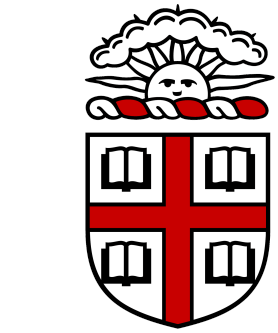

BROWN

SUMMER RESEARCH SYMPOSIUM

2024

Sayles Hall
11:00 am – 1:00 pm

Thursday, August 1
Life Sciences and Humanities

&

Friday, August 2
Physical and Social Sciences

PRESENTED BY
The College

SUMMER RESEARCH SYMPOSIUM

Sayles Hall

Main Green

Thursday, August 1

Life Sciences and Humanities Posters

11:00am – 11:05 am Welcome and Brief remarks
Associate Dean Oludurotimi Adetunji

11:05 am – 1:00 pm Research Poster Presentations

Friday, August 2

Physical and Social Sciences

11:00 am – 11:05 am Welcome and Brief remarks
Associate Dean Oludurotimi Adetunji

11:05 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 below.

POSTER LAYOUT

Thursday, August 1

Humanities and Life Sciences

[STAGE]

A16		B16	C16	D16	E16	F16	G16		
A15		B15	C15	D15	E15	F15	G15	H12	
A14		B14	C14	D14	E14	F14	G14	H11	
A13		B13	C13	D13	E13	F13	G13	H10	
A12		B12	C12	D12	E12	F12	G12	H9	
A11		B11	C11	D11	E11	F11	G11	H8	
A10		B10	C10	D10	E10	F10	G10	H7	
A9		B9	C9	D9	E9	F9	G9	H6	
A8		B8	C8	D8	E8	F8	G8	H5	
A7		B7	C7	D7	E7	F7	G7	H4	
A6		B6	C6	D6	E6	F6	G6	H3	
A5		B5	C5	D5	E5	F5	G5	H2	
A4		B4	C4	D4	E4	F4	G4	H1	
A3		B3	C3	D3	E3	F3	G3		
A2		B2	C2	D2	E2	F2	G2		
A1		B1	C1	D1	E1	F1	G1		

[ENTRANCE]

[LOBBY]

POSTER LAYOUT

Friday, August 2

Physical and Social Sciences

[STAGE]

A16	B16
A15	B15
A14	B14
A13	B13
A12	B12
A11	B11
A10	B10
A9	B9
A8	B8
A7	B7
A6	B6
A5	B5
A4	B4
A3	B3
A2	B2
A1	B1

C16	D16
C15	D16
C14	D14
C13	D13
C12	D12
C11	D11
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C3	D3
C2	D2
C1	D1

E16	F16
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E2	F2
E1	F1

G12
G11
G10
G9
G8
G7
G6
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G4
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G1

[ENTRANCE]

[LOBBY]

SYMPOSIUM ORGANIZERS

Oludurotimi Adetunji
Associate Dean of the College for Undergraduate Research and Inclusive Science; Director, UTRA Program

Linda Sutherland, Co-Curricular Program Manager

Avi Brach-Neufeld, Academic Data Analyst & Systems Engineer

ACKNOWLEDGEMENTS

Christina Paxson, President

Francis J. Doyle III, Provost

Rashid Zia, Dean of the College

Brown University Library

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The deadline for this is **September 1, 2024**

SUMMER RESEARCH SYMPOSIUM POSTERS
Thursday, August 1st
Humanities & Life Sciences

Humanities

Alexia Burford: **Poster #A1**

Home Institution: Howard University

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

Faculty Mentor: Dr. Christopher West, University Library

The Legacy of Black Student Activism at Brown University: Impact on Racial Progress & Leadership Development Post-1968 Walkout

This research highlights how the race-related goals set during the 1968 Walkout at Brown have shaped the measurement of racial progress over the decades, influencing leadership development and ushering in a new era of campus leadership. By analyzing the negotiation process during the Walkout and its enduring effects on Brown University's approach to racial equality, this study provides critical insights into the University's history and strive for diversity. Originating in fall 1964, the Afro-American Society (AAS) played a pivotal role in the historic Walkout. Qualitative interviews with former AAS members offer firsthand perspectives and insight on this moment. These interviews, alongside primary documents such as signed demands, Brown's responses, and the Black Student's Position Paper, provide crucial context and capture key discussions preceding the Walkout. Excerpts from The Brown Daily Herald from 1966-1968 contextualize the social climate globally, nationally, and on campus, elucidating their impact leading up to the Walkout. The University's progressing commitment to the demands of the 1968 Walkout is evident through initiatives like the Diversity and Inclusion Action Plan (DIAP), aimed at reshaping cultural traditions to benefit all students. This research honors the legacy of Black student activism, highlighting its impact and aiming to inspire continued positive change at Brown University and beyond.

Myah Burt: **Poster #A2**

Home Institution: Claflin University

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

Faculty Mentor: Dr. Ashley Champagne, University Library; Dr. Linford Fisher, History

The Importance of Reparative Storytelling: Amplifying the voices and perspectives of systematically underrepresented Indigenous communities in sharing the history of Indigenous Enslavement

European colonial powers perpetuated the hemispheric phenomenon of Indigenous enslavement in the Americas as they invaded and dictated Indigenous lands and culture through the late 1400s and into the early 1900s. Scholars have estimated that between 2.5 and 5 million Indigenous individuals were enslaved during this period alone (Stolen Relations, 2023). Archival information and storylines based on this topic have almost exclusively been told from the colonizer's perspective, consequently fostering a lack of public awareness and emotional sensitivity to the subject. The question then arises: How can we humanize the Indigenous individuals mentioned in archival documents despite the minimal information available about them? By examining archival material and collaborating with existing tribal partners, we seek to uncover the stories that have not been told, educate the public, and restore relationships disassembled by prejudiced history. This project will expose an impediment to understanding due to colonizers' voices primarily being readily available in archival material and oral histories, therefore raising awareness of Indigenous enslavement and fostering the repairment of Indigenous relationships.

Aidan Choi; Yuexiao Yang; Indigo Mudbhary: **Poster #A3**

Home Institution: Brown University

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

Faculty Mentor: Robert Lee, American Studies

Chronicling Chinese America: The Fong/Lee Family Archives

This summer, we have been organizing, cataloging, and digitizing approximately 5000 photographs and related ephemera (letters, family trees, etc.) that chronicle the history of two related families of Chinese ancestry – the Fongs and the Lees — in the United States from approximately 1890 to 1990. The two families became middle-class Chinese Americans over the course of the twentieth century, and their photographs and related ephemera document this transition. In addition to this archival work, the team has begun to meet with family members in order to get more information about the photographs and actively involve them in the project as it is happening in real-time. Ultimately, these photographs will constitute a publicly accessible, searchable digital archive that will benefit researchers interested in Chinese America, Asian American photography, and more.

Harris Galvin: **Poster #A4**

Home Institution: Brown University

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

Faculty Mentor: Laura Snyder, Education

Humanities Reimagined Project

The Humanities Reimagined Project produces curricula for high school humanities classrooms that adequately reflects students, their communities, and the diversity of the world around them. The curricula prepare students for success in high school and beyond with strong writing, research, and discussion skills.
The Power of Stories unit includes short stories and poetry by a diversity of authors. The unit explores the concept of identity from different perspectives and approaches.
The Poet X, a novel in verse, is the center of a unit on the importance of self expression when dealing with the issues such as coming of age, homophobia, sexual assault, and religious turmoil. The unit

explores finding and creating safe spaces through creative means.

Jacob Gelman: **Poster #A5**

Home Institution: Brown University

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

Faculty Mentor: Helis Sikk, Pembroke Center/Gender and Sexuality Studies Concentration

Developing a Class Syllabus on the History of HIV/AIDS Activism in the United States

This summer, I collaborated with Professor Helis Sikk at Brown University to design a comprehensive syllabus for a course focused on the history of HIV/AIDS activism in the United States. The primary objective of this project was to curate a robust and diverse collection of scholarly works, primary sources, and theoretical frameworks that encapsulate the multifaceted history and activism surrounding HIV/AIDS in the U.S. We meticulously reviewed an extensive range of literature and archival materials, ultimately distilling them into a coherent and impactful curriculum.

Our process involved several key considerations. First, we established clear learning objectives aimed at providing students with a nuanced understanding of the socio-political, cultural, and medical dimensions of HIV/AIDS activism. Additionally, we sought to integrate the histories of Brown University and Rhode Island, highlighting local activism and contributions to the broader national narrative.

The resulting syllabus is designed to not only educate students on historical events and figures but also to foster critical thinking and engagement with ongoing issues related to HIV/AIDS. This course is expected to be offered in the Spring of 2025.

Mal Go: **Poster #A6**

Home Institution: Brown University

Summer Research Program: John Hay Library Undergraduate Fellowship

Faculty Mentor: Leo Lovemore, University Library

A brief history of Traditional Midwifery to Clinical Obstetrics

Childbirth has always been a pivotal moment in human existence, intricately linked with the evolution of societies and their cultural frameworks. Central to this process has been the role of the midwife, whose presence and expertise have been crucial in ensuring the safety and well-being of both mother and child. This project delves into the essential role of midwives throughout history, examining how their practices have evolved across different cultures and time periods, as well as the macro and micro sociocultural factors that have shifted maternal care from midwifery to obstetrics (OB). Our analysis is women-centered, focusing on the diverse practices of midwifery from ancient times to the contemporary era. We explore the significant historical transitions from traditional midwifery to clinical obstetrics, highlighting the variations in childbirth practices and the sociocultural factors that influenced these changes. This journey through time and different cultures reveals how colonization, technological advancements, and pivotal moments in history have shaped the fields of midwifery and obstetrics. The purpose of this project is to provide a critical appraisal of the history of midwifery and clinical obstetrics. We aim to examine major transitions, sociocultural circumstances, significant developments, and evolutions in childbirth practices. Through this exploration, we address themes such as gender roles, the

status of women in society, maternal and fetal mortality, and the importance of practicing radical empathy in understanding who advanced the history of childbirth and how. Structured around consecutive historical periods, this project includes an "intermission" to closely examine common diseases related to pregnancy and childbirth that have played a significant role throughout history. By understanding the past, we can better appreciate the advancements and ongoing challenges in the field of obstetrics, ultimately advocating for a more holistic and culturally sensitive approach to maternal care. For clarification, when referring to “midwifery”, we are referring to the socially constructed practice of assisting women in childbirth and through their childbearing years with a holistic perspective. “Obstetrics” or “clinical obstetrics” refers to the branch of medicine and surgery concerned with childbirth and the care of women giving birth. As midwifery has been the predominant practice for childbirth for most of history, this project will primarily focus on its development and evolution compared to the relatively recent emergence of clinical obstetrics.

Meg Henning; Eliana Lopez: **Poster #A7**

Home Institution: Brown University

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

Faculty Mentor: Katherine Rieser, Education

Understanding Community Engaged Research in Building a Teacher Induction Program

This summer, our research focused on helping to develop an induction program for graduates of the Brown Masters in Teaching program who are entering their first year of teaching in local Rhode Island schools. Given the low retention rates and high demand for teachers in Rhode Island, this induction program was created with intentions of better understanding how the university can contribute to strengthening the teacher workforce. Over the course of the school year, the PI and other members of the community met to better understand how to better support early career teachers and together created an outline for an induction program pilot that will commence this fall. Focusing on matching new teachers to mentors that best suit them and professional development and workshops to ensure teachers are absorbing culturally responsive pedagogy in their disciplines and practice; the induction program will also create networking spaces that allow MAT alumni and early career teachers to connect, share resources, and professionally grow together.

Our work this summer has been mainly focused on looking at the meetings community members had with researchers over the year and understanding their process of building the induction proposal plan. From this, we started looking into existing literature and built the intensive outline of a study that will examine the upcoming year’s induction program. Through extensive research in writing a literature review and case study we were able to start to understand what the study component of an induction program will look like, how participants will be interviewed and how data will be collected. The primary research questions that we aim to answer through this study are centered around evaluating the effectiveness of community-based program development in educational settings, identifying the gaps in existing community-focused designs and assessing the advantages of programs alike. Specifically the study seeks to understand how we can measure the effectiveness of community-centered program development, what elements are missing from community-focused design when analyzing the creation of the Education Studies Department’s Induction Program for early career MAT alumni, and what the benefits are in this context. Additionally, the study investigates the overall impact of an induction program that incorporates mentorship and sessions focused on culturally relevant pedagogy on early career teachers’ empowerment and retention. It aims to examine how a program influences teachers’ sense of readiness and classroom preparedness and the role of culturally responsive teaching training in retaining

early career teachers.

Kyoungmin Lee: **Poster #A8**

Home Institution: Brown University

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

Faculty Mentor: Elizabeth "Beth" Cameron, Public Health-Health Services Policy & Practice; Aquielle Person, Pandemic Center

Leaning Forward: Structuring training exercises in biosecurity and biosafety for emerging pandemic preparedness/policy decision makers

The Pandemic Game Changers Initiative is the Pandemic Center's newest global fellowship that addresses the following question: How can we train the next generation of public health leaders on biosecurity and biosafety risks? In preparation for the fellowship's in-person workshop in Addis Ababa, Ethiopia this September, we developed interactive modules that prompt reflection on how to improve biosecurity and biosafety policy and how to better respond to biological crises.

In one particular module, we researched notable outbreaks of the recent past, such as Ebola in 2014 - 2016, analyzing the developments and remaining gaps in regional/global pandemic preparedness. We framed those outbreaks into interactive case studies for participants to apply their expertise. Through these case studies, we seek to guide participants as they identify specific barriers to better detection, preparedness, and response, and step into the shoes of biosecurity/biosafety policy decision-makers.

Life Science

Ashley Abrego Gonzalez: **Poster #A9**

Home Institution: The University of Texas Rio Grande Valley

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

Faculty Mentor: Lalit Beura, Bio Med Molecular, Microbiology & Immunology

Impact of Microbiome on Tissue Resident Memory CD8+ T Cell Differentiation in Vaginal Epithelial Organoids

The vaginal microbiome, predominantly composed of Lactobacillus species, is crucial for women's reproductive health by maintaining a protective barrier against infections. Disruptions in this microbiome, such as from antibiotic use or hormonal changes, can reduce Lactobacillus dominance and promote growth of pathogenic bacteria like Gardnerella vaginalis. Such alterations can modulate local innate and adaptive immune cell population of the vaginal mucosa. This study investigates how the vaginal microbiome influences the differentiation of the vaginal resident memory CD8+ T cells (TRM), a crucial cell type responsible for local antiviral defense. We used an in vitro model of vaginal epithelial organoid (VEO)-CD8 T cells co-culture to model TRM differentiation. Bacterial supernatants from pathogenic and commensal strains were applied to these co-cultures, and T cell phenotypes were analyzed using flow cytometry to assess changes in differentiation. Preliminary data suggest that cell-free supernatants from Gardnerella vaginalis bacteria might inhibit CD8+ TRM cell differentiation, while those from Lactobacillus

crispatus do not show this effect.This research could help our understanding of how the vaginal microbiome influences immune function, particularly the role of CD8+ T cells in preventing infections and maintaining reproductive health.

Mercy Adewumi: **Poster #A10**

Home Institution: Brown University

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

Faculty Mentor: Sendurai Mani, Bio Med Pathology & Laboratory Medicine

Investigating the Role of Serine 125 Phosphosite on FOXC2 in Regulating Stemness

Metastasis, the migration of cancer cells to distant organs from the primary tumor, worsens patient prognosis and poses a significant challenge in cancer treatment. The Mani Lab has found that one of the drivers of metastasis, epithelial-mesenchymal transition (EMT), not only increases motility properties but also allows for stem-like properties to develop, leading to cancer stem cell (CSC) generation. CSCs are difficult to target due to their ability to self-renew and differentiate, as well as being resistant to common chemotherapies, enriching treated tumors in CSCs and complicating treatment.

This project aims to identify regulatory factors of cancer stemness. The Mani Lab has identified Forkhead box C2 (FOXC2) as a key factor in EMT-induced stemness. FOXC2, a transcription factor necessary for early development differentiation, is typically absent in adult cells but re-expressed and highly expressed in aggressive metastatic cancer cells. Our lab group has also revealed that FOXC2 could be regulated by a G2/M kinase, Polo-like Kinase 1 (PLK1). Thus, this led us to hypothesize that the PLK1 specific phosphosite (serine 125) on FOXC2 is regulating EMT induced stemness in breast cancer.

Current ongoing work test our hypothesis is utilizing FOXC2 phosphosite mutant metastatic breast cell lines. Using these cell line models, we performed protein immunoblot to observe changes in mesenchymal and stem cell factor expression. As well as immunofluorescence assays to observe FOXC2 localization changes. We also conducted stem cell mammosphere forming assays to assess stemness properties. Lastly, we observed the effect of the S125 phosphosite on growth by conducting a time lapse proliferation assay. Overall, understanding the role of PLK1 induced phosphorylation of FOXC2 will allow us to better elucidate the drivers of breast cancer stem cells and hope that it will lead to developing a more efficacious targeted therapy towards resistant CSCs.

Adira Altman; Elena Yeh: **Poster #A11**

Home Institution: Brown University

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

Faculty Mentor: Melissa Palma, Family Medicine

Investigating the Intersection between Covid-19, Asian-American Violence, and Filipinx/a/o Mental Health: an AAPI Data Project and Literature Review

Mental health experiences for Asian American/Pacific Islander communities (AAPI) are understudied in medical literature, especially Filipinx/a/o-American communities (Nguyen et al., 2021). Current research places AAPI health in an aggregated or monolithic grouping. However, AAPI composes a diverse group of communities, each with their own health risks, socioeconomic status and cultural experiences (Adia 2020). When this data is disaggregated, it is shown that disparities in mental health negatively affect the Filipinx/a/o community (Chan 2020). Through a systematic review, we aim to investigate mental health in

Filipinx/a/o populations and its relationship with Asian-American violence and/or the Covid-19 pandemic. Currently, this project is in phase two of the systematic review, which is data extraction of 250+ screened papers. This project is ongoing, so no definite conclusions can be drawn at the moment. However, we can provide a sample of our understanding from the current data extracted. In the future, this research will be used to write policy proposals to support Filipinx/a/o-American mental health awareness.

Adia AC, Nazareno J, Operario D, Ponce NA. Health conditions, outcomes, and service access among Filipino, Vietnamese, Chinese, Japanese, and Korean adults in California, 2011-2017. Am J Public Health. 2020;110(4):520-526. doi:10.2105/AJPH.2019.305523

Chan, C. D., & Litam, S. D. A. (2021). Mental health equity of filipino communities in COVID-19: A framework for practice and advocacy. The Professional Counselor, 11(1), 73-85. doi:https://doi.org/10.15241/cdc.11.1.73

Nguyen, H. T., Zheng, A., Gugel, A., & Kistin, C. J. (2021). Asians and Asian Subgroups are Underrepresented in Medical Research Studies Published in High-Impact Generalist Journals. Journal of immigrant and minority health, 23(3), 646–649. https://doi.org/10.1007/s10903-021-01142-6

Jolymer Arocho Román: **Poster #A12**

Home Institution: Inter American University of Puerto Rico Aguadilla Campus

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

Faculty Mentor: Gilad Barnea, Bio Med Neuroscience

Assessing Pheromone-Mediated Parenting Behavior in Vmn2rC-/- Mice

Pheromones are chemical substances released by members of a species and detected by others of the same species where they induce innate intraspecies behaviors such as territorial defense, mating, and parental care. In mammals, pheromones are detected by specific receptors on sensory neurons in the vomeronasal organ. These receptors belong to two families: Vmn1r, expressed on apical vomeronasal sensory neurons (VSNs), or Vmn2r, expressed on basal VSNs. While apical VSNs express only one type of Vmn1r per neuron, basal VSNs express one receptor from class C of Vmn2r and another from class A, B, or D in a non-random fashion. However, the significance of Vmn2rC and Vmn2rABD co-expression and the specific role of Vmn2rCs in the induction of innate intraspecies behaviors is unknown. To study this, my lab established Vmn2rC-/-, a mouse line where the entire gene cluster for class C of Vmn2rs is deleted. My project uses this Vmn2rC-/- mouse line to test the hypothesis that Vmn2rCs are required for the proper display of innate parental behavior. My results will provide insight into the role of Vmn2rCs and the significance of Vmn2r co-expression in pheromone detection and processing.

Amira Artykbayeva: **Poster #A13**

Home Institution: Brown University

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

Faculty Mentor: Joo-hyun Song, Department of Cognitive and Psychological Sciences; Sean O'Bryan, Cognitive, Linguistic, and Psychological Sciences

Predicting learning outcomes through machine learning models trained on pupil size

Changes in pupil size provide a biomarker of mental effort while humans are engaged in cognitively demanding tasks. Therefore, we hypothesized that a machine learning classifier trained on different features of the pupillary response (e.g., pre- and post-trial velocities) may be able to identify whether

participants were high or low performers during a sensorimotor learning task that requires cognitive control.
A pool of 30 subjects completed a visuomotor rotation task with eye-tracking where they were asked to make reaching movements to targets appearing on a screen using a touch surface. Critically, after 40 trials where participants received cursor feedback that followed the path of their hand (baseline phase), the visual feedback was unexpectedly rotated by 45 degrees (learning phase). To achieve high performance, participants were required to adjust their reaching movements in the opposite direction of the rotated feedback. We classified subjects as high or low performers based on the hand angle they achieved by the end of the learning phase (+/- 30 degree cutoff).

