional rather than hyperactive subdomain. Fixation is also common in ADHD, making it possible that hyperfocus on perseverative thoughts results from attentional fixation, rather than a mood disorder. We will quantitatively assess the inter-relations among these symptoms via self-report measures examining traits associated with both externalizing and internalizing disorders. The Perseverative Thinking Questionnaire (PTQ) measures repetitive and intrusive thoughts, including those with depressive and anxiety-related content. The Barratt's Impulsivity Scale (BIS-15) measures impulsivity in three factors; attentional, motor, and non-planning. A moderated network analysis (n=300) of the items within these scales will assess 1) if measures of attentional impulsivity associate more strongly with perseverative thinking than do the motor and non-planning factors and 2) if they do so more strongly in women. These data could help explain the rates of differential diagnoses seen in women, as the diagnostic disparities continue into adulthood. Generally, this work may call for further distinction of these measures and have clinical relevance for diagnoses and targeted treatment.

Neil Mehta

Poster #F14

Home Institution: Brown University

Summer Research Program: SPRINT/Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Madina Agénor, Department of Behavioral and Social Sciences

HIV and STI prevention service utilization among transgender young adults

Young transgender adults face systemic barriers in accessing HIV prevention and testing services. To our knowledge, the overall prevalence of HIV testing and PrEP use among transgender and gender diverse U.S. young adults by gender identity and/or race/ethnicity is unknown, as well as the independent and joint association between gender identity and race/ethnicity and HIV testing and PrEP use.

This study uses results of the 2021 BEEHIVE survey (n=337), a questionnaire administered to previously-recruited subjects from the 2019 B*SHARP survey, which recruited young transgender and

gender diverse American adults through community organization outreach, university groups, and social media advertising, to identify disparities in access to HIV testing and PrEP utilization. Our analysis uses an intersectional lens, conceptualizing gender identity and race/ethnicity as simultaneously shaping HIV testing and PrEP use among transgender and gender diverse U.S. young adults.

Rubysela Rodriguez

Poster #F15

Home Institution: California State University Northridge

Summer Research Program: Leadership Alliance-Summer Research Early Identification Program (SR-EIP)

Faculty Mentor: David Rangel, Education

Parental Educational Attainments' Impact on Students' College Experiences in Latinx Families

Although extensive research has been conducted on the relationship between parental educational achievement and student academic success, little has focused on Latinx families. The research that has been conducted within Latinx families on the subject of education primarily focuses on first-generation students from working class families. The goal of this study is to gain insight on the experiences of Latinx college students from mixed-educated households, where one parent is college educated and the other is not, to better understand whether middle class Latinx students embody their parents' class advantage. By examining mixed-educated households, we aim to identify if the experiences of these students are aligned with more advantaged two college educated households or with that of their first-generation counterparts. Our research design consists of semi-structured interviews that examine students' living arrangements growing up, education history, aspirations, and their current college experience. Latinx students from mixed-educated households encounter both challenges and advantages that are unique to their specific lived experiences making it imperative to focus on this demographic to further our understanding of student achievement outcomes.

Thursday, August 4, 2022

Name	Poster #
Justin Cheng	#A1
Keith Richie	#A2
Nicolas Gascon	#A3
Siri Pierce; Lulu Cavicchi	#A4
Aaliyah Battle	#A5
Alan Zdon	#A6
Albert Wu	#A7
Aleah Davidsen; Caroline Worrell	#A8
Beatrice Dominique Campilan	#A9
Amanda Solano	#A10
Amy Gaulke	#A11
Angelica Aragon Vasquez	#A12
Anna Shlimak	#A13
Anne-Emilie Rouffiac	#A14
Ashley Choi	#A15
Austin Roy	#A16
Baihe Sun	#A17
Alexander Griffin	#A18
Brendan McMahon	#B1
Brynn Kroke; Mark Appleman	#B2
Caleb Ukaonu	#B3
Camille Donoho	#B4
Camille Leung	#B5
Carleigh Oberkfell	#B6
Caroline Troy	#B7