To test our hypothesis that pupil size could predict these learning outcomes, we first built a kNN-classifier focused on the late learning phase with k = 3, utilizing features such as the average pre-trial velocity, change in velocity, and time to peak velocity. Using a leave-one-out approach, this classifier achieved up to 80% prediction accuracy, indicating we could predict subject performance based on pupil features from the late learning phase.

Excitingly, we discovered we could train the model using only baseline reach data, representing trials before the rotation task. This allowed us to identify high or low performers without completing the rotation task. Using our kNN model with k = 3 and the same features described above, we achieved a 75% prediction accuracy based on pupil data from the baseline phase.

To further support our findings, we built a non-linear SVM classifier and a Decision Tree classifier, training both on baseline data, achieving accuracies of 79.1% and 76.4% respectively. Finally, we developed a voting machine classifier combining all three models that selects the majority-voted class based on the trial, providing a prediction accuracy of 77.8%.

Our results suggest that pupil data contains key information relevant to sensorimotor learning, allowing us to predict how well a subject will perform by training models on different learning phases and various pupil features. This approach highlights the potential for early identification of learning ability, reducing the need for extensive training.

Nirel Ayertey: **Poster #A14**
Home Institution: Brown University

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

Faculty Mentor: Gerard Nau, Bio Med Medicine

Designing Interfering Peptides to Block SARS-CoV-2 Invasion

Coronavirus disease 2019 (COVID-19) is a respiratory illness caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of July 2024, over 775 million COVID-19 cases and 7 million deaths have been recorded (World Health Organization, 2024). Understanding patients' immune response to the virus is an important step in fighting the disease. Deep RNA sequencing was used previously to characterize antibodies that are produced in patients with severe COVID-19. The top 20 amino acid CDR3 sequences, which define antigen binding, were identified in the antibodies produced by all the survivors (Fredericks et al., 2022). The short term objective of this study is to evaluate peptides defined by these CDR3 sequences for their ability to block SARS-CoV-2 binding to its cellular receptors. The longer term goal is to determine whether or not binding energies are correlated with inhibition of viral entry, and as such whether or not tools such as Autodock 4 and Autodock Vina are reliable predictors of neutralizing ability. The binding of peptides defined by the CDR3 sequences to the SARS-CoV-2 receptor

binding motif (RBM) was tested in silico using Autodock 4 and Autodock Vina. This produced a number of different docking conformations along with their corresponding binding energies. There appeared to be a correlation between the peptides' length and binding energies. The two peptides with the highest average binding energies were longer than the four peptides with the lowest average binding energies. Based on the docking results, eight peptides were selected for synthesis. These included four peptides with the lowest average binding energies including the shortest peptide, two peptides with the highest average binding energies, the longest peptide, and a scrambled sequence of the longest peptide. These peptides are being prepared for in vitro testing to determine if they can inhibit SARS-CoV-2 invasion. These results can also be used to determine if the size of the peptide has a more significant role to play in preventing viral invasion than binding energies. If these peptides successfully inhibit SARS-CoV-2 invasion, then there is the potential to use deep RNA sequencing as a method to scan for sequences to develop therapeutic peptides against other viruses.

Leanna Bai: **Poster #A15**

Home Institution: Brown University

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

Faculty Mentor: Nicolas Fawzi, Bio Med Molecular, Cellular Biology Biochemistry

Impact of ALS-Associated Mutations in a C-Terminal "Hotspot" on TDP-43 Phase Separation and Aggregation

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. Through various biochemical assays and microscopic techniques, the impact of these seven ALS-associated mutations on the C-terminal domain will be determined. 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.

Patience Beauchemin: **Poster #A16**

Home Institution: University of California Santa Cruz

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

Faculty Mentor: Emilia Huerta-Sanchez, Ecology, Evolution, and Organismal Biology

Identifying barrier loci in Heliconius through patterns of co-introgression across species

Demographic processes, natural selection, mutation, and recombination create patterns of diversity and divergence throughout the genome during the speciation process. Understanding the evolution of barrier loci—loci that contribute to barriers of gene flow—is pivotal for understanding the genetic underpinnings of speciation. Typically, barrier loci are identified by conducting genome-wide scans across species, where regions of high divergence are generally considered to have arisen from reproductive barriers. Here, we propose a new approach by first mapping out the introgression landscape and then leveraging correlations among regions devoid of introgression across a clade to identify candidate barrier loci. This new comparative approach offers an alternative for identifying barrier loci and studying the genetic basis of speciation.

Louis Boyang: **Poster #B1**

Home Institution: Brown University

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

Faculty Mentor: Robert Sobol, Department of Pathology and Laboratory Medicine

Investigating the impact of AP-Endonuclease 1 inhibition on PARP-activation, DNA damage induction and cancer cell survival

Base Excision Repair (BER) is a DNA repair pathway that corrects small, non-helix distorting base lesions, such as 3-methyladenine, 8-oxo-guanine, apurinic/apyrimidinic (AP) sites, or DNA single strand breaks (SSBs). Various cancer cells, such as Glioma Stem Cells (GSCs), experience elevated BER-mediated chemotherapy resistance, thus making them attractive targets for BER therapeutic modulation. AP Endonuclease 1 (APE1) is a critical BER protein that performs endonuclease strand scission after monofunctional glycosylase base removal or exonuclease gap tailoring after bifunctional glycosylase activity of many base adducts such as 3-methyladenine and 8-oxo-guanine or acts directly on AP-sites that result from chemical exposure. Once the lesion is removed by the glycosylases and/or APE1, additional BER protein complexes are recruited in response to Poly-ADP-Ribosylation (PARylation) around the DNA strand break to facilitate repair. Based on its functional role in BER, we hypothesize that APE1 inhibition would modulate the level of PARP-activation, would increase the level of replication-induced DNA damage and would show enhanced cytotoxicity in BRCA1/BRCA2 mutant tumors. To investigate this hypothesis, we have developed and optimized critical biological assays for each: (1): we will use our LivePAR assay to quantify the level of PARP-activation in response to each APE1 inhibitor; (2) we will measure DNA damage using the proxy biomarker gamma-H2AX in response to each APE1 inhibitor (measuring γH2AX after a 24 hour exposure will reveal if APE1 inhibition prevents the repair of SSBs and AP sites which are thus transformed into DSBs after DNA replication); and (3) we will determine if the APE1 inhibitors are cytotoxic in BRCA1/BRCA1 WT and mutant cancer cell lines. By investigating the impact of APE1 inhibitor on BER activity, DNA damage, and cell viability, we hope that our findings can elucidate the essentiality of APE1 in BER, serve as a blueprint for testing the efficacy of other APE1 inhibitors, and potentially lead to novel cancer therapies using APE1 inhibition.

Camille Brown: **Poster #B2**

Home Institution: The University of Texas at Austin

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

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

Mitonuclear compatibility: The role of genotype in mate preference of Drosophila melanogaster

As the main producers of cellular energy and the sites of critical metabolic and signalling processes, mitochondria are essential to the survival of eukaryotic cells. These organelles, once free-living eubacteria, contain their own independently replicating genome, yet are dependent on over 1000 imported nuclear gene products to properly function. The two genomes evolve together, with mitochondrial adaptation being driven by selection in females of a species. Due to the intimacy of mitonuclear interactions, incompatibilities between the genomes have been shown to reduce the mitochondria's metabolic ability in cyto-nuclear hybrids, and in plants are often implicated in hybrid breakdown. Sexual selection theory predicts that females should choose mates with 'good genes' that will benefit their offspring, and that males with 'good genes' can compete successfully for access to mates. The influence of mitonuclear interactions on organism viability has prompted the development of a 'mitonuclear matching hypothesis' that extends sexual selection theory to include female choice based on the compatibility the female mitochondrial genome with the male nuclear genome. Using Drosophila mito-nuclear hybrids created by the Rand lab, I test this hypothesis in both males and females by forming pairwise mate choice assays that give focal individuals a choice between individuals with (1) native or non-native mitochondrial genotype, with the same nuclear genotype as the focal and (2) native or non-native nuclear genotype, with the same mitochondrial genotype as the focal. Recording courtship, receptivity, and copulatory behaviors provides measures of male performance and both male and female preference that indicate how mitonuclear compatibility may be used as a criterion in the evaluation of potential mates.

Megan Carlson: **Poster #B3**
Home Institution: Brown University

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

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

Computational Analysis of Nuclear Organization Using SPRITE to Identify Three-dimensional DNA/RNA Contacts

The 3D nuclear organization plays a crucial role in cellular functions via gene regulation. While many techniques like HiC, microC, and HiChIP have revealed the importance of 3D contacts in transcription, our understanding of how nuclear organization shapes transcript processing, including RNA splicing, is still limited. RNA splicing is vital for cell and sex-specific transcriptomes and is often disrupted in many human diseases. Therefore, research focusing on understanding how spatial organization regulates mRNA splicing in various contexts is integral to our understanding of the genetic basis of health.

In this project, I have used a new technique called Split-Pool Recognition of Interactions by Tag Extension, or SPRITE, and its variant RD-SPRITE, developed by Guttman Lab in Caltech to identify three-dimensional contacts between DNA and RNA to determine clusters associated with sex-specific RNA splicing. Sex-specific splicing is conserved across different species, and many human neurological disorders are associated with splicing defects. Interestingly, many of these neurological disorders show gender biases. Thus, understanding how sex-specific splicing is regulated can improve management and therapeutics for these diseases. Therefore, I first customized the SPRITE/RD-SPRITE computational pipeline to explore sex-based splicing in Drosophila, a widely studied genetic model with extensive research in the field of sex-specific splicing. So far, this pipeline has only been used for mammalian

datasets, so I compiled a container using the Guttman lab pipeline for Drosophila SPRITE data analysis to identify male and female-specific 3D clusters associated with splicing and determine unique genomic features that characterize the sex-specific clusters.

Furthermore, I utilized published datasets, applying the SPRITE pipeline to identify cell-type specific 3D genomic clusters using mouse mammalian embryonic stem cells and myocyte data. I identified over one million clusters for each mammalian sample, each representing groups of DNAs and RNAs that share the same molecular barcode due to spatial proximity. Using heat maps as a visual tool, I compared clusters of different mouse cell types. I also ran human embryonic stem cell datasets and identified human 3D genomic clusters to determine functional conservation of 3D nuclear organization between mice and humans.

In the future, I plan to integrate computational analysis of SPRITE/RD-SPRITE Drosophila datasets with bulk and nascent transcriptomic datasets in male vs. female cells to elucidate the regulatory network that determines the targeting of sex-specific splicing events. This will help identify candidates that can shape particular splicing events, giving us scope to regulate splicing events to our advantage.

Amine Chajar: **Poster #B4**

Home Institution: Brown University

Summer Research Program: Techfoundation Data Science and Medical Research program

Faculty Mentor: Marie McDonnell, Earth, Environmental, and Planetary Science

How CGM use in the hospital could transform access to technology for people

While continuous glucose monitoring (CGM) has transformed the care of people with diabetes in the ambulatory setting, there continue to be significant barriers to access. These barriers were highlighted during the COVID-19 pandemic, while at the same time substantial progress was made toward the implementation and utilization of this technology in the hospital setting. In this commentary, we present a vision for a new model which leverages the transition of care from the hospital to incorporate CGM and specifically how it can, and should, positively impact overall access to this technology for patients who have been demonstrated to have the greatest benefit.

Anne Chang: **Poster #B5**

Home Institution: Brown University

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

Faculty Mentor: Justin Fallon, Bio Med Neuroscience

Developing a Quantitative Assay to Characterize the Activity of Antisense Oligonucleotides for Targeting Adult Hippocampal Neurogenesis

In Adult Hippocampal Neurogenesis (AHN), new neurons are generated and integrated into brain circuitry throughout life. The birth of neurons can influence cognition, emotion, and learning and memory. This role is applicable in multiple contexts of different neurodegenerative diseases and aging, including Alzheimer's, which exhibits impaired AHN. MuSK is a bone morphogenetic protein (BMP) co-receptor that regulates AHN in the MuSK-BMP pathway. Full length transcript of MuSK contains an Ig3 domain necessary for high-affinity BMP binding and inhibits the activation of neural stem cells (NSCs). Our lab created the ΔIg3 transcript, which excludes the Ig3 domain, to decrease BMP signaling and target AHN.

These findings indicate modulating MuSK has important implications in developing drug therapies for neurodegenerative disorders. Exon-skipping antisense oligonucleotides (ASOs) demonstrate the greatest potential for possible therapies. These small drugs, ASOs, bind to a targeted pre-mRNA sequence in cells and modulate the splicing of specific exons. Our lab has identified ASO3, which induces skipping of the MuSK exons encoding the Ig3 domain, while maintaining total MuSK transcript levels. Using immunostaining, qualitative evidence reveals ASO-treated cells have reduced levels of MuSK containing the Ig3 domain, but still exhibit normal protein expression of the splice-modified ΔIg3 transcript.

The goal of my study is to develop a quantitative assay to measure the expression of MuSK in vivo with ASO treatment. To achieve this goal, I am developing an In-Cell ELISA (Enzyme-Linked Immunosorbent Assay) with monoclonal antibodies specific to the Ig3 domain. Ultimately, I expect to compare levels of MuSK in full length and ΔIg3 transcript in the context of cells treated with ASO3. Currently, I am optimizing detection levels and maximizing sensitivity in purified MuSK; I will use these conditions as a basis for ELISAs in cultured myoblast cells, where MuSK is known to be active. If successful, this would set the stage for introducing ASO treatment in myoblasts and allow us to test the potency and dosage range of ASO3. Long-term, our assay could provide data for potential biomarkers in cerebrospinal fluid (CSF) during ASO delivery by quantitative measurement of protein expression.

Valen Chapel: **Poster #B6**

Home Institution: University of North Carolina at Chapel Hill

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

Faculty Mentor: Mamiko Yajima, Molecular Biology Cell Biology Biochemistry (MCB)

The Characterization of TDRD7 in Sea Urchin Embryos

LOTUS-domain proteins are vital for the development of germ cells in many animals. Mutations of the LOTUS domain in certain proteins can cause sterility and inhibit gametogenesis. In germ cells, the extended LOTUS (eLOTUS) domain has been shown to interact with Vasa, an RNA helicase also necessary for germ cell development. For example, in previous work the eLOTUS domain of TDRD5, TDRD7, and Oskar ensured Vasa was properly recruited to nuage granules in germ cells and stimulated Vasa helicase activity, suggesting an important relationship during gametogenesis. We previously characterized the role of Vasa in localized mRNA translation on the spindle during sea urchin embryogenesis. However, how Vasa is recruited to the spindle is unknown in these embryonic cells. To test whether the LOTUS-domain protein is involved in this process, we recently cloned TDRD7, which showed a similar spindle localization to Vasa on the spindle. To further explore the relationship between TDRD7 and Vasa in this context, we made a series of deletion and mutation constructs for TDRD7. These include full or partial deletions of the eLOTUS domain, point mutations at the Vasa interaction interface, and deletions of the intrinsically disordered region of TDRD7. Each of these TDRD7 mutants was then fused to GFP for in vivo visualization by confocal microscopy. Through these experiments, this work aims to identify the amino acids or regions of TDRD7 critical for its interaction with Vasa on the spindle, which may also contribute to localized translation on the spindle, a critical process for efficient embryogenesis.

Aman Bhutani: **Poster #B7**

Home Institution: Brown University

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

Faculty Mentor: Gerwald Jogl, Department of Molecular Biology, Cell Biology, and Biochemistry

Thermostable in vitro transcription-translation assay for Thermus thermophilus

Thermus thermophilus is a thermophilic bacterium and an important model organism for experiments in genetics and molecular biology. The bacterium grows at an optimum temperature of 65°C and is hence also a source of thermostable enzymes. Traditionally, E. coli has been used as a model organism to measure protein expression from wild-type and mutant ribosomes, including ribosomes isolated from E. coli, T. thermophilus, and R. marinus. In vitro transcription-translation (IVTT) assays have been well established for E. coli, which has an optimum temperature of 37°C. IVTT extracts for E. coli are commercially available, and the Jogl Lab has developed an IVTT assay using this extract, with nano-luciferase as a reporter protein. However, no such commercially available IVTT extract exists for T. thermophilus.

The goal of this project is to develop an IVTT assay for T. thermophilus following the paper "Thermostable in vitro transcription-translation compatible with microfluidic droplets" by Ribeiro et al. Due to T. thermophilus' high optimum temperature of 65°C, an IVTT assay for this species must use a thermostable reporter protein that does not denature. Hence, the project first establishes a standard curve for sfGFP (superfolder green fluorescent protein), using a plate reader to measure fluorescence. sfGFP contains several mutations from wild-type GFP, resulting in improved folding and fluorescence at higher temperatures. The linear dynamic range of sfGFP concentrations detectable by the Cytation Plate Reader was determined.

Once a standard curve was established, sfGFP plasmid DNA was linearized, and mRNA was transcribed, which would be added to the final IVTT reaction mix. Thermostable T. thermophilus enzymes, including pyruvate kinase, nucleoside diphosphate kinase, inorganic pyrophosphatase, adenylate kinase, and lactate dehydrogenase, were purified from competent E. coli cells after transformation. These enzymes are important for energy regeneration in the final reaction mix. S30 extracts, containing enzymes, factors, and ribosomes for in vitro translation, were prepared by grinding T. thermophilus cells with pre-cooled alumina in a pre-chilled mortar. These components, in addition to other components (MgGlut, KGlut, DTT, aa mix, PEP, folinic acid, total E. coli tRNAs, ATP/GTP, UTP/CTP, spermine), were assembled to develop the final IVTT extract. Eventually, mutant T. thermophilus ribosomes/antibiotics may be added to this IVTT extract to measure ribosomal activity.

Daniel Cheong: **Poster #B8**

Home Institution: Brown University

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

Faculty Mentor: Judy Liu, Bio Med Molecular, Cellular Biology Biochemistry

Effect of tissue-specific knockout of SLC13A5 on sleep patterns and epileptiform activity

Epilepsy is a neurological disorder characterized by recurrent seizures, affecting millions of people worldwide. Though the etiologies of epilepsy are diverse, the cause of many epileptic encephalopathies are monogenic. SLC13A5 Epilepsy (DEE25) is a developmental epileptic encephalopathy caused by loss of function mutations in the SLC13A5 gene, which encodes for a sodium-citrate cotransporter. In humans, this protein is expressed predominantly in the brain and liver. However, it is unclear which expression site of SLC13A5 is responsible for epileptogenesis during SLC13A5 dysfunction. Given that the role of SLC13A5 differs between tissues, studying the effects of tissue-specific SLC13A5 dysfunctions can

elucidate the mechanism behind SLC13A5 Epilepsy.
To study this, we generated full-body, liver-specific, and brain-specific SLC13A5 knockout mouse lines and measured epileptiform activity in freely moving mice using electroencephalography (EEG). We performed EEG headset implantation surgery on P60 mice and recorded EEG activity in the cortex and hippocampus, known foci of epileptiform activity in SLC13A5 Epilepsy. Recordings were analyzed for spikes, seizures, and sleep activity. Though our tissue-specific SLC13A5 knockout models did not display changes in the number of epileptiform discharges or sleep/wake patterns, liver-specific SLC13A5 knockout mice displayed an increased number of seizures. These results suggest that the epileptiform activity present in SLC13A5 Epilepsy is largely due to SLC13A5 dysfunction in the liver. Further studies will include further mouse EEG experiments, namely measuring effects of chronic citrate addition to wild-type mice and effects of dialysis on full-body and liver-specific SLC13A5 knockout mice.

Barron Clancy: **Poster #B9**
Home Institution: Brown University

Summer Research Program: Summer Research Assistantship in Biomedical Sciences

Faculty Mentor: Kristi Wharton, Bio Med Molecular, Cellular Biology Biochemistry

Trio and downstream targets act as modifiers of dSod1 ALS

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by the loss of motor circuit function, ultimately resulting in the death of motor neurons. While approximately 90% have unknown pathologies, the other 10% have inherited genetic mutations. Of the genetic, also known as familial cases, over one fifth involve a mutation to the SOD1 gene, which encodes the protein superoxide dismutase 1 (SOD1). These mutations typically result in aggregation of the SOD1 protein and accumulation of superoxide radicals, in addition to other destructive gain-of-function consequences. While previous work in the lab was performed using a homologous recombination model of Drosophila SOD1 (dSod1) ALS, a new CRISPR model has yet to be fully characterized. Through analyzing larval peristalsis and performing larval immunohistochemistry, I better characterized the larval phenotype of the dSod1[G85R] and dSod1[A4V] CRISPR-generated mutants.

Transcriptional target of the bone morphogenic protein (BMP) pathway, TRIO, has also been shown to modify various models of SOD1 ALS in multiple model organisms. Therefore, in addition to better characterizing our CRISPR dSod1 ALS model, I investigated the potential of alterations to the Drosophila ortholog trio and downstream targets such as Rac1 to modify dSod1 ALS mutants. I conducted eclosion assays in the dSod1[G85R] model modifying the gene trio and with a Rac1 inhibitor, and preliminary results suggest potential for alterations to this pathway to ameliorate the eclosion defect associated with dSod1[G85R] ALS.

Zita Cohen: **Poster #B10**
Home Institution: Brown University

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

Faculty Mentor: Kristi Wharton, Bio Med Molecular, Cellular Biology Biochemistry

Implications of BMP Signaling on Sex-Differences in SOD1 TDP-43 and G85R Models of ALS

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease that is characterized by a progressive loss of upper and lower motor function. ALS is caused by many different mutations, two of

which are in SOD1 and TARDBP genes, or dSod1 and Tbph in Drosophila. In our lab, we are looking to investigate the disrupted cellular processes behind these ALS-associated phenotypes and identify genetic ways to suppress them. Previously published research from our lab has shown that alterations to several genes in the BMP signaling pathway can rescue various motor defects in the dSod1[G85R] ALS model, including larval locomotion, eclosion, and neuromuscular junction (NMJ) integrity. However, it is unclear to what extent BMP signaling is able to suppress these ALS phenotypes. To address this, my project aimed to cross different overexpressions of different aspects of the BMP signaling pathway to determine which components would show the most significant differences. In my first experiment, I targeted the BMP signaling pathway in motor neurons of dSod1[G85R] Drosophila model to determine if there are sex-specific differences in the levels of phenotype suppression. We found that there were minimal differences in rescues based on sex in dSod1[G85R] models, but that females were more favorable to males when SaxA was upregulated. In the second experiment, we compared drosophila crossed with Oregon-R or a Tduor-SN-RNAi knockdown to analyze their ability to successfully eclose. To accomplish this, we took TDP-43 diseased drosophila and crossed them with either OrR or Tudor-SN knockdown. The results of this experiment showed us how diseased drosophila models will respond and their ability to eclose when there is a Tudor-SN knockdown so I could analyze if the Tudor-SN knockdown could rescue the eclosion defect. In my third experiment, I analyzed flies with TDP-43 ALS phenotypes by upregulating Rac1 and Trio of the BMP signaling pathway. With this, I hoped to identify if these recuses could relocalize the protein pMad to the nucleus. By dissecting the ventral nerve cord (VNC) and staining it I was able to localize pMad in the cells and analyze if the overexpression of Rac1 or Trio showed significant differences. My experiment showed that Rac1 had the highest success rate with relocalizing pMad to the nucleus compared to the overexpression of SaxA or Trio. Understanding sex-specific differences and the severity of the different proteins to cause higher defects in ALS Drosophila models will provide insights into the differential severity of neurodegeneration within the BMP signaling pathway with respect to different gene mutations that cause ALS.

Quinn Cowing: **Poster #B11**

Home Institution: Brown University

Summer Research Program: IBES Internship

Faculty Mentor: Dawn King, Institute at Brown for Environment and Society

Assessing Tautog Habitat Differentiation Between Age Classes: Do Tautog Juveniles Favor Sites With Higher Algal Cover in the Providence River Estuary?

Tautog (*Tautoga onitis*) is a site-specific estuarine fish species with a range from Nova Scotia to South Carolina. While Tautog adults migrate to the mouth of estuaries during the spring, this estuarine environment is where juvenile Tautog reside until they reach maturity and begin to. When 1 year or younger (YOY), Tautog juveniles are a deep rich green color. As they age beyond this cutoff, Tautog develop a striped gray-brown coloration. Prior research attributes this phenotypic shift to the habitat preferences of the two age groups (Able and Fahay 2010); claiming the color shift helps the fish camouflage. YOY occupy vegetated habitat while older Tautog occupy more structured habitat (reefs, shipwrecks, pilings, rocky coast, wharves). While backed with research, this claim hasn't been studied in the Providence River Estuary (PRE). Yet, declining oyster reefs and eelgrass beds in the PRE provide an opportunity to investigate this relationship when the habitats are threatened. To visualize the habitat preferences of each age class I designed a map. Tautog juvenile data was sourced from an ongoing juvenile fish survey conducted by The Nature Conservancy in Rhode Island (TNCRI). Seine surveys were repeated once per month from May to October between 2017 and 2023. Larger Tautog were sampled in TNCRI's fish trap surveys that were repeated once per month from May to October between 2018 and

2023. To compare Tautog assemblages with site characteristics, four comparison sites were chosen based on varied substrates and algal cover. To classify site rugosity and vegetation status I utilized drop camera data from a SeaGrant TNC project, dive survey data, nautical charts, and aerial data. Initial visualizations suggest that YOY Tautog are more abundant at sites with higher vegetation. Ongoing work seeks to improve site characterization of both seine and survey sites. This will facilitate further research into the relationship between Tautog age classes and their habitat preferences.

Clifton David: **Poster #B12**

Home Institution: CUNY-BROOKLYN COLLEGE

Summer Research Program: BP-ENDURE

Faculty Mentor: Theresa Desrochers, Neuroscience

The Gulf Between Self-assesment and Performance

Numerous studies have explored the interplay between instructor's feedback and learner's self-assessment in their relation to academic performance. Further, many have studied self-efficacy, being an individual's ability to have confidence in actions needed to achieve a specific goal. However, there is a lack of understanding regarding the role of clarity of instruction and its impact on one's ability to confidently assess performance on a task. Though this study is limited in the aspect of evaluating directly the impact of instruction (or lack) in relation to self-report of performance, however I seek to, at the base, comprehend the correlation between participant's self-assessment to their actual performance. Participants were given a sequential task involving pattern recognition and decision making without knowledge of its objective. Thereafter, from a survey given after the task, self-rated performance and actual performance were analyzed. I hypothesize that the participant's performance, evaluated based on error rate (ER) and response time (RT), will demonstrate a consistent level of competency. Conversely, their self-assessment will underestimate their performance. Being conscious of this relationship may allow us to understand the role that lack of instruction can play on perceived performance and actual performance. Further, it will inform future studies pertaining to instruction and its clarity (or lack thereof) as a mechanism for building confidence when it comes to learning, and the relationship between one's ability to learn and assessment of learning, related but distinct terms.

Nicole Dennis Talley: **Poster #B13**

Home Institution: Brown University

Summer Research Program: Undergraduate taking on summer research

Faculty Mentor: Anne Hart, Bio Med Neuroscience

Assessing Alternative Glutamatergic and Cholinergic Degeneration in Amyotrophic Lateral Sclerosis. +

Amyotrophic Lateral Sclerosis (ALS) is a devastating, late-onset disease that results in the progressive degeneration of motor neurons. Mutations to superoxide dismutase type 1 (SOD1) specifically affect spinal cholinergic and cortical layer 5 glutamatergic neurons in patients. This neurodegenerative specificity is conserved in the model nematode C. elegans, where expression of the patient allele sod-1 G85R leads to degeneration in a subset of cholinergic and glutamatergic neurons (Baskoylu et al, 2018). However, only this subgroup of glutamatergic and cholinergic neurons have been thoroughly investigated

for degeneration phenotypes, and these current models are limited in their ability to visualize axonal degeneration. We hypothesize that other glutamatergic and cholinergic neurons also degenerate in the presence of the sod-1 G85R mutation. By determining how additional glutamatergic and cholinergic neurons react in sod-1 G85R expression, we can more clearly investigate the cellular mechanisms underlying neurodegeneration. Neurons with long processes may be more sensitive to oxidative stress because of their need for extra support and maintenance, and thus we focus on assessing glutamatergic and cholinergic neurons with long axons. Two glutamatergic neurons were studied: ALM, a mechanosensory neuron with a long dendrite that runs along the anterior side of C. elegans, and PVQ, an interneuron whose axon spans the entire length of the body. PVQ did not demonstrate any stress-induced defects or degeneration with sod-1 G85Rs knock-in model, ALM shows stress-induced defects through a blebbing phenotype, which could indicate an unhealthy neuron. Future experiments for this project include determining if blebbing or degeneration has a higher prevalence in aged C. elegans, and testing the cholinergic motor neuron DA9 for neurodegeneration or stress-induced defects.

Marina Espinosa: **Poster #B14**

Home Institution: California State University Dominguez Hills

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

Faculty Mentor: Thomas Roberts, Ecology, Evolution, and Organismal Biology; Emily McParland, Biology (Bio)

3D Analysis of Eye and Extraocular Muscle Dimensions in Vertebrates Via Digital Segmentation

All vertebrates have six extraocular (EO) muscles that insert into the outer layer of the eye that facilitate eye motion with high speed and precision. They consist of four rectus muscles – superior, inferior, medial, and lateral rectus -- that originate in the back of the eye and two uniquely oriented oblique muscles – superior and inferior oblique. Despite high conservation of EO muscle morphology, a broad interspecies comparative study of extraocular muscle anatomy has not been conducted. Because important contractile properties of muscles (e.g., maximum force and maximum strain) are also conserved across vertebrates, anatomical measures like muscle length and cross-sectional area can inform our understanding of extraocular muscle mechanical function. Here, we utilize open-sourced diffusible iodine-based contrast-enhanced computed tomography (DiceCT) scans to construct three-dimensional models of EO muscles and eyes from multiple vertebrate species. From these models and gross dissection, we measured eye diameter and volume, and EO muscle length and cross-sectional area to functionally assess similarities and differences of vertebrate species. We compared co-contracting muscle pair metrics across species with differing behaviors and morphologies such as lateral eyed and frontal eyed species. We also compared the same muscle metrics with eye size to assess scaling of the EO muscle system across different species and muscles. This study pilots a broad comparative analysis of vertebrate EO muscle function, aiming to quantify conserved and derived traits in muscular eyes.

Brittany Durham: **Poster #B15**

Home Institution: Washington University in St. Louis

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

Faculty Mentor: Alfred Ayala, Pathobiology Department

Balancing Septic Immunity: Assessing V-Domain Immunoglobulin Suppressor of T-Cell Activation (VISTA) Effect on the Polarization of Bone Marrow-Derived Macrophages

Trauma, such as hypovolemic shock, is a priming predispositional event that leads to an increased inflammatory response and a higher risk for organ failure relative to secondary septic insult. Sepsis is defined as a dysregulated immune response to an infection leading to organ failure. This life-threatening condition and its complications contribute to approximately 35% of deaths in U.S. hospitals. The combined conditions of hypovolemic shock and sepsis typically lead to the development of Acute Respiratory Distress Syndrome (ARDS). ARDS is characterized by the excessive accumulation of immune cells and fluid to the lungs leading to impaired gas exchange. Negative checkpoint proteins (NCP) have emerged as potential molecular targets for treating sepsis due to their role in regulating immune responses. V-Domain Immunoglobulin Suppressor of T cell Activation (VISTA) is a negative checkpoint protein that is distinct from other proteins of the B7-CD28 superfamily due to its structure, function, and expression patterns. In murine septic models, VISTA has been shown to have a protective role in reducing tissue inflammation, regulating T-cell accumulation, and potentially rescuing septic shock. As a part of the septic immune response, macrophages are key cells involved in the balance between pro-inflammatory and anti-inflammatory responses. VISTA is expressed on macrophages, however, in the context of septic immune dysfunction, little is known about its role in the function and polarization of bone marrow-derived macrophages. This study examines if VISTA expression is involved in the M1/M2 polarization of bone marrow-derived macrophages during septic conditions and assesses its potential influence on the pro-inflammatory IRF-5 signaling pathway and soluble cytokine release. Post murine models of sepsis, cytokine-stimulated bone marrow-derived macrophages from WT and VISTA -/- mice were analyzed and compared to determine the potential role of VISTA expression in regulating macrophage function/polarization. The results of this study could indicate how bone marrow-derived macrophages contribute to the immune response of septic ARDS.

Tony El Nemer: **Poster #B16**

Home Institution: Brown University

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

Faculty Mentor: Frederike Petzschner, Robert J. & Nancy D. Carney Institute for Brain Science; Debbie Yee, Department of Cognitive and Psychological Sciences

Characterizing the Spatiotemporal Dynamics of Pain

Chronic Pain affects 116 million Americans, surpassing the total affected by heart disease, cancer, and diabetes. There are two significant obstacles to the effective treatment of Chronic Pain. First, peripheral interventions, such as back pain surgery, radiofrequency ablation, or epidural injections, frequently fail to provide substantial pain relief to a large proportion of patients. Second, there are no accurate predictors for treatment response or pain trajectory in Chronic Pain. One potential explanation for the limited efficacy of current interventions is that pain assessment is subjective and highly variable. Clinical measures of pain traditionally provide subjective ratings of pain at a single time point. Yet, in the real world, an individual's subjective pain likely fluctuates depending on various factors (e.g., time of day, mood, physical activities). To address such challenges, the SOMA app was created by the Psychiatry, Embodiment, and Computation Lab to track and the explore the impact of medications and other treatments on Chronic Pain over a prolonged time period. SOMA utilizes experience sampling methods (ESM) as an ecologically valid approach for measuring the subjective ratings of pain, mood, and daily activities.

This project uses a longitudinal dataset (across four months) gathered through SOMA to visualize the

spatiotemporal dynamics of Chronic Pain. We developed a graphical user interface via ShinyApps to illustrate longitudinal pain intensity trends and spatial distributions for users through interactive body maps. Such visualizations allow for personalized assessments of how different pain interventions (e.g., treatments, medications) impact pain ratings over time. We conducted co-occurrence analyses to examine the interaction between treatments, medications, and pain locations across a diverse patient cohort at the group and single-subject levels. We applied clustering techniques to spatially organize pain locations and visualize them on a body map. Future directions entail using data-driven approaches (e.g., machine learning) to predict the efficacy of various pain interventions in alleviating different types of pain based on spatial location. We also plan to examine the effects of medication and treatment on pain over differing time windows (e.g., current day, next day, next week). Ultimately, capturing the heterogeneity of the critical features that influence self-reported pain will allow us to generate a personalized pain profile that can predict the efficacy of treatments for Chronic Pain.

Saraphina Forman: **Poster #C1**

Home Institution: Brown University

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

Faculty Mentor: Alison DeLong, Bio Med Molecular, Cellular Biology Biochemistry

Correcting ER-rors: Does PP2A regulate the Unfolded Protein Response in Arabidopsis?

Protein phosphatase 2A (PP2A) is a highly conserved heterotrimeric holoenzyme composed of a scaffolding A subunit, a regulatory B subunit, and a catalytic C subunit. B subunits control substrate specificity of holoenzyme complexes; they are encoded by three distinct and unrelated gene families, designated B55, B56, and B72. The DeLong lab studies PP2A functions using the A subunit loss-of-function mutant rcn1 as well as some mutants that ablate the function of specific B subunits.

A recent publication reported that PP2A regulates the unfolded protein response (UPR), an endoplasmic reticulum (ER) stress response triggered by an accumulation of unfolded proteins in the ER. The report found that rcn1 seedlings showed reduced growth inhibition and reduced BiP3 mRNA expression than wild-type plants when grown on tunicamycin-containing medium. An alternative explanation for these results may be that decreased PP2A activity in the rcn1 mutant limits cellular uptake of TM, blocking UPR in these experiments. We seek to resolve this puzzle by assaying BiP3 expression after treatment with other UPR-inducing stressors: heat shock and dithiothreitol (DTT), a reducing agent known to induce UPR. We also aim to add new information by analyzing a B72 subunit mutant, in addition to the A subunit mutant, rcn1. These experiments will distinguish between possible PP2A roles in regulating UPR versus TM uptake, and will determine whether B72 regulatory subunits play roles in either of these processes.

Mmasiolu Gamero: **Poster #C2**

Home Institution: Brown University

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

Faculty Mentor: Ruth Colwill, Cognitive, Linguistic, and Psychological Sciences

The Effects of Temperature and Estradiol Exposure on Zebrafish Larvae Behavior and Gene Expression

As estradiol becomes a more common pollutant in various water ways, understanding their impact on

affected wildlife is becoming increasingly important. This project investigated the effects of estradiol exposure on zebrafish larvae.

Jesus Gonzalez: **Poster #C3**

Home Institution: Brown University

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

Faculty Mentor: Carlos Aizenman, Neuroscience

Role of Inhibition in Fast Homeostatic Synaptic Plasticity in Xenopus laevis Optic Tectum

The purpose of this project was to examine fast forms of homeostatic plasticity in the optic tectum of Xenopus laevis tadpoles to determine if the tectal circuit undergoes homeostatic compensation in response to pharmacological perturbation over the course of hours. The optic tectum is the region responsible for visual and mechanosensory processing, and its structure and function are dependent on sensory experience. During embryonic development, activity within the tectum must be maintained within a range in order for the circuit to properly function as it's being established. It has been shown that prolonged exposure to extreme environmental stimuli can alter the strength of sensory inputs postsynaptically over the course of days, but it has yet to be established what occurs in a shorter time period following exposure to acute perturbations to synaptic activity. Postsynaptic plasticity mechanisms are considered too slow to effectively regulate the potentiation of visual and tectal synapses. The objective of this project was to determine the potential forms of fast homeostatic synaptic plasticity in the optic tectum. To attain this objective, we tested the hypothesis that an acute decrease in excitatory synaptic activity would induce a homeostatic decrease in inhibitory synaptic activity over the course of hours. The optic tectum is a recurrent network of inhibitory and excitatory neurons that receive direct visual input from retinal ganglion cell axons. Using a pharmacological AMPA receptor antagonist, we reduced excitatory activity and continuously recorded inhibitory postsynaptic currents over 3-4 hours using whole-cell electrophysiology. Although the effect is small, it appeared that the strength of inhibitory input decreased in response to the AMPA receptor antagonist.

Marli Graves: **Poster #C4**

Home Institution: North Carolina Agricultural & Technical State University

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

Faculty Mentor: Tri Nguyen, Department of Cognitive and Psychological Sciences; Joo-Hyun Song, Department of Cognitive and Psychological Sciences

Decoding Content of Working Memory from Pupillometry Data Using Recurrence Quantification

Pupil dilation and constriction are indicators of cognitive function including memory,learning, and attention. Unlike traditional methods that measure pupil size shortly after an event, our research extends the analysis across an extended period of time. We used recurrence analysis to quantify similarities in the response across time. In this experiment, individual differences in cognitive function are assessed through tasks requiring the memorization of three, five, or seven items. Pupillometry tracks pupil size during memorization tasks and provides insights into the cognitive function associated with working memory. Recurrence analysis is applied to pupillometry data to obtain the determinism metric, which measures how often we see the same response pattern throughout the task. One hypothesis is that the response to fewer items will exhibit greater regularity in the pattern because the response is well-practiced. The

alternative hypothesis is that more items would have more regularity in the pattern because it requires memorization in a more systematic structure.The preliminary data shows a correlation between the working memory capacity and determinism. This suggests that long range analysis of pupillometry can differentiate between the different amounts of information being stored in working memory.

Jada Hall: **Poster #C5**

Home Institution: Tougaloo College

Summer Research Program: Professor Tang's NSF Program, Brown Department of Physics

Faculty Mentor: Jay Tang, Physics

Effects of cell length on the swimming behavior of flagellated bacteria confined by a solid surface

Bacterial interactions with surfaces profoundly influence the environment, notably by initiating adsorption and subsequent growth of biofilms. Flagellated bacteria swim in circular trajectories near a surface due to increased hydrodynamic drag on the counter rotating flagella and the cell body. Little work, however, has been performed on the effects of cell length on the circular trajectories. We perform such a study on a gut bacterium, Enterobacter sp. SM3, which is peritrichous and rodlike, but can grow into variable length. We image SM3 cells near the bottom surface on an inverted microscope and analyze the acquired trajectories using a custom Python algorithm. We observed that the strong boundary surface not only causes the run trajectories to become circular, but it restricts the tumbles into brief turns after which the bacterium continues to swim in circular trajectories close to the surface. We measured the run time, velocity, turning time, turning angle, turning velocity, and trajectory curvature, all as functions of cell length. These results will be compared with computer simulations that take into account the near-surface hydrodynamic interaction. The work is expected to elucidate the essential physics that accounts for bacterial motion near surfaces and how it depends on the bacterial morphology and locomotion.

Maya Hawkins: **Poster #C6**

Home Institution: New York University

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

Faculty Mentor: Kristi Wharton, Bio Med Molecular, Cellular Biology Biochemistry; John Santiago, Bio Med Molecular, Cellular Biology Biochemistry

The Role of BMP Signaling in Neurodegenerative Phenotypes Associated with a SOD1 and TDP-43 Model of ALS

Amyotrophic lateral sclerosis (ALS) is a devastating neurodegenerative disease that affects upper and lower motor neurons to cause loss of muscle control. Mutations in specific genes, such as SOD1 and TARDBP, or dSod1 and Tbph in Drosophila, have been linked to ALS. The normal function of these two genes is quite different. SOD1 encodes superoxide dismutase, which is an enzyme that breaks down toxic superoxide in the body produced from aerobic metabolism, and TARDBP encodes the TDP-43 protein known to regulate transcription. It is unclear how mutations in these apparently dissimilar genes can produce similar disease phenotypes. To gain insight into this mystery, our lab is exploring the disrupted cellular processes underlying these ALS-associated phenotypes and genetic interventions that suppress them. To model these ALS phenotypes, we generate patient alleles in the orthologous genes of the Drosophila melanogaster. Previously, our lab identified several genes in the BMP signaling pathway that can rescue various motor defects of the dSod1G85R ALS model, such as larval locomotion, eclosion, and neuromuscular junction (NMJ) structure and function. Data from the lab has shown a differential

response of sexes to severity of neurodegeneration. However, a sex-specific suppression by BMP signaling has not been examined. Therefore, in dSod1G85R, I will investigate the possibility for sex-specific suppression by BMP signaling in addition to sex-specific effects in a Tbph-ALS model. If there are sex-specific effects in Tbph, we can then ask if those are rescued by BMP signaling activation. To accomplish this, I have examined the impact of activating BMP signaling on eclosion rates in dSod1G85R Drosophila, which is a measure of motor function. More specifically, the sex of mutants that show successful eclosion following activation of BMP signaling has been quantified. Similarly, successful eclosion in the Tbph model has also been quantified. Overall, these results will determine whether two different ALS models share differences in severity based on sex and whether they share in their response to BMP signaling-dependent suppression. Knowing sex-specific differences in these Drosophila models gives scientists a means by which to probe the cellular mechanisms that are responsible for whether males or females develop more severe neurodegeneration associated with gene mutations known to cause ALS.