Carolyn Lai; Alyssa Steinbaum; Alayna Bellavia; Makena Mette	#B8 & #B9
Chloe Shin; Genevieve Craig	#B10
Claire Gray	#B11
Courtney Frazier	#B12
Elizabeth Ding	#B13
Daniel Betensky	#B14
Diane Story	#B15
Eden Allen	#B16
Eli Flomenhoft	#B17
Emily Sun	#C1
Erin Elgas	#C2
Eseosa Uwaifo	#C3
Hamsa Shanmugam	#C4
Hanna Richman	#C5
Hanna Wang	#C6
Harshini Venkatachalam	#C7
Henry Lee	#C8
Imaad Said; Owen Wogmon; Lauren Eusebio	#C9
Jarra Omar	#C10
Jasmine Shum	#C11
Jelynn Tatad	#C12
Jennifer Chen; Melany Veliz	#C13
Jennifer Cheng	#C14
Jessica Hong	#C15
Joanne Lee	#C16
John Maragakis	#C17

José Candelaria Marrero	#D1
Joshua Acosta Gonzalez	#D2
Jude Adelman	#D3
Julian Ramprashad; Onyx Richards; Aseel Rafat	#D4 & #D5
Kathryn Lee	#D6
Kayleen Vicente	#D7
Kealyn Bowie	#D8
Kyle Lam	#D9
Kyoko Leaman	#D10
Leanna Bai	#D11
Lizi Zhang	#D12
Lud Milca F Ceus	#D13
Madison Liesching; Jacob `Eberson; William Connolly	#D14 & #D15
Mariana Witmer	#D16
Mattan Pelah	#D17
Meghan Gormley	#E1
Melissa Aldana, Claire Gray	#E2
Michael Jia; Joyce Gao	#E3
Miyoly Alvarado Álvarez	#E4
Muneet Gill	#E5
Mylena Corona	#E6
Neal Yin	#E7
Nicole Dennis Talley	#E8
Nina Li	#E9
Nina Magid	#E10
Olive Cooper	#E11

Paige Eversole	#E12
Peter Gonzalez	#E13
Pranav Mahableshwarkar	#E14
Qile Jiang; Carly Ferrell; Margaret Olivia Leu	#E15
Rebecca Kim; Zelig Karondo	#E16
Max Ulibarri	#E 17
Rebecca Blum	#F1
Rohan Freedman; Miauaxochitl Haskie	#F2
Ryan Henry	#F3
Samara Cummings	#F4
Silvia Blanco	#F5
Sira Morales	#F6
Sydney Tucker	#F7
Talia Fernandez; Hannah Park	#F8
Tej Tummala	#F9
Theodore LaBonte-Clark	#F10
Valentin Kirilenko	#F11
Valeria Brown	#F12
Vanny DaFonseca	#F13
William Pelit	#F14
Yongkuan Zhang	#F15
Zander Hary	#F16
Zenovia Gonzalez	#F17

Friday, August 5, 2022

Name	Poster #
Advay Mansingka	#A1
Aicha Sama	#A2
Alexa Schultz	#A3
Alexander Wilk	#A4
Anjali Srinivasan; Alberto Lopez Resendiz	#A5
Apollonia Arellano	#A6
Ben Johnson	#A7
Benjamin Schornstein; Sam Liang	#A8 & #A9
Brian Freedman	#A10
Caroline Snyder	#A11
Charlie Medeiros	#A12
Christina Marsh	#A13
Christopher Shin	#A14
Clara Tandar	#A15
Connor Macken; Timothé Desbordes	#A16
Dani Romero Mejia; Alex Green; Lucca Paris	#B1 & #B2
Daniel Wexler; Lorenzo Davidson	#B3
Daniel Zhou	#B4
Dayna Jackson; Caylan Hagood; Gabriella Orfanides; Evrim Ozcan; Jared Ramirez; Raul Ayala	#B5 & #B6
Ding Ding Wei; Natalie Love	#B7 & #B8
Jackson Moore	#B9
Gabriella Orfanides; Evrim Ozcan; Jared Ramirez; Caylan Hagood; Dayna Jackson; Raul Ayala	#B10 & #B11
Giang Thai	#B12