Emilia Herdes: **Poster #C7**

Home Institution: Brown University

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

Faculty Mentor: Anubhav Tripathi, School of Engineering

Development of an automated microRNA detection system for early cancer diagnosis

MicroRNAs are short non-coding sequences that are present in all cells and are crucial for gene regulation. Disruption to microRNAs can lead to the over- or underexpression of associated genes, which may result in uncontrolled cell proliferation - the core mechanism of tumor development. Notably, a growing body of evidence demonstrates that microRNAs play a key role in the tumorigenesis of numerous human cancers. Currently, cancers are often detected at an advanced stage, which has detrimental consequences for an individual's prognosis and quality of life. Moreover, cancer diagnosis currently requires a tissue biopsy, necessitating an invasive procedure. Recent studies have demonstrated the feasibility of detecting microRNA in the bloodstream and have demonstrated a correlation between microRNA concentration and the presence of cancerous tissue. However, the current process, from blood extraction to microRNA detection, involves multiple complex protocols and various machinery, making it time-consuming, expensive and difficult to reproduce. The objective of this project is to advance the development of an automated system capable of analyzing blood to quantify concentrations of specific microRNAs associated with various cancers. This field of research holds significant promise for early cancer detection.

Alex Hernandez Manriquez; Amar Aqel; Melissa Robles Banuelos; Regan Cavin; Joseph Suh:
. **Poster #C8**

Home Institution: Brown University

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

Faculty Mentor: Glenn Radice, Bio Med Neuroscience

Vinculin Y822 phosphorylation regulates cardiomyocyte adhesion dynamics and adherens junction maturation in the heart

In 2021, complications from cardiovascular disease accounted for one-third of all global fatalities. The

neonatal mammalian heart is capable of regeneration after injury, but this ability is lost seven days after birth. Understanding mechanisms that affect neonatal cardiac growth might allow us to develop novel regenerative therapies to compensate for the loss of cells upon injury. Previous work has established that the maturation of mechanotransductive cadherin junctions sequesters transcriptional co-activators at the intercalated disc (ICD), causing neonatal heart cells to exit the cell cycle. These junctions mechanically couple adjacent cardiomyocytes and consist of transmembrane N-cadherin proteins that bind to cellular actin cytoskeletons through various intermediate proteins. Vinculin (Vcl), a cytoskeletal adaptor protein, undergoes post-translational modification in response to mechanical force. Subsequent phosphorylation of vinculin at residue Y822 (pVcl-Y822) is critical for force-induced cytoskeletal remodeling and adhesion strengthening in cadherin junctions. Using CRISPR-mediated genome editing, we mutated tyrosine (Y) to a non-phosphorylatable phenylalanine (F) at residue 822 in the Vcl mouse gene to characterize the impacts of pVcl on the mechanical equilibrium and growth of cardiomyocytes. This novel animal model demonstrated how vinculin phosphorylation at Y822 correlates with the remodeling of the cadherin junctions in the embryonic heart, which declines in postnatal and adult hearts. We characterized the novel Vcl Y822F mouse model in terms of cardiac structure and function, junction formation, and intercalated discs, highlighting the impact of vinculin phosphorylation on the mechanical equilibrium of cardiomyocytes and its implications for heart disease and growth.

Derek Hessinger: **Poster #C9**

Home Institution: Colby College

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

Faculty Mentor: Theresa Desrochers, Neuroscience; Kati Conen, Bio Med Neuroscience

Evaluating the Performance of Autoencoders for Spike Sorting Automation

Extracellular recordings are critical for understanding neurological processes, as they capture the firing patterns of specific neurons during distinct tasks which can assist in defining their functionality. However, these recordings are often contaminated by noise from various sources, including non-target neuron activity, electrode drift, and environmental electrical signals. This noise significantly complicates the accurate detection of unique spiking patterns and their attribution to specific neurons. Therefore, the raw extracellular data must be manually filtered to remove unwanted noise, where spikes of similar shapes are sorted together and assigned to individual neurons. The process of spike sorting, crucial for data analysis, is time-intensive and often delays further investigation. While attempts to automate the spike sorting pipeline have been proposed, they frequently lack generalization. Our project explores the potential of deep learning networks to partially or fully automate this process. We employed Convolutional Neural Networks (CNNs) to isolate spikes from noise, followed by autoencoders with density-based clustering algorithms to extract features and group similar spike patterns. We evaluated three distinct autoencoder architectures: deep networks, ensemble networks, and competitive Hebbian networks. Our results demonstrate that the CNN successfully separated noise from spikes with approximately 94% accuracy. However, the autoencoders and clustering algorithms struggled in creating robust cluster separation and assigning cluster sizes that matched ground-truth labeling.

Lindsey Hofflander: **Poster #C10**

Home Institution: Brown University

Summer Research Program: Continuation of Independent Study in Neuroscience Department

Faculty Mentor: Gilad Barnea, Bio Med Neuroscience; Anthony Crown, Bio Med Neuroscience

Neuronal Control of Steering Movements in Drosophila

Animals rely on sensory cues to navigate through their environment for survival. During navigational behaviors, animals coordinate these various sensory cues into movements through space. In order to achieve this, the brain must integrate information from various sensory modalities into a single movement decision. In Drosophila, the brain controls navigational behaviors by transforming sensory signals into topographic maps of space. These maps of space act as an internal compass system and are located in a series of neuropil structures termed the central complex. Although the central complex has been the subject of extensive functional characterization, it is not clear how neuronal activity in this circuitry manifests as behavior. To address this gap in knowledge, we examined a major input population to the central complex, the PFNs. Here, we profile the contributions of neuronal activity in the PFNs and locomotor behaviors using automated behavioral tracking. We found that flies will orient themselves with a dynamic optic flow stimulus to form curved walking trajectories. We then thermogenetically silenced subpopulations of central complex neurons and revealed that this behavior is mediated by the fly's internal compass system. Specifically, silencing PFNs abolishes the curved walking trajectories we observed in the wild type. These flies, instead, exhibit straightened walking trajectories, which we interpret as a deficit in steering control. From these results we conclude that the PFNs are a key circuit node for coordinating steering behaviors during locomotion.

Jiaying Hou; Pauline Cooper: **Poster #C11**

Home Institution: Brown University

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

Faculty Mentor: Mark Johnson, Bio Med Molecular, Cellular Biology Biochemistry

Unraveling Pollen Tube Heat Stress Responses: Reverse Genetic Analysis of the RALF Pathway and Heat Shock Proteins

Rising temperatures due to climate change threaten crop yield. Pollen tube growth, crucial for carrying sperm cells to ovules, is particularly vulnerable to heat stress. Elucidating the molecular pathways of pollen tube growth and their response to heat stress is essential for developing heat-tolerant crops. The RALF signaling pathway, involving Rapid Alkalinization Factors (RALF) and LORELEI-like GPI-anchored proteins (LLGs), mediates pollen tube growth. In Arabidopsis, LLG2 and LLG3 facilitate the binding of RALF4 and RALF19 to receptor-like kinases on the plasma membrane of pollen tubes, triggering downstream signaling pathways that guide growth. While well-studied in Arabidopsis, the RALF pathway in tomatoes remains largely unexplored. Phylogenetic analysis and RNA-seq data identify tomato RALF1 as a homolog of Arabidopsis RALF4/19 and LLG2/3 as homologs of Arabidopsis LLG2/3, with both genes highly expressed in mature pollen and pollen tubes. Heat Shock Proteins (HSPs) regulate plant responses to heat stress through various mechanisms. HSP101, in particular, is essential in the heat stress response. Constitutive expression of HSP101 can eliminate the need to precondition plants against heat stress, suggesting that boosting HSP101 levels could enhance thermotolerance in crops. While HSP101 is known to act as a protein refolding chaperone in other tissues, its exact role in pollen is still unclear. This study aims to produce loss of function mutant lines of RALF1, LLG 2/3, and HSP101 in thermotolerant and thermosensitive tomato cultivars to better understand the RALF signaling pathway in pollen tube germination under normal and heat stress conditions. CRISPR-Cas9 introduced targeted mutations in T1 Heinz and Tamaulipas tomato plants, creating single loss-of-function mutants for RALF1,

LLG2/3, and HSP101. DNA was extracted from T2 and F1 plants using the leaf boil method. PCR amplified the regions containing the CRISPR-targeted guide, and products were sequenced to detect heterozygous or homozygous deletions. Sequencing data were analyzed to identify loss-of-function mutations in RALF1, LLG2/3, and HSP101. We successfully identified loss-of-function mutant lines for RALF1 and HSP101; however, generating mutants for LLG2/3 has proven challenging. Further investigation is required to determine if this difficulty is due to a faulty CRISPR-Cas construct or if LLG2/3 is essential for tomato fertilization, making natural propagation of mutant lines unfeasible. Eliciting a phenotypic response in the loss of function mutant lines we obtained will help us further understand the RALF signaling pathway and the function of HSP101 under heat stress, contributing to the development of thermotolerant tomato plants.

Jane Hwang: **Poster #C12**

Home Institution: Brown University

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

Faculty Mentor: Xiaodi Chen, Department of Pediatrics at the Warren Alpert Medical School

In Vitro Oxygen Glucose Deprivation Model to Study Ischemic Cell Death in HUVEC Cells

Exposure to hypoxic ischemic encephalopathy (HIE) can cause significant damage resulting in long-term neurological deficits, sensory and motor impairments. Limited therapies are available to ameliorate or reverse the outcomes of HIE in full-term infants. Oxygen Glucose Deprivation (OGD) is one of the most common in vitro models of ischemic stroke and is used extensively for preclinical stroke research. Here, an OGD model for stroke injury in the Human Umbilical Vein Endothelial Cell (HUVEC) line was created. Both cell proliferation and cell viability decreased in HUVECs exposed to OGD for >24 hours. This finding has implications for future research of an OGD model incorporating potential therapeutic strategies, such as Inter-alpha-Inhibitor Proteins (IAIPs) to treat HIE in neonates. This conclusion also further supplements already ongoing research in the mechanisms behind HIE and the biomedical applications for HUVECs and IAIPs.

Yumiko Imai: **Poster #C13**

Home Institution: Brown University

Summer Research Program: Pathology and Laboratory Medicine Student Research Assistant

Faculty Mentor: Sendurai Mani, Bio Med Pathology & Laboratory Medicine; Petra den Hollander, Bio Med Pathology & Laboratory Medicine

Establishing reporter systems to study Cancer Stem Cells

Cancer is the second leading cause of death in the U.S., with 90% of patients who succumb to their disease having metastases. Therefore, targeting the metastatic process is essential to making an impact on patient survival. The epithelial-mesenchymal transition (EMT) is crucial for metastatic progression as it endows cancer cells with mesenchymal and stem-like properties. In a tumor, the cancer stem cells (CSCs) are a minority yet disproportionally contribute to metastatic progression, chemotherapy resistance, and cancer relapse. To develop targeted therapies for CSCs, we require more characterization of the EMT-induced CSCs to better understand the molecular mechanisms controlling stemness and identify targetable vulnerabilities. To address this knowledge gap, I have worked to develop and

characterize different CSC-specific promoter-reporter systems expressing fluorescent markers to identify CSCs.

We have designed a fluorescent reporter ddGFP (an unstable form of GFP) under the EMT-transcription factor FOXC2 promoter . The Mani lab has extensively demonstrated that FOXC2 is a central mediator in maintaining both stemness and mesenchymal properties endowed by EMT. Separately, we obtained a CSCs promoter-reporter system (SORE6), which induces the expression of GFP in the presence of stemness enforcing transcription factors SOX2 and OCT4. We independently transduced the FOXC2-promoter reporter (FOXC2-PR) and the SORE6 into SUM159, a FOXC2+, triple-negative breast cancer cell line with stemness properties.

We observed varying levels of GFP across these cells with both reporters, supporting the notion that not every cell within a population has equal levels of stemness. Next, we transduced MCF10A, a non-cancerous immortalized breast epithelial cell line, with both constructs. We observed an increase in GFP in MCF10A cells with the FOXC2 PR over 6 days, which agrees with the gain of stemness properties during EMT induction. Finally, we tested if the SORE6+ cells with the highest levels of GFP possessed the highest stemness properties. Here, we sorted GFP positive or GFP negative cells and we are planning to use these cells in a western blot assay to validate that the GFP positive cells from the SORE reporter construct have increased stemness markers. In this study, I characterized and validated two CSC reporter systems and I hope to further develop these constructs to track and enrich CSCs for downstream assays.

Sebastian Jauregui: **Poster #C14**

Home Institution: California State University, Northridge

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

Faculty Mentor: Thomas Serre, Department of Cognitive and Psychological Sciences

Analysis of the Stability of Muscle Activations to the Spinal Cord Stimulation in Sheep: Intra-day vs. Inter-day drift

Our spinal cord controls all body movements. With a spinal cord injury, motor function loss can occur from the injury site downward. In the context of this impairment, exploring the impact of various Epidural Electrical Stimulation (EES) conditions on motor outputs becomes essential in our efforts to restore motor function. However, the mapping from EES to motor output is subject to change, resulting from neural signals drifting across days. Here, we show how this mapping from EES to motor outputs varies across multiple days of recordings. By analyzing electromyography (EMG) activity of six lower limb muscles after EES, we estimated intra-day and inter-day drift to assess the need for corrections, which will guide the development of an adaptive correction algorithm. We plan to implement this adaptive algorithm to allow a fixed pretrained mapping from EES parameters to motor outputs. This will enable robust use across days without the need for retrainings. The four days we selected were randomly spaced to account for all possible factors that could influence intra-day and inter-day drift. Our results for the four days suggest that inter-day drift is greater than intra-day drift, suggesting the need for an adaptive algorithm that accounts for changes over multiple days when EES is utilized for the restoration of motor control in individuals with spinal cord injuries.

Celia Johnson: **Poster #C15**

Home Institution: Brown University

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

Faculty Mentor: Mark Johnson, Bio Med Molecular, Cellular Biology Biochemistry

Some Like It Cold: Visualizing tomato pistil morphology through cryosectioning

In flowering plants, the process of fertilization is carefully regulated by the pistil. Pollen grains containing sperm cells land on the pistil and form elongated structures called pollen tubes, which grow through the pistil. It is thought that complex interactions between the pistil and pollen tubes allow for directed growth of pollen tubes toward the ovules. Though tomato is an important crop plant, little is known about the morphology of its pistil. In particular, the cell types in the pistil and the roles those cells play in pollen tube guidance have not been fully characterized. Using single nuclei RNA-sequencing, our lab has generated transcriptome data for every cell in the pollinated pistil. To build on that data, we intend to perform in-situ hybridization on the pistil, allowing us to label specific cell populations and to understand when and where the different populations might interact with pollen tubes. The technique we are using to visualize the internal anatomy of the pistil is cryosectioning, a technique commonly used in other model organisms but relatively rare in plants. During cryosectioning, tissues are embedded in a glycol and resin-containing medium and frozen into a solid block. The block is then cut into thin slices, which are stained to reveal various morphological aspects. Due to the absence of a commonly-accepted protocol for cryosectioning pistil tissue, our first step was to optimize the cryosectioning procedure to produce optimal images. We experimented with using fresh and pre-fixed tissue, altering the tissue preparation method, and changing the size of the slices, among other modifications. We found that increasing the width of the sections to 14 micrometers, thicker than most sectioning done in other models, and using a vacuum to allow the embedding medium to fully penetrate the tissue were the most effective modifications. Compared to fresh tissue, fixed tissue better preserved the structures of the pistil but did not adhere as well to the slides, leading to loss of sample during washing steps. Going forward, we intend to figure out how to improve the adhesion of the fixed tissue samples to the slides. We also plan to increase the duration of the vacuum step to create even stronger tissue. Ultimately, optimizing the cryosectioning procedure and performing in-situ hybridization will allow us to combine genetic and morphological analysis to provide a complete understanding of pistil-pollen tube dynamics.

Nyia Jones: **Poster #C16**

Home Institution: Brooklyn College

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

Faculty Mentor: David Badre, Department of Cognitive and Psychological Sciences

Decoding retrieved task stimuli from EEG data

Influential theories of human cognition hypothesize that we automatically store and retrieve episodic representations of our environment (‘event-files’), which can guide future behavior. Prior work has shown that a stimulus need only be presented once for it to be included in an event-file and remain durable for long periods of time. However, these studies used stimuli which were all task-relevant: task cues, the subjects of categorization, or central targets. We explored if task-irrelevant stimuli are also automatically integrated into event-files, by presenting task-irrelevant items (images) prior to each trial of a task-switching paradigm. The same item was presented only twice. We attempted to decode (measure) the retrieval of previous task stimuli, using EEG (electroencephalogram) data.

Hawa Konate; Bailey Merlino: **Poster #D1**

Home Institutions: Morgan State University; Brown University

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

Faculty Mentor: Phylis Dennery, Bio Med Molecular, Cellular Biology Biochemistry; Katy Hegarty, Bio Med Molecular, Cellular Biology Biochemistry

Investigating Lamb Senescence: Comparative Ontogeny in Normoxic vs Hyperoxic Environments

Senescence is a
cellular process that occurs during aging which is characterized by cell cycle arrest. It also occurs at specific times during embryonic development in many organs including the lung. This may be important to ensuring proper lung morphology as the animal matures. Nevertheless, injury can also result in lung senescence therefore it is important to understand whether lung injury seen in premature infants such as invasive mechanical ventilation (IMV). can disrupt the normal ontology of lung senescence. We hypothesized that IMV will result in lung injury resulting in increased senescence and disrupted lung morphology in the lamb. Unventilated/untreated lungs from lambs at 100, 130, 140 and 151 (term) days as well as at one-month of age were evaluated for p21, a known marker of senescence using qPCR, for markers of DNA damage, gamma H2AX and FOXO4, by Western analysis, and for lung morphology via H&E staining. Preterm lambs born at 130 days were also assessed for lung markers of senescence, DNA damage and changes in morphology as above, after 6 days and 21 days of invasive mechanical ventilation plus room air recovery for 5 months, and compared to gestational age matched non-ventilated controls (140 days and 5 months respectively. These data will allow us to better understand the normal ontogeny of senescence and determine whether this is altered after mechanical ventilation thus providing insights into the effects of assisted ventilation on postnatal lung development.

Chloe Kurka: **Poster #D2**

Home Institution: Brown University

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

Faculty Mentor: Ruth Colwill, Cognitive, Linguistic, and Psychological Sciences

BHPF on Larval Zebrafish Social Behavior

Since the ban of BPA, a variety of bisphenols have been made to replace this chemical in plastic manufacturing. One of them, fluorene-9-bisphenol (BHPF), has been found in human serum samples yet remains largely unstudied. In this project, we researched the effects of BHPF on the social behavior of zebrafish larvae. Due to its function as an endocrine-disrupting chemical, we hypothesized that a continuous administration at the environmentally relevant concentration from 0-11 days post fertilization (dpf) would decrease shoal cohesion at 11dpf and decrease social preference at 13dpf. Furthermore, this would correspond with a decrease in the fold activation of estrogen receptors and a decrease in oxytocin receptors, and an increase in activation of receptors for excitatory and inhibitory transmission.

Kevin Kwon: **Poster #D3**

Home Institution: Brown University

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

Faculty Mentor: Wafik El-Deiry, Bio Med Pathology & Laboratory Medicine

Combinations and Mechanisms of Synergy between Palbociclib, Lurbinectedin, and ONC206 in Novel Therapy of Small Cell Lung Cancer

Small cell lung cancer accounts for around 15% of new lung cancer diagnoses in the US, being highly associated with cigarette smoking and radon exposure. SCLC is currently known to be highly responsive to Cisplatin + Etopside combination treatment, but is also known for relapsing and quickly developing resistance, with the 5 year survival rate being around 7%. Lurbinectedin is a drug recently approved for use by the FDA for the treatment of relapsed lung cancer. We hope to study the potential efficacy of a novel treatment of Lurbinectedin in combination with imipridone Onc206 as well as cdk 4/6 inhibitor palbociclib through cell viability assays and examine immune activation through T cell co cultures. Additionally, we aim to investigate the mechanisms for potential synergistic effects and changes in protein expression along the DNA damage response pathway. Preliminary results suggest that the combination of Lurbinectedin, ONC206, and Palbociclib has effects on cell death and immune activation compared to individual treatments. Further investigation into the molecular mechanisms of this synergy will provide valuable insights for developing more effective treatments.

Lillian Langbein: **Poster #D4**

Home Institution: Brown University

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

Faculty Mentor: Sendurai Mani, Bio Med Pathology & Laboratory Medicine

The effect of P38-MAPK inhibition on chemoresistant breast cancer cells

Triple-negative breast cancer (TNBC) is known for its aggressive nature and propensity to metastasize. Unlike other breast cancer subtypes, TNBC lacks targeted therapies, leading to limited treatment options and frequent development of resistance against available therapies. Chemotherapy acts by targeting cells that are actively proliferating; within the tumor microenvironment, the rapidly proliferating cells are susceptible to chemotherapy-induced cytotoxic effects. However, there is also a subset of poorly differentiated cancer stem cells, which are often associated with therapy resistance and tumor relapse.

Doxorubicin, belonging to the anthracycline group of drugs, is a widely used chemotherapy drug for TNBC patients. It is a topoisomerase (Topo) II inhibitor, which acts by inhibiting Topo-II function and stabilizing the damaged DNA-enzyme complex resulting in stable DNA double stranded breaks (DSBs). Doxorubicin also promotes a rapid surge in reactive oxygen stress (ROS) leading to cytotoxicity. Both of these cell states can induce stress and lead to the induction of apoptosis.

P38-MAPK (mitogen-activated protein kinase), a stress-response kinase in the cell, is upregulated in cancer stem cells in response to the aforementioned doxorubicin-mediated cellular stress. P38-MAPK exerts cytoprotective effects on the cancer cells by preventing cell cycle progression in cells with damaged DNA. Additionally, p38 MAPK activates and recruits DNA repair proteins as a DNA damage

response, ultimately avoiding apoptosis. Therefore, we hypothesized that a combination therapy involving p38 inhibition together with doxorubicin would enable a more stable DNA damage, likely due to impaired DNA repair mechanisms, leading to increased cancer cell death.

To test our hypothesis, I developed doxorubicin-resistant 4T1 cells (TNBC syngeneic mouse cell model) by continuous exposure of cells with doxorubicin for 72 hours and subsequently treating the cells with p38 MAPK inhibitor and/or doxorubicin. Changes in stemness and DNA damage responses are evaluated using a range of techniques, including Western blotting, flow cytometry, and confocal microscopy. The findings from this study will enable a better understanding about the mechanism by which p38 MAPK inhibitor acts as a sensitizing agent for doxorubicin-resistant tumor cells, as well as highlight its role in tackling adaptive resistance developed against doxorubicin by cancer cells.

Johanna Leang: **Poster #D5**

Home Institution: Brown University

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

Faculty Mentor: Megan Kizer, Chemistry

Characterization of Glycosaminoglycans From Marine Sponges

Glycosaminoglycans (GAGs) are linear, polyanionic polysaccharides composed of repeating disaccharide units of hexuronic acid and hexosamine. GAGs are ubiquitous across biology, and are critically involved in many cellular processes, including cell growth and differentiation, adhesion and infection, and anticoagulation and wound repair. Currently, the most well-known GAGs, such as hyaluronic acid, heparan sulfate, and chondroitin sulfate, are derived from mammalian tissues and have extensive uses in cosmetics, pharmaceuticals, and medicine. Recent studies have additionally shown the presence of bioactive GAGs in a variety of marine animals, with one of these being sponges. This project aims to characterize the GAGs extracted from three invasive sponge species from Kane'ohe Bay on the island of Oahu, Hawaii: Mycale grandis, Monanchora clathrata, and Gelliodes wilsoni. As existing structural information for GAGs from these species is lacking, this project relies on a glycomics approach towards deconvoluting the polysaccharide sequence and structure. The GAGs will be characterized through the blending of both analytical techniques such as LC-MS/MS, IR, NMR, as well as biochemical techniques, including PAGE and colorimetric assays. These orthogonal characterization methods, employed on both fully intact and hydrolyzed GAG samples, will provide global and sequence-level structural information. As previous literature has reported that bioactive polysaccharides from marine species are sulfated, we hypothesize that the GAGs extracted from the three new marine sponge species will also be sulfated, and could provide novel materials for biomedical applications. Following characterization of the new marine sponge GAGs, we will test these materials in various immunological contexts, ultimately linking GAG structure to immune function to open new horizons for vaccine adjuvants and antivirals.

Joanne Lee: **Poster #D6**

Home Institution: Brown University

Summer Research Program: Summer Research Assistantship in Biomedical Sciences

Faculty Mentor: Athar Malik, Bio Med Neurosurgery

Analysis of midline shift recovery effects on recovery of consciousness

Midline shift (MLS) is defined as a displacement of brain tissue across the natural centerline of the brain. The displacement of midline brain structures occurs due to an increase in intracranial pressure, such as by a subdural hematoma, or by the presence of a mass lesion. This can result in significant neurological deficits such as seizures, sleep disorders, neurodegenerative diseases, neuroendocrine dysregulation, and psychiatric problems. Retrospective studies have established that an increased MLS correlates with a poorer prognosis. In some cases, after a decompressive intervention such as a craniectomy, the brain moves back towards its baseline position, decreasing the severity of the MLS. Although existing literature suggests a correlation between the severity of the initial MLS and a poor neurological outcome, little is known about the potential relationship between MLS recovery and neurological outcome. We hypothesize that MLS recovery correlates with recovery of neurological function as critical structures are decompressed and return to baseline. A retrospective chart review was conducted for patients at Rhode Island Hospital who underwent brain surgery then exhibited a recovery of MLS. The amount of MLS recovery was then compared to the amount of recovery of neurological function after surgery, measured by progress on the Glasgow Coma Scale, a measurement of one's level of consciousness. Ultimately, this project stands to both fill a long-standing gap in literature about MLS and yield new insight into potential indicators of neurological recovery and patient outcomes.

Stefan Leonard: **Poster #D7**

Home Institution: Brown University

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

Faculty Mentor: Robert Sobol, Department of Pathology and Laboratory Medicine

USP1 inhibitor impact and relationship to PARGi efficacy and BER status

Ubiquitin Specific Protease 1 (USP1) presents an emerging clinical target for Poly-ADP-Ribose Polymerase inhibitor (PARPi) resistant and Breast Cancer Gene 1/2 (BRCA1/2) mutant tumors. USP1 is a member of the deubiquitinating enzyme class (DUBs) responsible for the cleavage of ubiquitin tags on proliferating cell nuclear antigen (PCNA). In the context of DNA repair, USP1 facilitates proper PCNA-mediated polymerase switching from error-prone trans-lesion synthesis (TLS) polymerases to delta/epsilon polymerases on post-lesion sites. USP1 deubiquitinating activity has also been linked to homologous recombination (HR) repair activity. Previous studies have shown that chemical inhibition of USP1 results in decreased nuclear PCNA levels and consequently decreased DNA synthesis, S phase arrest, and increased basal levels of DNA damage. Additionally, due to its critical role in DNA synthesis and repair, USP1 inhibitors (USP1i) have a synthetic lethal relationship with PARPi. However, limited work has been done to uncover the impact and relationship of USP1i with Poly-ADP-Ribose Glycohydrolase inhibitors (PARGi), an emerging clinical option for PARPi resistant and BRCA1/2 mutant tumors. The primary objective of this project is to uncover the effects of a USP1i and PARGi combination therapy on a cancer cell line in vitro. Our central hypothesis is that USP1i treatment will lead to enhanced PARGi response. We will test our hypothesis by performing the following experiments: we will test whether base excision repair has a protective effect against USP1i by comparing WT vs XRCC1-KO cell lines. Next, we will test ML323, a potent USP1i, in combination with PARGi, to determine whether there is an additive or synergistic cell killing effect. This work may lead to future mechanistic developments of both USP1i and PARGi-mediated cancer cell death and future progress towards introducing USP1i and related deubiquitinating enzyme inhibitors as clinically useful therapeutical approaches to PARPi resistant and HR deficient tumors.

Liana Lewis: **Poster #D8**

Home Institution: Brown University

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

Faculty Mentor: Kate O'Conner Giles, Bio Med Neuroscience

Influence of core active zone protein on trafficking and localisation of the α2δ-3 calcium channel auxiliary subunit

Synaptic transmission is the backbone of the neural activity that composes higher order processes of the brain. Understanding synaptic transmission and modulation gives us insight into how the brain encodes complex processes like learning and memory. At the synapse, neurotransmission is mediated by calcium influx via presynaptic calcium channels. Calcium influx triggers synaptic vesicle fusion to the presynaptic membrane and exocytosis of their contents into the synaptic cleft, which occurs at specialized areas called active zones. Active zones contain many proteins that work together to influence synapse structure, organization and function. One such active zone protein, Bruchpilot (BRP), is a synaptic scaffolding protein which aids in organizing synaptic vesicles and calcium channels for neurotransmission in Drosophila. BRP regulates calcium channel clustering, and we have found that it is crucial for calcium channel abundance at active zones. In addition to the pore-forming subunit where Ca2+ ions pass through, calcium channels require β and α2δ auxiliary subunits for their trafficking and function. One Drosophila α2δ subunit, Straightjacket (Stj), influences synapse organization, function, and calcium channel abundance at neuromuscular junction synapses (Dickman et al., 2008; Kurshan et al., 2009; Hoover et al., 2019). Here we investigate BRP's influence on the abundance of this important α2δ subunit Stj, and how this may differ at synapses of different function. Understanding the influence of BRP on α2δ will give us insight into how the calcium channel complex, auxiliary subunits included, are regulated at synapses and how this relationship impacts neural communication.

Jason Lin: **Poster #D9**

Home Institution: Brown University

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

Faculty Mentor: Karthikeyani Chellappa, Molecular Microbiology and Immunology; Ritambhara Singh, Computer Science

Comparative metabolomics analysis to predict biological age across mammals

The rise of an aging population is a significant health care and economic burden worldwide. While life spans are increasing, health spans have not kept pace, leading to a rise in chronic age-related diseases. Computational models used to develop "Aging clocks," predict aging rates and biological age regardless of chronological age. These clocks aim to identify biomarkers and elucidate mechanisms of aging. Currently, these clocks focus on methylation, transcriptomics, and genomic data, overlooking other biomarkers like metabolites. In this project, we analyze the intersection between metabolism, chronological, and biological age using machine and deep learning models to determine potential mechanisms associated with the age-associated decline in metabolic resilience.

We used metabolomics datasets generated from two independent cohorts (1) the Arrivale dataset generated by the Institute of Systems Biology (PMID: 32363781) composed of 652 metabolites and 34 metadata features collected from 1,475 individuals (2) the Wisconsin Registry of Alzhiemer's project (WRAP) dataset (PMID: 29322089), a longitudinal study of 1,700 individuals with 1,097 metabolites and 64 metadata features like cholesterol levels and BMI. Using the metadata from these datasets, we generated a biological-aging index indicative of an individual's overall health, thus measuring their healthspan and biological age.

We applied machine learning (ML) and deep learning (DL) models to predict chronological age and a biological age metric based on metabolomics data. We tested various ML models, including linear regression, random forest, LASSO, ElasticNet, and Ridge, and found that the ensemble nature and power of XGBoost models performed best. With the ISB dataset, our optimal XGBoost ML model predicts the chronological age in humans with a mean absolute error of 4.97 and an R^2 value of 0.66. It identified known age-associated metabolites like DHEA-S (Dehydroepiandrosterone sulfate) and novel metabolites like VMA (Vanillylmandelic Acid) as significant for chronological age prediction. We also found that even though individual significant metabolites had small correlations with age, cumulatively they performed well in predicting chronological age. Our DL models, specifically Multi-Layer Perceptrons, surpassed the performance of the ML models, indicating that DL models better capture the variational complexity found within metabolomics data.

Using the WRAP dataset, we will validate the model developed with the ISB dataset and incorporate the prediction of biological age metrics to develop more accurate metabolites associated with age-related diseases. This project concludes that human metabolomic data is a powerful tool for predicting chronological and biological age metrics and discovering novel metabolites critical for aging. In the future, we plan to perform a comparative analysis of metabolomics datasets collected in mouse models and for treatments of biological aging.

Zhuoyang Lyu: **Poster #D10**
Home Institution: Brown University

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

Faculty Mentor: Ian Wong, School of Engineering

Understanding Cellular Migration Patterns Using Deep Attention Model

Cellular motion is a fundamental process in all multicellular organisms, playing a crucial role in development, immune responses, and disease progression, including cancer. Recent advancements in cellular imaging technology and computer vision have enabled the collection of large-scale data, facilitating data-driven analyses through statistics or deep learning methodologies. Among these, self-attention based deep learning models have demonstrated significant potential in deciphering complex interaction patterns.

In this study, we conducted data clustering and analysis on cell morphology and motility features. Our findings revealed trends in cell morphology changes and identified distinct cell morphological states along with their defining characteristics. Analysis of cell migration also uncovered clusters and movement patterns. We further designed and trained a predictive deep learning model to understand cellular migration patterns and interactions between normal cells and tumor cells. Our model incorporates cell type, morphology, and motility features of a focal cell and its neighboring cells to predict cellular motion. By leveraging the model's predictive capabilities, we aim to uncover patterns and derive insights into how interactions between different types of neighboring cells influence cell migration.

Maya Magavi: **Poster #D11**
Home Institution: Brown University

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

Faculty Mentor: Marissa Gray, School of Engineering

Detecting sleep deprivation in working environments

Sleep deprivation in high-stress work environments can compromise safety, cause health issues, and negatively impact the work being done. Our research focuses on the detection and analysis of sleep deprivation to foster safer and more efficient work environments. We are using machine learning to develop a pipeline to identify a sleep-impaired state from physiological data.

In the past, eye and face tracking, heart rate, electrodermal activity (EDA), motion, and voice recordings have all been used to identify sleep deprivation. We aim to further optimize the accuracy of our prediction model by feeding it multiple types of data such as heart rate, EDA, and potentially motion tracking. While shown to be effective, we had concerns that eye and face tracking or voice recording would be difficult to carry out in an active or loud environment.

Currently, we are in the process of preliminary data collection to better understand the data and determine the best approach for a larger study. This involves collecting heart rate, EDA, and motion data over multiple days using the Empatica E4 sensor. This data is paired with results from the Psychomotor Vigilance Task (PVT), which has been proven to be very effective in identifying sleep deprivation.

Interpreting the data will involve preprocessing, including dimensionality reduction, cleaning, and standardization of the dataset. Next, we will train a model to classify data as corresponding to either a sleep-deprived state or a normal state. Past studies have used Convolutional Neural Networks, Time Batched Long Short-Term Memory (TB-LSTM) networks, Recurrent Neural Networks, Linear Discriminant classification models, Naive Bayes classifiers, and Random Forest classifiers to model similar problems. As we move forward, we will experiment with different models and determine the best to apply to this challenge.

Will Malloy: **Poster #D12**

Home Institution: Brown University

Summer Research Program: Royce Fellowship

Faculty Mentor: Sarah Lummis, Institute at Brown for Environment and Society

Salinity drives relative abundance and distribution by sex of blue crab (Callinectes sapidus) throughout the Providence River Estuary

Despite being well established in the Providence River Estuary (PRE), research on the blue crab (Callinectes sapidus) has historically focused on the mid-Atlantic and Gulf of Mexico, regions where the species has been commercially significant for decades. The species' population structure in New England, including the PRE, remains poorly understood by comparison. As water temperatures rise, blue crab populations may be driven northward in their range, prompting New England states to consider adopting commercial fishing regulations. In anticipation of potential management and regulatory decisions, understanding local population dynamics in the region is increasingly important. An ongoing juvenile fish survey conducted by The Nature Conservancy in Rhode Island has collected data on the abundance of C. sapidus in the PRE, creating new insights into the species' population structure in the estuary. Seines were hauled along the shoreline at twelve sites in the Providence and Seekonk Rivers. Surveys were repeated once per month from May to October between 2021 and 2023. Crabs captured were then identified to genus or species, measured to the nearest millimeter at the widest point of the carapace, identified by sex, enumerated, and released. Additionally, temperature, salinity, and dissolved

oxygen were recorded during sampling. The sites were grouped into two distinct salinity regimes: five of the twelve study sites were classified as mesohaline (~5–18 ppt), while seven of the sites were classified as polyhaline (~18–30 ppt). Initial analysis suggests that C. sapidus were more abundant at the mesohaline sites and that salinity is a factor influencing the ratio of males to females observed. In particular, a higher proportion of males were observed at the mesohaline sites. Ongoing work seeks to characterize the relationship between the salinity and the length of individuals observed. Furthermore, data collected during the 2024 season will shed light on the role of sexual maturity in determining the distribution of crabs throughout the PRE.

Chigozie Manu: **Poster #D13**

Home Institution: Brown University

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

Faculty Mentor: Vikas Srivastava, School of Engineering; Zahra Ahmed, School of Engineering

Current Advancements in Hydrogel-Based Immunotherapeutic Drug Delivery for Targeting Tumor Microenvironments

Tumor microenvironments (TME) are complex and adaptive components of cancers, exhibiting heterogeneous and unpredictable characteristics that pose significant treatment challenges. The variable composition and intricate connectivity between the tumor and body often render traditional chemotherapeutic treatments ineffective, leading to increased side effects and cytotoxicity. While immunotherapies have revolutionized cancer treatment, a significant portion of patients do not respond to immunotherapy, experience adverse side effects, or develop resistance, primarily due to the immunosuppressive TME. In recent years, the use of immunotherapies delivered through hydrogels has garnered attention and optimism as a promising cancer treatment platform. These hydrogels offer markedly reduced side effects, increased biocompatibility, customizable degradation rates, and enhanced capability to modulate the TME. This review investigates the latest advancements in hydrogel-based delivery systems for immunotherapy, focusing on their roles in enhancing drug stability and release, improving targeting specificity, and modulating the TME to enhance therapeutic outcomes. By consolidating recent research findings, this review highlights the significant potential of hydrogel systems in cancer treatment, discussing their mechanisms of action, development, and future directions for overcoming current implementation limitations.

Jaidan Marano: **Poster #D14**

Home Institution: Lafayette College

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

Faculty Mentor: Robert Sobol, Legoretta Cancer center

Probing the impact of the chemotherapeutic agent TAS-102 on the cellular response to PARG inhibition and base excision repair status

Ovarian cancers remain a therapeutic challenge. Recently, it was shown that, in colorectal and pancreatic cancers, targeting base excision repair (BER) by inhibition of poly(ADP-ribose) polymerase 1 (PARP1) while simultaneously inducing DNA damage using a nucleoside analog, namely trifluridine/tipiracil hydrochloride (TAS-102), may be beneficial during the therapy of p53 mutant cancers. As cancers often acquire resistance to PARP inhibition-triggered cell death by reactivating tolerance mechanisms like

homologous recombination (e.g. BRCA1 or BRCA2), we tested whether BER is required for TAS-102 resistance in ovarian cancer cells. Secondly, as inhibitors targeting poly(ADP-ribose) glycohydrolase (PARG) are becoming an option in PARP1 inhibitor-resistant tumors, we tested whether TAS-102 synergizes with PARG inhibition. Addressing our first aim, we will make use of an ES-2 ovarian cancer cell line where XRCC1 was knocked out (ES-2/XRCC1-KO) and compare its TAS-102-induced cytotoxic response to the parental ES-2 cells. XRCC1 is a scaffolding protein required for BER and its knockout sensitizes cells to drugs inducing base damage. To address our second aim, ES-2 cells will be exposed to a PARG inhibitor (PARGi) (PD1D 00017273) on its own and in combination with TAS-102 and the cytotoxic responses will be determined to elucidate the combination treatment's effectiveness. PARG plays a role in the final steps of BER where it removes the poly(ADP-ribose) (PAR) chains synthesized by PARP1. Experimental work is ongoing, and it is envisaged that these findings will clarify the roles of BER and PARG in the protection of cancer cells against TAS-102-induced cell kill.

Mateen Markzar: **Poster #D15**

Home Institution: Brown University

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

Faculty Mentor: Eric Morrow, Bio Med Molecular, Cellular Biology Biochemistry; Gajendra Kumar, Bio Med Molecular, Cellular Biology Biochemistry

10% alanine supplemental diet as a treatment for GPT2 protein deficiency

The Morrow Lab has identified a rare disease in humans caused by a mutation in the gene that encodes for GPT2, a mitochondrial protein. GPT2 is responsible for neuronal growth and survival, specifically, alanine synthesis and replenishment of TCA intermediates. In humans, GPT2 deficiency has been observed to cause microcephaly, motor deficits such as progressive spastic paraplegia, and intellectual disability. In mouse models, GPT2-null mice exhibit profound inhibition of alanine biosynthesis, as well as motor deficits and premature death around one month. The mutation in GPT2 prevents the transamination of glutamate to alanine, a normally non-essential amino acid into an essential one. The GPT2-null mice exhibit smaller upper and lower motor neurons, which may explain their premature death. Alanine is a critical energy source for muscles and the central nervous system; supplementing the mice with a diet that is high in supplemental alanine extends survival of the mutant animals, allowing them to be studied and compared to the WT and mutant mice. We are investigating the use of a supplemental alanine diet on mice motor neurons, using cell histology, microscopy, and quantitative methods.

Gabriel Martinez: **Poster #D16**

Home Institution: John Jay College of Criminal Justice

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

Faculty Mentor: Yang Zhou, Bio Med Molecular, Microbiology & Immunology

Characterizing Type 2 Innate Lymphoid Cells (ILC2) in Mouse Models of Lung Fibrosis and Atopic Asthma

Innate Lymphoid Cells type 2, or ILC2s, represent a pivotal component of the immune system, playing a crucial role in both homeostasis and immune responses. These cells are part of the broader family of

innate lymphoid cells, distinct from adaptive immune cells such as T cells and B cells. ILC2s are particularly noted for their ability to produce cytokines in response to various stimuli, thereby influencing inflammation, tissue repair, and allergic responses. Their discovery has illuminated new pathways in immunology, offering insights into diseases ranging from asthma and allergies to metabolic disorders and tissue regeneration. Understanding ILC2s continues to deepen our comprehension of immune system dynamics and holds promise for novel therapeutic interventions. The main problem still facing today is characterizing and identifying ILC2. Through the mice model NMUR1 Cre-eGFP it is believed that ILC2 gives off a green fluorescent protein, properly characterizing ILC2s. A total of 3 GFP-positive mice and 6 GFP-negative mice were used in the experiment. A grouping of 1 GFP positive and 2 GFP negative was created each receiving a different treatment to compare ILC2. Group 1A received the drug Alternaria, known to increase ILC2. Group 2A received bleomycin known to decrease ILC2. Lastly, group 2C was the control that only received the buffer (PBS- phosphate-buffered saline) in which the drugs were dissolved. Through our evidence we can observe the expected result, observing an increase in ILC2 in the Alternia compared to Bleomycin and Standard.