Helene Koumans; Chelyn Park	#B13
Imani Finkley	#B14
Isabella MacNaughton	#B15
Jacob Vietorisz	#C1
Jessiel Castillo	#C2
Karen Liu	#C3
Katherine Alcazar	#C4
Katrina Taylor	#C5
Kayden Obsitnik	#C6
Kevin Rapp; Jeffrey Tejada	#C7
Kian Kafaie	#C8
Lily Tran	#C9
Lucas Weissman	#C10
Luis Tsatsos Montoliu	#C11
Luke Randall	#C12
Lydia Stone	#C13
Valencia Ajeh	#C14
Willis Bilderback	#C15
Yungeun Kim	#C16
Madelyn Stewart	#D1
Maria Clara Rapoza	#D2
Maya Gong	#D3
Mia Hines	#D4
Morgan Jones	#D5
Muhammad Shafiq	#D6
Nadia McGlynn	#D7

Natalie Chang	#D8
Nathan Craig	#D9
Nnenna Nwankwo	#D10
Patrick McCann	#D11
Pittayuth Yoosiri	#D12
Rachel Ma; Lyndon Lam; Aditya Ganeshan; Benjamin Spiegel; David Paulius; Roma Patel	#D13 & #D14
Rachel Rowey; Angelina Schorr	#D15
Raul Ayala; Jared Ramirez	#D16
Riley Flores	#E1
Ryan Luo	#E2
Sabrina Tolppi	#E3
Safah Tariq	#E4
Shaw Miller	#E5
Tobias Meng-Saccoccio	#E6
Toluwalope Ogunfowora	#E7
Tony Pan	#E8
Troy Conklin; Jim James	#E9 & #E10
Tyler Gurth	#E11
Ula Jones	#E12
William Yang	#E13
Zaynab Al-Rashed	#E14
Katie Goss	#E15
Annie Liang	#E16
Ariel Stein	#F1
Benjamin Burns	#F2
Camille Aquino	#F3

Alison Lu; Orly Richter; Naile Ozpolat; Claire Kim	#F4 & #F5
Daniela Figueroa	#F6
Devon Newman	#F7
Eugena Choi	#F8
Jahred Rosa-Sullivan	#F9
Marina Hahn	#F10
Matthew Campos	#F11
Mona Malone	#F12
Nancy Collie-Beard	#F13
Neil Mehta	#F14
Rubysela Rodriguez	#F15

SUMMER RESEARCH PROGRAMS REPRESENTED

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- Biomedical Engineering Research Assistant
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- Leadership Alliance-Summer Research Early Identification Program (SR-EIP)
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- Space Grant/NASA
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- Summer Research Program, Weiss Lab
- The Carney Institute for Brain Science
- Undergraduate Research Assistantship in MCB
- Voss Environmental Fellows
- Weiss Summer Fellowship, RI-INBRE SURF

REPRESENTED INSTITUTIONS

- Amherst College
- Arizona State University
- Azusa Pacific University
- Brown University
- CUNY Hunter College
- California State Polytechnic University, San Luis Obispo
- California State University Northridge
- Colgate University
- College of Mount Saint Vincent
- Cornell University
- Florida State University
- Georgia Institute of Technology
- Georgia Institute of Technology (Jim James)
- Grinnell College
- Hampshire College
- Harvey Mudd College
- Haverford College
- Howard University
- Hunter College CUNY
- Inter American University of Puerto Rico
- Lafayette College
- Mercer University
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- Rutgers University
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- The Ohio State University
- Tougaloo College
- UCLA
- UMass Amherst
- University of California, Davis
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- University of Puerto Rico at Cayey

- University of Puerto Rico, Rio Piedras Campus
- Vanderbilt University
- Vassar
- Washington University in St. Louis
- Western Washington University
- Williams College
- Worcester Polytechnic Institute
- Xavier University of Louisiana
- Yale University