Kayla Mash: **Poster #E1**

Home Institution: University of Colorado Boulder

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

Faculty Mentor: Deblin Jana, School of Engineering; Tejal Desai, Provost's Office

Click chemistry-mediated fabrication of DNA scaffolded nanoparticles for dendritic cell targeting

Immunotherapy has paved the way for modern therapeutics in scenarios ranging from cancer to autoimmune diseases. Modulating our innate immune system is necessary to combat such diseases while providing long-term immunity. Central to the immune response are antigen-presenting cells, specifically dendritic cells. Thus, targeted drug delivery to dendritic cells is of particular interest for immunomodulation. However, traditional fabrication methods of targeted nanoparticles do not offer targeting antibody presentation in a high and controllable manner, hindering their efficacy. In our group, we had previously designed a DNA-scaffolding method to offer 3-times higher antibody presentation in a controllable manner on biodegradable PLGA-PEG particles. These particles are promising candidates for targeted drug delivery due to their tunable surface-loading properties, which allow for the optimization of ligand-receptor interactions for enhanced cellular uptake. In our work, we have modified and optimized the synthetic paradigm of DNA-scaffolded particles through click chemistry and nanoprecipitation. We scaffolded our nanoparticles with different densities of a dendritic cell targeting antibody, DEC205, in a controllable manner. Flow cytometry and confocal microscopy analysis of cellular targeting were utilized to optimize the nanoparticle formulation in vitro. Our research aims to demonstrate the robust design of a nanoparticle system that can target dendritic cells for future immunomodulation applications.

Gabriela Meléndez Martínez: **Poster #E2**

Home Institution: University of Puerto Rico - Mayagüez

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

Faculty Mentor: Frank Sellke, Bio Med Surgery

Impact of Metabolic Syndrome on the Myocardial Proteome in a Large Animal Model of Chronic

Coronary Artery Disease

Metabolic syndrome, characterized by a cluster of conditions such as obesity, high blood pressure, high blood sugar, elevated blood triglycerides, and low HDL cholesterol, significantly increases the risk of developing heart disease, stroke, and type 2 diabetes. The prevalence of metabolic syndrome is alarmingly high, with over 42% of the U.S. population classified as obese and over 10% diagnosed with type 2 diabetes. These conditions can lead to severe health complications, including chronic coronary artery disease (CAD), a major cause of morbidity and mortality worldwide. Understanding the molecular mechanisms underlying the impact of metabolic syndrome on myocardial tissue is crucial for developing effective treatments for CAD. In this study, we investigate the effects of metabolic syndrome on the myocardial proteome in a large animal model, specifically Yorkshire swine, which closely mimics human cardiovascular physiology. The approach integrates dietary manipulation of Yorkshire swine (n=19) through the use of a normal diet (n=8) and high-fat diet (n=11). To induce CAD, an ameroid constrictor was placed on the left coronary circumflex artery. At the end of a seven-week post-surgery period, the swine underwent terminal harvest and functional measurements were taken to assess cardiac function. Non-ischemic myocardial tissue samples were collected and proteomic profiling was utilized to elucidate the effects of a high-fat diet on myocardial tissue in the context of metabolic syndrome and coronary artery disease. The myocardial tissue samples demonstrated an increase in β-oxidation and amino acid metabolism along with a decrease in multiple cytoskeletal organization pathways. This implies that, while a high-fat diet might initially enhance cardiac performance by modifying metabolism, the eventual decline in cytoskeletal integrity could account for long-term adverse effects. This would explain the paradoxical beneficial effects of obesity demonstrated in some clinical studies.

Davon Michael: **Poster #E3**

Home Institution: North Carolina A&T State University

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

Faculty Mentor: Sean Lawler, Bio Med Pathology & Laboratory Medicine

Effects of STING Agonist ADU-S100 on High-Grade Glioma Cell Lines

Glioblastoma multiforme (GBM) and diffuse midline glioma (DMG), are some of the most common forms of brain cancer. Both GBM and DMG are extremely deadly, with patients experiencing an average survival time of 15 months. These gliomas are also highly immunosuppressive, growing without disturbance from the immune system. Many studies have been conducted with the goal of eliminating the tumor's immunosuppressive characteristics, allowing the immune system to kill the cancer. Through such studies, STING agonist ADU-S100 demonstrates strong potential in eliminating the immunosuppressive nature of glioma cells within the brain. In this study, we hypothesize that agonist ADU-S100 administration will induce comparable upregulation of the STING pathway and subsequent cytokine release in both GBM and DMG cells. To test this hypothesis, we subject cells to ADU-S100, activating the desired pathway and triggering cytokine release. Using an ELISA test, we measure cytokine amount from glioblastoma cells and diffuse midline glioma cells when subjected to the STING agonist. Additionally, a Pierce Assay and Western Blot is conducted in order to view the activation of the desired pathway. Using HCMEC cells as a standard, we determine the similarities and differences of STING in triggering an immunological response within GBM and DMG cells. The findings of this study are expected to enhance our understanding of how the GBM and DMG cancers respond to immunotherapy.

AJ Murphy: **Poster #E4**

Home Institution: Brown University

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

Faculty Mentor: Jill Kreiling, Bio Med Molecular, Cellular Biology Biochemistry

The effects of Tazarotene on the development of Amyloid plaques and tau tangles

Alzheimer's disease (AD) is a brain disease which causes the erosion of memories, and is present in about 10% of people above the age of 65. AD is correlated with the buildup of Amyloid-□ plaques and Tau-tangles in the brain. Previous research has shown that drugs that affect the Calcineurin pathway have reduced the amount of Amyloid-□ plaques and Tau-tangles, and reduces the prevalence of AD in those above the age of 65.. Calcineurin is a protein phosphatase that dephosphorylates the nuclear factor of activated T-Cells (NFATs). NFATs are transcription factors which play a role in long term potentiation and depression, which causes memory formation. Using a collaboration with the Creton lab, a zebrafish larvae drug screen is used to identify drugs which affect neurological function. Two of the drugs identified were Tazarotene and Acitretin, both of which were developed to treat psoriasis. Acitretin effects on AD is being explored extensively and has been shown to affect the Calcineurin pathway, and reduce the amount of Amyloid-□ plaques in mouse and human models. Tazarotene has not received the same attention and is the subject of this study. This experiment will first determine the concentration in which ReN cells (an immortalized progenitor cell line with mutations that cause Amyloid-□ plaques and Tau-tangles after a few weeks) would survive long term exposure. Afterwards the ReN cells will be grown into organoid and expose to the drugs for 6-10 weeks, which then the amount of Amyloid-□ plaques and Tau-tangles would be compared to a control group treated only with DMSO. Tazarotene would also be used to treat non-organoid differentiated ReN cells for a week. Western blots will be used to measure the amount of pNFATs vs NFATs, and the cells would be stained to see if NFATs are concentrated in the nucleus of the cells. This would test if Tazarotene affects the Calcineurin pathway.

Akiva Najman-Licht; Chris Chang; Sid Udata; Annie Wu; Alec Chen; Alan Mach: **Poster #E5**

Home Institutions: Brown University; Brown University; Brown University; Brown University; Macalester; Brown University

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

Faculty Mentor: Shane Lee, Neurosurgery

Bridging the Gap: Identifying Neural Signatures of Motor Symptoms in Parkinson’s Disease During Naturalistic Movement

Objective. Identifying correlates of neural activity and motor symptoms through kinematic and neural analysis is essential to understanding onset of motor symptoms in Parkinson’s Disease (PD) and improving efficacy of treatments such as deep brain stimulation(DBS). PD is the second most common neurological disorder in the US, affecting 1 million Americans annually, with the prevalence expected to rise to 1.2 million by 2030. PD is characterized by a loss of dopaminergic neurons in the substantia nigra pars compacta, part of a series of structures called the basal ganglia that are implicated in motor control, reward-seeking, and cognitive function. Common motor symptoms include tremor, rigidity, bradykinesia, and freezing of gait, which significantly impair patients' daily activities and quality of life; predicting and preventing these symptoms is vital to improving patient outcomes. While the behavioral manifestations of PD are well characterized, the specific neural signatures that underlie these behavioral outcomes remain

elusive. An experimental paradigm that simultaneously records movement data and neural activity is necessary to precisely characterize neural correlates to behavioral events and enable a clearer understanding of the neural mechanisms behind PD symptoms.

Approach. We will capture 3D motion dynamics via a motion capture system and muscle activity via electromyography (EMG) from both people with PD and healthy controls walking on a track while performing a 2-alternative forced choice paradigm. Points are displayed to motivate walking either to the left or the right. Concurrently, we will record EEG to monitor neural activity and cognitive load, using a dual-task paradigm where subjects choose their walking path on the track. Synchronized motion, muscle activity, and EEG data will be analyzed to identify neural signatures of physiological symptoms.

Significance. This study will identify the neurophysiological correlates of physical symptoms in PD patients. By understanding the unique individual correlates between neural data and behavioral symptoms, treatments in the form of closed-loop DBS can be more specifically and effectively optimized to detect characteristic neural signatures of motor symptoms and treat them before they happen.

Levi Neuwirth; Kaley Newlin: **Poster #E6**

Home Institution: Brown University

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

Faculty Mentor: Liqi Shu, Neurology

NeuroPose: A Novel System for Three-Dimensional Kinematic Analysis in Stroke Rehabilitation

Markerless motion capture has long been sought after due to the inconveniences and high costs associated with marker-based motion capture systems. Human pose estimation holds significant potential for enhancing movement analysis during patient recovery, providing valuable insights into rehabilitation progress and movement healthiness. Advances in pose estimation technology enabling depth perception in three dimensions form the foundation of our system, NeuroPose. This system is designed for ease of use and cost-effectiveness, capable of functioning with a single iPhone video without the need for multiple cameras or complex calibration. NeuroPose achieves comprehensive kinematic analysis by extracting relevant joint position-time data in three dimensions. Our system successfully establishes 3D joint extraction from pose estimation, and we are currently focusing on data collection and the development of scoring methodologies. These methodologies include Principal Component Analysis and Mahalanobis Distance (PCA-MD) to compare deviations in the stroke group relative to a healthy control group during various functional tasks such as drinking water and performing a 10-foot ambulation with a turn. Preliminary results demonstrate that NeuroPose offers a robust and precise means of monitoring motor recovery, paving the way for more personalized and effective rehabilitation strategies in the future.

Jerry O'Mara; Nathan Depiero: **Poster #E7**

Home Institution: Brown University

Summer Research Program: SPRINT|Undergraduate Teaching and Research Awards (UTRA), Summer Research Assistantship in Biomedical Sciences

Faculty Mentor: Christina Cuomo, Molecular Microbiology and Immunology

Grouping of Candida auris populations to track the development and proliferation of

pan-resistant strains

Background

The emergence of pan-drug resistant fungal stains poses a new and eminent threat to the global health community. Raising the risk of a new global pandemic from a never before seen deadly pathogen fungi. To identify likely deadly stains and prevent the introductions of new stains I have set out to identify and document how the new deadly stains emerged.

Methods

In this paper a data set of different strains of C.Auris were collected from a variety of different papers about C.Auris. Information including the stains DNA sequence, date of collection, region or hospital, and drug resistant levels were compiled into large vcf and csv files to have computations performed on them with OSCAR. Ocean State Center for Advanced Resources. From these computations we have identified many pan resistance fungal stains with a large amount of isolates coming from the New York and New Jersey metropolitan area. Genetic diversity of C.Auris between and within patients was derived using pairwise differences in single nucleotide polymorphisms (SNPs).

Yahir Oseguera: **Poster #E8**

Home Institution: Brown University

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

Faculty Mentor: Mark Johnson, Bio Med Molecular, Cellular Biology Biochemistry

We Love to Go Live: Live Imaging Experiments Provide Quantitative Data Into the Phenotypic Nature of RALF Peptides

The effects of rising global temperatures pose a significant risk to food security for future generations. For tomato fruit to be successfully produced, the pollen grain must land on the pistil, germinate a pollen tube, and fertilize an ovule to produce a seed. While pollen grains are known to be resilient, having the ability to survive extreme conditions, the pollen tube is currently the most vulnerable stage of fertilization. As such, direct efforts have been made to study the molecular mechanisms that contribute to the integrity and germination pathway of a pollen tube. Previous in vitro live imaging experiments and quantitative analysis have determined that thermosensitive varieties of tomato pollen are susceptible to high temperatures and have a higher burst percentage. Thermotolerant varieties are less susceptible to high temperatures and compared to thermosensitive varieties have a lower burst percentage. In vivo, it is hypothesized that the pistil of the tomato provides extra resistance to external strenuous conditions. As such RNA-seq was performed in Arabidopsis thaliana to identify the major components that assist in germination and elongation of pollen tubes. From the RNA-seq data, arose a family of peptides known as the RALF peptides that provide a “lock and key” mechanism that determines what pollen tube makes it to the pistil and which ones germination gets halted. However, RNA-seq data in tomato indicates that RALF peptides differ from the “lock and key” and even localize in areas that weren’t reported in the arabidopsis data. To gain some insight into the influence of RALF on tomato pollen, four RALF peptides were selected (RALF1-4), and three cultivars were selected(Heniz, Tamaulipas, Nagcarlang). These cultivars were subjected to 1mM of each respective RALF peptide and tested at both 28ºC and 34ºC. Preliminary results from the aforementioned experiments indicated a lower percentage of germination, suggesting the peptides in vitro hinder the ability of the pollen grain to properly germinate a pollen tube. Overall, the

identification of phenotypes in vitro can provide quantitative data that can be used to design further experiments.

Leila Paltrowitz: **Poster #E9**

Home Institution: Brown University

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

Faculty Mentor: Richard Bennett, Bio Med Molecular, Microbiology & Immunology

Regulation of Filamentation in the Fungal Pathogen Candida albicans

Candida albicans is the most common fungal pathogen encountered in the clinic and the major cause of fungal disease in humans. Typically, C. albicans lives commensally in its host, yet it can become pathogenic and cause life-threatening infections, particularly in immunocompromised individuals. The ability of C. albicans to make this transition from a commensal to a pathogen is related to its ability to undergo a reversible morphological shift from oval-shaped yeast cells to hyphal filaments, a process known as filamentation. Since filamentation is correlated with this shift from commensalism to virulence, there is interest in developing a system to control filamentation in C. albicans in an inducible manner.

This project aimed to regulate filamentation in C. albicans by placing the filamentation program under the control of chemical cues. In this project, the established “SMASh-TAG” protein degradation technique was applied to C. albicans. The SMASh-tag technique (Small Molecule-Assisted Shutoff) involves the fusion of proteins to a degron that is removed in the absence of a drug, allowing for the degradation of target proteins only in the presence of the drug. Here, the SMASh-tag system was established in C. albicans and its ability to suppress mneon fluorescence in the presence of the drug confirmed its efficacy in this species. The SMASh-tag system was then used to tag NRG1, a negative regulator of filamentation in C. albicans, allowing for inducible control of filamentation.

Sophie Phipps: **Poster #E10**

Home Institution: Brown University

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

Faculty Mentor: Kate O'Connor-Giles, Bio Med Neuroscience

Investigating the neuronal roles of PDZD8 and VAP-33A mediated ER Membrane Contact Sites

Sites of apposition between organelles, referred to as membrane contact sites (MCSs), are hotspots for intracellular signaling, lipid metabolism, and organelle biogenesis/dynamics in eukaryotic cells. The endoplasmic reticulum (ER) forms an extensive and dynamic network of MCSs with almost all organelles. We identified the resident ER protein PDZD8 as a positive regulator of activity-dependent synapse formation. PDZD8 is an SMP (synaptotagmin-like mitochondrial-lipid-binding) domain protein belonging to the tubular lipid-binding protein (TULIP) superfamily of lipid transfer proteins. We find that PDZD8 is broadly expressed in neurons, where it predominantly localizes to ER-Late endosome/Lysosome (LEL) MCSs. Overall we show that PDZD8 increases autophagic flux to promote synapse formation during periods of high demand such as activity-dependent synaptogenesis. Using IP-Mass Spectroscopy, we have identified Vamp-Associated Protein (VAP)-A, another ER tethering protein as a strong interactor of PDZD8. Interestingly, loss of VAP-A at the Drosophila NMJ results in fewer synaptic boutons, whereas overexpression induces ectopic formation of small boutons, similar to PDZD8 and atg1. In this project, I

am investigating the relationship between VAP-A and PDZD8 as mediators of synaptogenesis and autophagy at ER-LEL MCSs.

Adelaide Poulson: **Poster #E11**

Home Institution: Brown University

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

Faculty Mentor: Theresa Raimondo, School of Engineering

Development of a 3D in vitro model of ovarian cancer and design of lipid nanoparticles for drug delivery into solid tumors

Ovarian cancer is an aggressive cancer, largely due to its propensity for forming multicellular aggregates, called spheroids, that detach from their primary location and travel to novel sites to form secondary tumors. The tight cell-to-cell adhesions within these spheroids present a challenge for drug delivery, as the dense tissue of the tumor is difficult for therapeutics to penetrate. As current treatments for cancer such as chemotherapy and surgery often have high relapse rates, attention has more recently turned to molecular therapies, such as the use of small interfering RNA (siRNA).

In this project, cancer cell spheroids are grown in the lab and serve as an in vitro model for measuring the penetration of fluorescently labeled lipid nanoparticles (LNPs) into solid tumors. Cell spheroids are cultivated using 2 different methods, the hanging drop technique and a microwell, 3D PetriDish. Both methods facilitate the self-assembly of cells into spheroids, the hanging drop technique relying on gravity to aggregate cells hanging in drops of DMEM F-12 (media) from the underside of the lid of a petri dish, and the microwell 3D PetriDish method relying on nonadhesive micro-molded agarose gels to draw cells together. The LNPs are developed by mixing 4 lipid components: ionizable lipids (MC3), phospholipids (DSPC), cholesterol, and PEGylated lipids (DMG-C-PEG2k) in ethanol, and then rapidly pipette mixing the lipid-ethanol solution with siRNA dissolved in sodium citrate buffer. Rapid mixing allows the siRNA to be encapsulated into the LNP. Using a lipophilic fluorescent dye incorporated into the ethanol solution, the siRNA-LNP is imaged and assessed on its ability to penetrate the spheroids under confocal microscopy.

The development of this in vitro model will be a powerful tool in screening novel cancer therapies and optimizing their delivery into solid tumors. Insights gained from this study could potentially inform the development of future RNA-based cancer treatments that leverage LNPs as an effective mechanism for RNA delivery and the blocking of cell-to-cell adhesions.

Derek Puin: **Poster #E12**

Home Institution: Hunter College

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

Faculty Mentor: Christopher Mantsounga, Bio Med Medicine

Inflammatory macrophage phenotype in angiogenesis in response to femoral artery ligation

Abstract:
Peripheral artery disease (PAD) is a manifestation of systemic atherosclerosis that leads to significant narrowing of arteries distal to the arch of the aorta. Critical limb ischemia (CLI) is the most severe

manifestation of PAD. Without timely diagnosis and revascularization, patients with CLI are at risk of devastating complications including loss of limb and life. PAD-mediated ischemia causes an inflammatory response that is intended to restore perfusion and homeostasis by releasing cytokines and other angiogenic molecules. CLI and wound injury animal models have shown the impact of monocytes/macrophages as a source of angiogenic mediators leading to new capillaries, new arterial growth, and wound healing.
Recently in the hindlimb ischemia mouse model, we have shown a new signaling pathway involving macrophage IL-1β/VEGF-A (Vascular endothelial growth factor A) during early acute ischemic phase. While we do not negate the importance of "M1" transitioning to "M2" macrophage phenotypes in the late phase of vascular injury response, we sought to investigate the key role of early inflammatory macrophages response, its role in VEGF-A expression, and subsequently inflammatory angiogenesis. Our results demonstrate the importance of pro-inflammatory macrophages recruited in ischemic sites and their role as a major source of VEGF-A required for angiogenesis. Clodronate liposomes macrophage depletion mouse model, myeloid-specific VEGF deleted mouse, and Control M1 bone marrow transplantation experiments have shown the necessity of an efficient and adequate early inflammatory regulation leading to new capillaries and new arterial growth while M2 macrophage markers were unaffected.

Timothy Pyon: **Poster #E13**

Home Institution: Brown University

Summer Research Program: Undergraduate Research Assistant in Borton Lab

Faculty Mentor: David Borton, School of Engineering

Selective Lower Extremity Muscle Activation with Epidural Electrical Stimulation in Individuals with Spinal Cord Injury

Spinal cord injury (SCI) can lead to lifelong deficits in sensory, motor, and autonomic functions. Recently, studies have shown that epidural electrical stimulation (EES) can improve and restore these functions in people with a SCI. In EES, electrodes (often in the shape of a grid-like array or lead) are placed epidurally caudal to the lesion. Individual electrodes, also referred to as contacts, can be used to electrically stimulate sensorimotor networks in the spinal cord that innervate lower extremity musculature. However, the specifics of individual muscle activity and the full capabilities of EES to specifically target different patterns of muscle response are not yet fully understood. In this project, we aim to deepen our understanding of how we can selectively activate individual muscles and how utilizing a high-density electrode array improves our ability to restore function to people with a SCI. Utilizing two electrode arrays with more contacts than previously used in human SCI research (one implanted rostral, and one implanted caudal to the injury), we demonstrate our ability to safely and selectively activate muscles of the lower body with EES in people with a SCI. By sweeping through different frequencies, amplitudes, and locations of stimulation on the caudal paddle, we produced lower body muscle responses that were measured with surface electromyography (EMG) recordings on 12 muscles. We recorded at the left and right vastus lateralis (VL), medial hamstring (MH), tibialis anterior (TA), medial gastrocnemius (MG) soleus (SOL), and flexor carpi radialis (Forearm). Utilizing the concurrent stimulation and EMG recordings, we were able to evaluate the magnitude of muscle activation resulting from each stimulation, then identify stimulation parameters that most selectively activated different muscles. The selective EES parameters align with our expectations based on anatomical positioning of sensorimotor pools in the spinal cord (e.g., lateral stimulation resulted in preferential ipsilateral muscle activation and proximal/distal muscles were preferentially activated by rostral and caudal contacts, respectively). This information can help activate the appropriate muscles for different tasks, such as standing or walking. Here, we

demonstrate the potential that a high density electrode array has in selectively activating muscles below the lesion in individuals with a SCI, which could result in improved performance using EES to restore motor function.

Valeria Quero: **Poster #E14**

Home Institution: Brown University

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

Faculty Mentor: Theresa Desrochers, Neuroscience

Generalization of a Convolutional Neural Network-based Spike Sorting Pipeline

Spike sorting forms the basis of electrophysiology data analysis. However, the manual approach has several pitfalls, including researcher bias and a lack of agreement even among expert human sorters. Therefore, automating the spike sorting pipeline, to a partial or full extent, has been the focus of numerous studies, resulting in multiple open-source projects. Moreover, recent literature has demonstrated the efficacy of Neural Networks for both the detection of spike events and classification into putative neurons. Among these algorithms, Convolutional Neural Networks (CNNs) have been particularly promising. Nevertheless, employing CNNs presents challenges related to training data dependency and model generalization.
In this research, I focused on addressing the generalization problem in the use of CNNs for spike sorting. I applied two different CNN architectures for unit-noise classification and unit sorting, using experimental, hand-labeled data from two different non-human primates' EEG recordings covering the orbitofrontal cortex and the lateral prefrontal cortex. The objectives are to evaluate the accuracy of both CNNs and assess their generalization capability to unseen data from a different session, subject, and brain area, especially under varying signal-to-noise ratio (SNR) conditions. Performance metrics such as classification accuracy, precision, recall, and robustness to noise were used to evaluate the models. Moreover, I aimed to determine the minimal number of labeled waveforms needed to achieve reliable performance while performing different data augmentation techniques on those waveforms.
The CNN for unit-noise classification achieved an accuracy of 95.1% when trained on 1% of the data from the orbitofrontal cortex session and 92.7% on the unseen dataset from the lateral prefrontal cortex. Increasing the training size to 40% yielded a 2% increase in accuracy for the additional dataset. The results for the unit-classification CNN indicated a need for varied training sizes across channels. When 16 waveforms were used, the accuracy ranged from 28.6% to 96.2%. When 128 waveforms were used, the accuracy ranged from 76.0% to 97.4%. Thus, CNNs represent a scalable solution for large-scale spike sorting for channels with moderate levels of noise, while especially noisy or complex channels may require larger training sets.

Tasawwar Rahman: **Poster #E15**

Home Institution: Brown University

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

Faculty Mentor: Sofia Lizarraga, Bio Med Molecular, Cellular Biology Biochemistry; Erica Larschan, Bio Med Molecular, Cellular Biology Biochemistry

Co-Expression Network Analysis in Autism Spectrum Disorder Patients with Immune Signatures

Autism Spectrum Disorder (ASD) is a set of complex neurodevelopmental disorders affecting how people

interact with others, communicate, learn, and behave. ASD has further been linked to immunological abnormalities, and it's critical to understand the differential transcriptomic landscape of these phenotypes to better target precision medicine. To study these differences, weighted gene co-expression networks were constructed using autism patient data (n = 8), and gene ontology analysis was performed. We further looked for differentially expressed genes and subsetted for synaptic genes within our co-expression networks. These data help elucidate some of the pathways of our clinical phenotypes and provide insight into target genes for further study.

Vivek Rajani: **Poster #E16**

Home Institution: Brown University

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

Faculty Mentor: Ying Ma, Public Health-Biostatistics; Alexander Brodsky, Bio Med Pathology & Laboratory Medicine

spTransform: Benchmarking Transformation Methods on Spatially Resolved Transcriptomics Data and Downstream Analysis

Spatially resolved transcriptomics (SRT) is a rapidly advancing technology that enables gene expression profiling of tissue samples with spatial localization. SRT has provided invaluable insights into various spatially dependent biological phenomena, such as tissue organization, intercellular communication, and disease mechanisms. Approaches for capturing the spatial transcription profile of tissues can be subdivided into two categories: imaging-based (e.g. MERFISH, seqFISH, seqFISH+, 10x Xenium, STARmap, FISSEQ) and sequencing-based (e.g. 10x Visium, Slide-seq, Stereo-seq, Seq-Scope), with each platform differing in their resolution, gene probe capacity, and workflow. As a result, transformation and normalization of the genomic data are often crucial preprocessing steps needed to account for these technical factors, which can obscure underlying biological signals. Considering the relative novelty of SRT, there is currently no comprehensive evaluation of the effect of these transformation methods on the analysis and interpretation of SRT data across both approaches and their constitutive platforms. As such, this study investigates the performance of 16 transformation methods on common downstream analyses, including highly variable gene (HVG) selection, gene set enrichment analysis (GSEA), gene co-expression network identification, and spatial domain detection. Benchmarking of multiple publicly available datasets reveals trends that vary by transformation and technology. For example, certain transformations have shorter runtimes and smaller memory demands, which incentivize their usage for high-dimensional data. In addition, other transformations characterize spatial domains that are more consistent with the true annotation, highlighting their greater ability to extract biologically meaningful information. Furthermore, HVG selection is highly influenced by the SRT platform. Imaging-based technologies often require prior selection of a small subset of marker genes due to technical limitations, increasing the likelihood that the selected HVGs are similar across the transformations. In total, these results aim to provide guidance for which transformation method can unlock the most biologically accurate information from SRT data based on the platform used, the tissue type, and the analysis conducted.

Lizeth Sanchez: **Poster #F1**

Home Institution: Brown University

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

Faculty Mentor: Theresa Raimondo, School of Engineering

Optimization of lipid nanoparticles (LNPs) for therapeutic RNA delivery to cancer cells

siRNA is a promising new therapeutic modality for cancer, however it requires that the siRNA is delivered to the target cancer cells. Lipid nanoparticles (LNPs) are a new drug delivery method that can deliver nucleic acids to target cells. They are composed of four lipid components: cholesterol, PEG, DSPC, and an ionizable lipid. We hypothesize that by optimizing the ionizable lipid and the lipid mole ratios, we will be able to obtain favorable siRNA encapsulation and cancer delivery results.

LNP formulation will be optimized by using different lipid molar ratios with the ultimate goal of fabricating a safe and effective drug delivery system for uptake by breast (MDA-MD-231) and ovarian (OVCAR3) cancer cells. Eleven different formulations using MC3 as the ionizable lipid were imaged and compared by size, PDI, and transfection efficiency. Additionally, more parameters will be tested such as mixing methods (hand mixing vs. vortex mixing). Data will be collected using a dynamic light scattering (DLS) machine which provides LNP size and polydispersity information. Moreover, a RiboGreen RNA Assay will be used to measure the RNA concentration to calculate the encapsulation efficiencies of the LNPs. Thus far, hand mixing has resulted in smaller MC3 particle sizes according to DLS readings, compared to vortex mixing.

Ongoing and future work will use fluorescently labeled LNP to allow us to quantify the delivery into cells by using an EVOS microscope and plate reader. In the future, RT-qPCR will be performed to calculate gene silencing. The results from this investigation bring us a step closer to understanding the new field of LNPs as a cancer therapy.

Roselyn Santana; Samantha Zhang: **Poster #F2**
Home Institution: Brown University

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

Faculty Mentor: Sofia Lizarraga, Bio Med Molecular, Cellular Biology Biochemistry

The effect of SETD2 pathogenic variants on stem cell pluripotency and morphology in autism spectrum disorder.

Autism spectrum disorder (ASD) is a disorder of neural connectivity that is characterized by difficulty with communication and social interactions. In the Lizarraga laboratory, human induced pluripotent stem cell (iPSC) experimental systems are being used to investigate how pathogenic variants of different ASD risk genes can result in these defects of neural connectivity. Specifically, we are focusing on the protein SETD2. There is an overrepresentation of chromatin regulators, like SETD2, that have high-risk variants associated with ASD. SETD2 is an enzyme that is responsible for trimethylation of lysine 36 on Histone H3 (H3K36me3). Histone methylation plays a role in orchestrating the expression of critical gene networks making it an important factor in neurodevelopment. It has also been proposed that SETD2 can regulate alternative splicing through its methyltransferase activity and interaction with spliceosome machinery. Individuals with mutations in SETD2 can present with ASD, intellectual disabilities, and seizures. While SETD2 has previously been identified as a high confidence ASD-risk gene, how pathogenic variants lead to neurological disorders and whether impairing methyltransferase activity or alternative splicing regulation underlies ASD-related phenotypes remains unclear. Our work aims to elucidate the function of SETD2 in human neuronal development. We established an initial human iPSC line (11A) from a previously characterized male neurotypical individual. Using the CRISPR/Cas9 Ribonucleoprotein (RNP) system, we introduced two missense pathogenic mutations (R1740W and R1740Q) near the catalytic domain of the SETD2 protein. Both pathogenic variants are highly recurrent

de novo heterozygous variants and have been connected to microcephaly, severe intellectual disability, and seizures. To characterize the effect of SETD2 pathogenic variants in the maintenance of stem cell pluripotency, we utilized a combination of morphological assessments and western blot analysis of classical pluripotency markers (OCT4, SOX2, and NANOG). Our findings indicate that altering the function of SETD2 impacts stem cell pluripotency and morphology. Our next steps will involve differentiating iPSCs from 11A or SETD2-mutant lines into neurons to characterize their growth and activity throughout neurodevelopment. This work holds promise for future research which seeks to identify the role of SETD2 in alternative splicing and gene expression in human neurons.

Ashley Seong; Tasiemobi Ajie-Anozie: **Poster #F3**
Home Institution: Brown University

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

Faculty Mentor: David Sheinberg, Bio Med Neuroscience

How efficient is object recognition through touch?

Humans rely on our senses to learn about the outside world and object recognition is central to this process. While visual object recognition has been extensively studied for decades, much less is known about how we recognize objects through our other senses. In this study, we explore the limits of recognition by touch, a biologically primitive capacity that is particularly important for mammalian species with highly developed hands. Our understanding of the mechanisms of haptic object recognition has been hindered by the challenge of systematically presenting physical shapes in experimental settings. To address this limitation, our group has developed a "pneumatic haptic display" capable of creating a virtually unlimited number of novel physical shapes. Using this haptic display as well as a traditional computer-controlled visual display, we designed an object matching task to assess subjects' ability to recognize novel shapes by either vision or touch. Using this paradigm we can analyze not only perceptual abilities, but also how exploratory movements contribute to recognition performance. Insights gathered from this work will inform subsequent neurophysiological studies in animals, aimed at understanding the brain processes of multisensory processing and its potential impairments.

Jayleann Serrano: **Poster #F4**

Home Institution: University of Puerto Rico, Rio Piedras Campus

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

Faculty Mentor: Thomas Roberts, Ecology, Evolution, and Organismal Biology; Emily McParland, Biology (Bio)

Mechanics of Eye Movements: Force-Velocities and Length-Tension Relationships in Extraocular Muscles

Muscle physiology provides a foundational understanding of how muscles contract, generate force, and facilitate movement. Skeletal muscles act in co-contracting pairs (agonist/antagonist) that work against one another when they contract. Complex interactions between these pairs are crucial for coordinated and efficient movements. Extraocular (EO) muscles are a system of muscles that consist of three sets of agonistic/antagonistic pairs that facilitate quick and precise eye motions in a variety of environments. Although ocular anatomy is well-established and conserved throughout evolution, eye motion mechanics

via EO muscles is understudied. Here, we couple existing eye-tracking data with known basic muscle biomechanical data from humans and non-human primates to predict and analyze the limits of the EO muscle system. First, we used published eye-tracking data that quantified velocity and acceleration of normal eye movement and properties that directly affect ocular movement (i.e. saccades and smooth pursuits). We then extracted biomechanically-relevant metrics such as muscle length, cross-sectional area, and eye size from these same species. Using these variables, we calculated the upper limits of motion variables like inertia, velocity, and acceleration using mathematical modeling. We compared these calculated results of the upper limits of muscle function to real eye-tracking data to gain insights into whether extraocular muscle performance matches inertial demands. This analysis expands our understanding of the mechanical function of extraocular muscles, ocular mobility and normal eye function.

Mohammed Serri: **Poster #F5**
Home Institution: Brooklyn college

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

Faculty Mentor: Christopher Moore, Bio Med Neuroscience; Sonia Mayoral, Bio Med Neuroscience

Investigating the Impact of PDGF on Thalamic OPC Populations

Making memories and recalling them depends on safe, well-timed delivery of fast electrical signals across wide regions of the brain. These fast signals are carried by action potentials, fast pulses (a few milliseconds in delivery time) that travel down the axon, the wires connecting brain regions. This fast, specific relay crucially depends on myelination, enwrapping axons to insulate them and perform several other cellular functions. Oligodendrocytes are the cell type that creates this essential myelin, ensuring that coordinated communication can occur.
Oligodendrocyte precursor cells (OPCs) are the sole source of myelinating oligodendrocytes in the brain. Accordingly, alterations in OPC genetics are major predictors of memory conditions such as Alzheimer's Disease.
To test the role of OPCs broadly, and specifically in processes like memory, we have developed a model system that decreases OPC densities throughout the CNS. PDGF (platelet-derived growth factor) has been identified as a key factor, influencing OPC proliferation, and we genetically eliminated PDGF signaling in OPCs by removing the PDGF receptor (PDGFRa) selectively in OPCs. While this results in reduced OPC densities in various brain regions, its impact on the thalamus, a key region involved in relaying memory information, has not yet been determined.
In my project, I am systematically characterizing OPC distribution in specific nuclei within the thalamus of normal (control) mice and PDGFRa conditional knock out (cKO) mice. We are mapping three thalamic regions—VPM, POm, and LGd—and an external region, the dentate gyrus, in sagittal brain sections of three-month-old mice immunostained for the OPC marker NG2. We count NG2+ OPC densities in these mapped regions to determine whether OPC densities are significantly reduced in PDGFRa cKO compared to controls.
My initial findings suggest that thalamic subregions, but not all brain areas, show decreased OPC densities in our model. The significant reduction of thalamic OPCs in the PDGFRa cKO will allow for future studies examining the role of OPCs in the modulation of thalamic activity and subsequent memory formation. Mapping these differences could reveal new strategies for neural repair, and offer insights for future research and treatment of neurodegenerative diseases.

Nina Shin: **Poster #F6**
Home Institution: Brown University

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

Faculty Mentor: Ruhul Abid, Bio Med Surgery

Optimization of GeoMx Digital Spatial Profiler morphology staining parameters for cardiomyocytes and vasculature

Cardiovascular disease has been the leading cause of death in the United States and globally for several decades. There are 224 million patients with ischemic heart disease worldwide, underscoring the importance of a deeper understanding of cardiovascular pathophysiology. The Abid Lab previously demonstrated in a murine model of permanent ligation myocardial infarction (MI) with transgenic overexpression of mitochondrial superoxide dismutase (MnSOD) that a reduction of mitochondrial reactive oxygen species (mito-ROS) in endothelial cells (ECs) stimulated oxidative phosphorylation in ECs, improved angiogenesis, and preserved cardiac function compared to control mice. Understanding the mechanisms of how mito-ROS modulation impacts myocardial recovery could provide insights into better treatment options for MI. Spatial transcriptomics is an ideal tool to investigate these underlying pathways because it allows for the analysis of the spatial distribution of RNA in intact tissues. By using the GeoMx Digital Spatial Profiler by NanoString, a spatial transcriptomics platform, we aim to elucidate how overexpression of MnSOD impacts the localized transcriptomic profile of post-MI mouse hearts in the ischemic infarct, border, and remote healthy regions. Successful spatial RNA profiling necessitates highly optimized immunohistochemistry (IHC) protocols to preserve RNA integrity and well-defined fluorescent antibody selection for accurate downstream segmentation of RNA. Cardiomyocytes and endothelial cells were identified as the primary cell populations of interest, and a series of stains comparing standard IHC and GeoMx protocols were performed with variations in cardiac and vascular targets, clonality of the markers, and antigen retrieval conditions. Cardiac marker targets that we tested include alpha-actinin-1, cardiac muscle alpha actin, and cardiac troponin I (cTnI). Vascular markers that we tested include isolectin B4 (IB4), vascular endothelial-cadherin (VE-cadherin), and CD31. While alpha-actinin and IB4 stained brightly in the GeoMx protocol, they are not ideal targets: anti-alpha-actinin isoforms also stain smooth muscle and anti-IB4 stains saccharides of the EC glycocalyx which can be found on other cells. cTnI and CD31 are more specific targets, but CD31 proteins are not well preserved in the GeoMx protocol unlike in the standard IHC protocol; our stains suggest that cardiomyocyte stains need antigen retrieval while endothelial markers appear to be damaged by retrieval. Ongoing work will determine optimal GeoMx morphology staining conditions to isolate these populations in mouse hearts. As part of the GeoMx workflow, these stains will allow us to illuminate the pathways involving changes in endothelial cell metabolism and endothelial-cardiomyocyte crosstalk enabling myocardial preservation post-MI.

Zoe Siegel: **Poster #F7**
Home Institution: Brown University

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

Faculty Mentor: Chun Geun Lee, Bio Med Molecular, Microbiology & Immunology; Takayuki Sadanaga, Bio Med Molecular, Microbiology & Immunology

The Critical Role of TGF-β-Stratifin Axis in the Regulation of Alveolar Remodeling and Lung Fibrosis

Stratifin (SFN), also known as 14-3-3σ, is a member of the 14-3-3 family of adaptor proteins and regulates multiple signaling processes associated with cellular proliferation, apoptosis, differentiation, and inflammation. In general, SFN is induced by p53 and plays a critical role in the induction of genes associated with DNA damage responses, cell cycle inhibition and cell death responses. In lung

adenocarcinoma, SFN expression is increased, and alveolar type II overexpression of SFN results in tumors. This study examines the specific role of SFN in the pathogenesis of Idiopathic Pulmonary Fibrosis (IPF).

In preliminary studies, SFN was differentially expressed in patients with chronic obstructive lung disease (COPD) and IPF. SFN was also shown to be highly expressed in the aberrant basaloid epithelial cells of the lungs of IPF patients. Critically, Transforming Growth Factor-β (TGF-β) has been reported in the pathogenesis of IPF and COPD. In fact, we have demonstrated that in vivo silencing of SFN using siRNA significantly reduced TGF-β-stimulated lung fibrosis in mice, suggesting a significant role of SFN in TGF-β-induced lung disease.

The TGF-β regulation of SFN expression in airway epithelial cells is being explored in vitro. A549 and Normal Human Bronchial Epithelial (NHBE) cells are treated with a time and dose response of TGF-β and Chitinase 3-like 1 (CHI3L1). The expression of SFN, TBF-β, and markers for aberrant basaloid cells, KRT5 (+), P63 (+) and KRT17 (-), are assessed using qPCR and Western Blot.

Chris Stein: **Poster #F8**

Home Institution: CUNY Hunter College

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

Faculty Mentor: Molly McQuillan, Neuroscience; Sonia Mayoral, PhD, Bio Med Neuroscience

Investigating the Neuroprotective Effect of Myelin on SARM1-Mediated Wallerian Degeneration

Myelin is a compact sheath formed from oligodendrocytes that insulates neurons. It is most known to maximize the speed of action potentials in neurons, however, it has now been implicated to play a neuroprotective role in neurodegenerative diseases, such as multiple sclerosis (MS), which involves the destruction of CNS myelin. Though the myelin sheath plays this protective role, the mechanisms underlying its protection remain unknown. To study this, our lab has generated a novel mouse model that removes the growth factor receptor (PDGFRa) from oligodendrocyte precursor cells (OPCs). This produces a robust phenotype where OPCs differentiate and myelinate only the posterior portion of the optic nerves. Using this model, we found that the presence of myelin delays Wallerian Degeneration (WD). WD is a specific, well-characterized degeneration process in which the transection of the optic nerve sets off a cascade of biological events that result in the cytoskeletal structure of the axon ultimately disintegrating before being cleared away entirely. To better understand the mechanism of myelin's protection, we focused on SARM1, a prodegenerative key regulator of the WD pathway. We knocked out SARM1 in our PDGFRa cKO mice and induced WD by performing monocular enucleations (transections), which provide us with both an intact and enucleated nerve within each animal. We then examined the rate of degeneration using immunohistochemistry and staining for a marker of degeneration called DegenoTag, which allowed us to measure the extent of degeneration in each optic nerve for comparison. Our findings have the potential to give new insights into therapeutic approaches for neurodegenerative disease.

Lukas Strelecky: **Poster #F9**

Home Institution: Brown University

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

Faculty Mentor: Liqi Shu, Neurology

Acute Ischemic Stroke and Intraparenchymal Hemorrhage Risk Following Migraine Hospital Admission

Introduction–Migraine with aura (MA) has been identified as a possible risk factor for acute ischemic stroke (AIS) and intraparenchymal hemorrhage (IPH). Previous studies have established that MA is an independent predictor of AIS, but also suggested association with confounding cardiovascular risk factors such as hypertension and atrial fibrillation. Previous studies examining the relationship between MA and IPH are scarce, but MA is known to be associated with vascular structure abnormalities, endothelial dysfunction, and coagulopathies, which could precipitate IPH risk. We sought to evaluate the association of MA to AIS and IPH while adjusting for cardiovascular risk factors.

Methods–We utilized data from the Healthcare Cost and Utilization Project's National Readmission Database between 2016 and 2019. Identification of all diagnoses was based on standard and validated ICD-10-CM codes. The reference group for analysis contained all adult patients admitted during the study period. A multivariable Cox regression model was used to assess AIS and IPH readmission risk in patients with MA, adjusted for significant confounding risk factors. Kaplan-Meier curves were plotted to visualize survival over time.

Results–Among 101,840,764 patients (mean age 45.85, 58.03% female) admitted during the study period, 1,655,087 (1.63%) patients were admitted with any migraine diagnosis and 96,576 (0.10%) had a principal or non-principal diagnosis of MA. Within 90 days, 411,941 (0.40%) patients had subsequent AIS readmission and 395,866 (0.39%) had an IPH readmission. After adjustment for coronary artery disease, atrial fibrillation, hypertension, hyperlipidemia, diabetes mellitus, and smoking, patients with MA demonstrated an elevated risk for 90-day AIS (adjusted hazard ratio [aHR] 1.82, 95% CI 1.62-2.05, $p < 0.001$). Adjusting for cancer, coagulopathy, and hypertension, migraine with aura was associated with greater risk for IPH readmission (aHR 1.50, 95% CI 1.13-1.99, p=0.005). Subgroup analyses in patients under 55 years of age and stratified across demographic subgroups continued to show similarly increased risk.

Conclusions–In a comprehensive national database, after adjustment for significant cardiovascular risk factors, migraine with aura is associated with increased risk for both AIS and IPH readmission. The main strength of our study is the large patient population, but our study lacks information on certain confounding variables such as medication usage and is susceptible to coding errors. Future studies should seek to investigate the underlying pathomechanisms and devise clinical strategies to mitigate risk in this vulnerable population.

Yousuf Suleman: **Poster #F10**

Home Institution: Brown University

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

Faculty Mentor: Lalit Beura, Bio Med Molecular, Microbiology & Immunology

Optimizing Growth and Differentiation of Murine Trophoblast Organoids to Explore Immune Interactions at the Maternal-Fetal Interface

The maternal-fetal interface is a highly dynamic and complex microenvironment where cellular interactions are tightly regulated to ensure successful pregnancy. CD8 T cells, potent cytotoxic killer cells

of our immune system, undergo a remarkable downregulation of their effector capabilities during pregnancy. However, the mechanisms underlying this functional adaptation remain poorly understood. This project aims to establish a better in vitro model system to recapitulate the stromal-immune interaction between fetal trophoblast, the outermost fetal cell layer and the CD8 T cell. Current cell culturing techniques only allow for two-dimensional growth of trophoblasts and biased differentiation into a single trophoblast lineage, and as such do not faithfully represent the in vivo placental environment. Here we employed an organoid-based model utilizing fetal mouse-derived trophoblasts, a model allowing for three-dimensional growth of cells. For this, we embedded trophoblast stem cells in an artificial extracellular matrix, that when treated with specific growth factors were able to generate organoids structurally resembling the in vivo trophoblast layer. We further attempted differentiation of several distinct trophoblast lineages using defined culture conditions and their phenotypic and transcriptional characterization is underway. The development of an organoid-based model for studying maternal-fetal interactions will contribute to advancing our understanding of reproductive immunology and may have implications for therapeutic interventions aimed at supporting healthy pregnancies.

Clara Tandar: **Poster #F11**

Home Institution: Brown University

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

Faculty Mentor: Eric Darling, Bio Med Pathology & Laboratory Medicine

Cell-like microparticles with tunable mechanochemical properties for drug delivery systems

Michelle Tanujaya: **Poster #F12**

Home Institution: Temple University

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

Faculty Mentor: Jessica Plavicki, Bio Med Pathology & Laboratory Medicine

Identification of novel sox9a and sox9b functions in development

Sox9 is a transcription factor known to have important roles in multiple organs and tissues, including the brain, heart, retina, gonads, and craniofacial structures. Mutations in Sox9 can cause Campomelic dysplasia, a devastating genetic disorder that usually results in death. Individuals who survive postnatally have musculoskeletal malformations, XY sex reversal, cleft palate, hydrocephalus, and intellectual disabilities. In addition to genetic mutations in Sox9, environmental contaminant exposure disrupts normal Sox9 function and reduces Sox9b expression. Sox9 is necessary for the induction and maintenance of different stem cell populations across the different germ layers. Its expression regulates the formation of different neural crest derivatives such as chondrocytes, melanocytes, and cells of the peripheral nervous system. There are many Sox genes with Sox9 belonging to the SoxE gene family, which are necessary for the development of oligodendrocytes, Schwann cells, and astrocytes. The lab uses zebrafish as our model organism because they have rapid and transparent development, allowing us to study neural development in vivo. Although zebrafish have co-orthologs to human Sox9, sox9a, and sox9b, there is a high level of conservation in protein structure. Using CRISPR/Cas9, our lab generated mutants in sox9a and sox9b to study the functions of sox9a and sox9b in neural development. Our preliminary data suggest that sox9a and sox9b display dynamic expression in neural development. sox9a and sox9b mutants have reduced brain size, enlarged ventricles, and changes in network formation. We are currently

characterizing the expression profiles of the two orthologues and the loss of function phenotypes.

Sevara Tashkhanova: **Poster #F13**

Home Institution: University of Nevada Reno

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

Faculty Mentor: Alan Morrison, Bio Med Medicine

Perivascular cuffing associated with experimental COVID-19 pneumonia in animals with advanced age.

The coronavirus disease (COVID-19) initially triggered a global pandemic involving severe respiratory illness causing significant mortality, but as it moves toward an endemic cycle assocaited with lower mortality akin to the common cold, many questions remain. Despite comprehensive advancements in our understanding of the pathobiology of SARS-CoV-2, the betacoronavirus that causes COVID-19, mechanisms determining disease severity remain partially defined. For example, severe outcomes have been notably pronounced in individuals with chronic illnesses and advanced age, yet the exact relationship between age and disease severity remains elusive.

This study aims to utilize an experimental humanized mouse model to investigate whether age- related changes contribute to severe histopathological alterations found in lung tissue during acute infection with SARS-CoV-2. Mice aged 12- and 104-weeks were intranasally infected with 300 TCID50, and then lung tissue samples were collected 6 days post infection. Histological analysis included H&E staining for tissue morphology and cellular infiltrates, Masson's trichrome staining for collagen deposition visualization, Viral Nucleocapsid Immunohistochemistry staining for COVID-19 virus identification, and CD68 Immunohistochemistry staining to assess macrophage localization and density.

Our findings reveal that while COVID-19 infection led to increased collagen deposition and reduced air space in mice of all ages, these changes were more pronounced with advancing age. Specifically, increased perivascular cuffing was associated experimental COVID-19 in aged mice and may be a mechanism for hypoxemia. Understanding the mechanisms driving age-specific presentations of COVID-19 pathology may inform future therapeutic strategies.

Pran Teelucksingh: **Poster #F14**

Home Institution: Brown University

Summer Research Program: Voss Environmental Fellows, The Reade Y. Tompson Summer Award

Faculty Mentor: Megan Kizer, Chemistry

Designing a streamlined system for the extraction, analysis, and purification of recombinantly expressed C. jejuni glycan antigens

Campylobacter jejuni is an enteropathogenic bacteria that is capable of N-linked protein glycosylation through the pgl series of enzymes. Protein glycosylation (pgl) in *C. jejuni* produces a heptasaccharide glycan in the periplasmic space that is highly immunogenic and critical for pathogenicity. This system can be functionally transferred to E. coli to safely and effectively upscale the production of the *C. jejuni* heptasaccharide glycan. Previous studies have engineered the recombinant pgl system to produce glycan antigens from other pathogenic bacterial species, making it an appealing platform for the development of novel vaccine technologies. In this project, we developed a system for the optimized recombinant expression, extraction, and purification of *C. jejuni* glycan antigens. Expression was tested on CLM24 and SDB1 (O-antigen k/o) *E. coli* strains transformed with a plasmid encoding the pgl gene cluster. Glycan extraction was performed using osmotic-lysis and acid hydrolysis, and confirmation of expression was achieved through TLC analysis. Purification and structural confirmation was achieved through column chromatography and MALDI-MS respectively.

This system will later serve as the platform to produce *Neisseria gonorrhoeae* glycan antigens at scale, which the Kizer lab will utilize to develop a vaccine candidate against multidrug resistant gonorrhea.

Demetria Tolbert: **Poster #F15**

Home Institution: Tougaloo College

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

Faculty Mentor: Craig Lefort, Bio Med Surgery

Engineering Monocytes: Guiding Murine Myeloid Progenitor Cell Lines Towards the Monocyte Lineage

Monocytes, white blood cells derived from the myeloid lineage in the bone marrow, are notable for their ability to transform into macrophages or dendritic cells when they migrate into tissues. As those effector cell types, they engulf and digest foreign substances, dead cells, and debris to maintain tissue integrity and initiate immune responses. The Lefort Lab has previously developed a conditionally-immortalized murine myeloid progenitor cell line in which the HoxB8 transcription factor is conditionally upregulated to block the cells' maturation and differentiation. When transplanted into mice, these cells have been shown to differentiate almost exclusively into mature neutrophils, another innate immune cell type. We hypothesize that our myeloid progenitors are conditionally immortalized in a granulocyte-monocyte progenitor state, with potential to differentiate into monocytes as well as granulocytes. The goals of this study are (i) to assess whether our myeloid progenitors have potential to differentiate into monocytes and (ii) to engineer a monocyte-restricted progenitor line from our multipotent myeloid progenitor line. Preliminary results show that our myeloid progenitors, when introduced to macrophage colony-stimulating factor media, can differentiate into ~10-17% monocytes. Then, knockout three target proteins in our myeloid progenitors (Gfi1, ELANE, and Cebpa) that act as transcriptional factors or repressors important for neutrophil differentiation, which we hypothesize will enhance progenitor differentiation toward the monocyte lineage to produce a monocyte progenitor line. Generating a monocyte progenitor line is beneficial for in vitro and in vivo studies of monocyte function, and could be developed eventually as a cellular therapy for patients with monocytopenia or with macrophage dysfunction.

Claudia Toledo Molinary: **Poster #F16**

Home Institution: University of Puerto Rico, Humacao campus

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

Faculty Mentor: Thomas Serre, Department of Cognitive and Psychological Sciences

Circadian Analysis of the Behavior of 5XFAD Mice Using Automated Continuous Behavioral Monitoring

Alzheimer's disease is a neurodegenerative disease affecting memory, movement, and cognition. Decreased activity is a pre-symptomatic marker associated with Alzheimer's. Thus, this experiment aims to study the distribution of behaviors of Alzheimer's in 5XFAD mice. We use mice because they have a short lifespan, allowing us to see the progressive effect of a transgenic form of Alzheimer's. We measured day and night behaviors through an automated continuous behavioral monitoring system (ACBM) developed at Brown. ACBM analyzes and categorizes nine behaviors: drink, eat, rest, hang, groom, sniff, rear, walk, and eat with hands at 24 frames per second for ten mice in each condition. We hypothesized that, as the disease progresses, mice's activity will decrease, and they will spend most of their time resting due to the neural atrophy caused by Alzheimer's. Our analysis provides an in-depth characterization of the mice's behavior with a particular focus on characterizing these animals' behavior during light and dark hours.

Mae Torra: **Poster #G1**

Home Institution: University of Central Florida

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

Faculty Mentor: Thomas Serre, Department of Cognitive and Psychological Sciences

Assessing Spinal Cord Stimulation: Analysis of EMG and Movement Correlations in Sheep

Epidural electrical stimulation (EES) is a growing area of focus for researchers aiming to restore motor function after spinal cord injury. However, identifying optimal EES parameters for generating given target movements is a significant challenge due to the complex nature of spinal cord physiology and the variability in responses to stimulation. In spinal cord injury studies applying EES, the two widely used methods of analyzing motor outcomes are through the collection of electromyography (EMG) or kinematics data. EMG data captures the fundamental dynamics of muscle activity, though it can be influenced by noise and may not accurately depict movement. Kinematics data illustrates the observable real-world effects of movement but does not provide insights into the underlying neural mechanisms. Through experimentation on sheep, we apply various EES parameters while simultaneously collecting EMG and kinematics data to assess the resultant muscle responses. We aim to analyze the impact of different EES parameters by comparing their observed effects in EMG and kinematics data. By doing this, we are also able to gauge any discrepancy between EMG and kinematics data. Overall, this approach will provide a deeper understanding of EES-induced motor control in spinal cord circuitry, with potential future implications in developing methods for restoring motor function after spinal cord injury.

Cassandra Travis: **Poster #G2**

Home Institution: Brown University

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

Faculty Mentor: Mark Johnson, Bio Med Molecular, Cellular Biology Biochemistry

Too much of a good thing: RALF1/4 induces pollen tube germination in tomato, limiting tube growth at high concentrations

Climate change has exposed plants to higher-than-typical temperatures globally, resulting in limited fruit production in vital components of our food supply, like tomato (Solanum lycopersicum). For a tomato plant to produce fruit, a complex process regulated by interactions between the pollen tube and the pistil must occur, in which pollen grains containing sperm cells must land on the stigma, form elongated structures known as pollen tubes, and successfully extend through the pistil to the ovules. Pollen germination and growth is an incredibly heat-sensitive process, so it is important to understand how this process is regulated so we may develop strategies to protect fruit development as global warming continues to threaten agricultural productivity across the planet. In Arabidopsis, Rapid Alkalinization Factors (RALFs) have been identified as key regulators of the pollen tube growth process. While the function of RALFs in tomato has not been extensively studied, this project seeks to determine if these signaling molecules play a role in regulating pollen tube growth. RNA-sequencing data has revealed pollen-expressed RALF homologs in tomato, with RALF1 and RALF4 showing high similarity. When synthetic RALF1/4 peptides are applied to tomato pistils prior to pollination, pollen tube growth is limited, suggesting these peptides regulate growth. Scanning electron microscopy has shown that RALF4 treatment causes multiple pollen tubes to grow from one pollen grain, suggesting RALF molecules induce pollen germination in tomato. These findings indicate that RALFs may regulate pollen grain germination in tomato at specific concentrations, but too high of a concentration can limit pollen tube growth. While our current research indicates that RALFs play a significant role in regulating pollen tube growth and germination, further studies are needed to fully understand their function under heat stress. By better understanding how RALFs function under high temperatures, it may be possible to ensure plants can maintain reproductive success under climate change-induced stresses.

Hope Trygstad: Poster #G3

Home Institution: Barnard College (Columbia University)

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

Faculty Mentor: Chen Sun, Computer Science

From Spongebob to the Simpsons: Multimodal Emotion Detection In Cartoon Characters

Human-computer interaction is an important consideration in the field of technology, and improving emotion detection can be one area to significantly enhance user experience. This experiment investigates the ability of various AI models to identify the emotions of animated cartoon characters, using multimodal prompts that combine facial expressions and dialogue. Utilizing a dataset curated from popular cartoons, including Spongebob, The Amazing World of Gumball, Courage the Cowardly Dog, The Simpsons, and Adventure Time, we annotated characters' faces and their corresponding dialogues to create a multimodal dataset with 105 data points. The study evaluates the performance of AI models such as GPT-4o, BLIP-2, and LLaVa-Next in accurately recognizing emotions expressed by these characters.. The models were tasked with identifying one or two emotions—happiness, anger, sadness, fear, surprise, disgust, or contempt—expressed by the characters. When provided with an additional variable that indicates whether the dialogue was said by the character in the image, GPT-4o achieved an accuracy rate of 87.61% in identifying the emotions. This research underscores the potential of multimodal AI approaches in enhancing machine understanding of emotional cues.

Sid Udata; Chris Chang; Ketan Pamurthy: Poster #G4

Home Institution: Brown University

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

Faculty Mentor: Shane Lee, Neurosurgery

Deep Brain Stimulation Optimization in Parkinson's Patients

Background:
Parkinson's Disease (PD) is a prevalent neurological disorder in the US, affecting 1 million Americans annually, and projected to increase to 1.2 million by 2030 [1]. PD is characterized by the degeneration of dopaminergic neurons in the substantia nigra pars compacta, leading to motor symptoms including tremor, rigidity, and bradykinesia [2]. For medication-refractory PD, Deep Brain Stimulation (DBS) can be an effective treatment. DBS involves implanting electrodes in areas such as the subthalamic nucleus (STN), globus pallidus interna (GPi), or ventral intermediate nucleus (VIM), depending on the specific symptoms and their severity. Stimulation shape, frequency, and intensity are tailored to each patient based on symptom presentation and response to medications, offering an alternative when drug therapy alone is insufficient.
In PD, increased beta (β) oscillations (13–30 Hz) in the basal ganglia and motor cortex are linked to motor symptoms and disease severity [3]. DBS is thought to improve motor function by disrupting β [4]. However, manually-tuned closed-loop DBS may not optimally target all symptoms of PD or provide meaningful improvement in developing adaptive DBS systems for personalized treatment. Thus, we aim to optimally select parameters that minimize the pathological oscillations selectively.
This project involves 1) optimizing a patient-specific stimulation pattern to reduce β and 2) implementing a closed-loop algorithm for brain activity monitoring and DBS administration.

Methodology: The experiment was monitored through two mediums: a behavioral task run through MATLAB and NIMH's MonkeyLogic as well as a Python script running unilateral DBS (StimDesign). Subjects engaged in a random pen-tracking behavioral task designed to elicit detectable levels of β, which the StimDesign program will attempt to reduce.

StimDesign Algorithms: The Stimulation Design algorithm optimizes frequency and pulse-width parameters to minimize β, through Initial Surface Mapping, Optimization, and Validation steps. In Initial Surface Mapping, 9 parameter sets are tested to broadly map stimulation effects on β. Optimization refines this map through quasi-random sampling and Bayesian optimization to find the lowest β. Finally, Validation confirms the reliability of our optimal parameters.

Closed-Loop DBS: Currently, open-loop DBS relies on manual optimization of a continuous stimulus by neurologists to alleviate motor symptoms. Closed-loop systems will use implanted electrodes to detect patient-specific neural tremor signatures and apply machine learning-driven stimulation in real time.

Torsten Ullrich: Poster #G5

Home Institution: Brown University

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

Faculty Mentor: Wael Asaad, Neurosurgery & Neuroscience; Shane Lee, Neurosurgery

Neural representation of timing in the ventral intermediate nucleus

Deep brain stimulation (DBS) of the ventral intermediate nucleus (VIM) is a surgical intervention for patients with medication-refractory essential tremor (ET). Because the VIM receives input from the cerebellum, which is implicated in timing behavior, VIM activity may encode timing processes. During DBS implantation, we recorded from VIM while the patient performed the behavioral task: reproducing visually cued time intervals ranging from 500 to 1500 ms. We utilized a semi-automated spike sorting pipeline to characterize the spiking activity of individual neurons in VIM, synchronized to the behavioral task, in intraoperative patients (n=12). We enrolled additional preoperative patients (n=67), postoperative patients (n=7), and controls (n=5) to evaluate whether ET patients have any baseline deficits in the behavioral task. ET patients demonstrated significantly more variable reproduction times compared to controls. This effect manifested primarily at the shortest intervals. As a result, the characteristic Weber effect, which describes increased variability with increased reproduction time, was eliminated in ET patients. Instead, error was largely consistent across intervals. Prior research indicates that reproduction times are biased towards the mean of the prior distribution of observed intervals. In addition to increased reproduction error, ET patients exhibited a significantly increased bias towards the mean of the prior at the shortest interval. Providing feedback after an early response significantly amplified this effect in the subsequent trial. These results suggest that ET patients are systematically more variable at time interval reproduction, which is best explained by a particular deficit in reproducing shorter intervals that may increase sensitivity to feedback. The cerebellum is implicated in both ET pathophysiology and subsecond timing. Therefore, the observed effect may be pathological and complicate the generalization of neural findings outside the ET population, especially for the shortest intervals. Current efforts are ongoing to characterize timing-related single neuron activity in VIM.

W. Ryan Waite: **Poster #G6**

Home Institution: Brown University

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

Faculty Mentor: Joo-Hyun Song, Department of Cognitive and Psychological Sciences

The role of working memory in learning novel motor skills

Working memory is important in all forms of learning, including learning of motor skills, whether in sports, physical therapy, or a new hobby. However, most research so far has only focused on the effect of working memory capacity on learning long sequences or adaptation of well-learned actions, and not on learning novel skills, which relies on working memory to correct errors. This is interesting because unlike discrete information (words, objects, numbers, etc.), which can be verbalized, motor parameters (speed, angle, posture, or timing) are not easily converted into verbal form and must rely on sensory information (the colloquial “feel” of 3-point throw, for example). In this project, we investigate whether working memory stores timing information in a motor learning task. Motor learning may require working memory resources to store timing information between repetitions of the action to correct errors and continually improve performance. If so, having to use those working memory resources for a different timing-based task is expected to inhibit motor learning. Over two days, participants learned a precision throw task, where they must throw a virtual ball over an obstacle to hit a small target. Between each throw, participants must perform an interference task, in which they must memorize and then respond to either task-relevant (timing) or task-irrelevant (pitch) information about a sound. Preliminary data showed that participants in the experimental group (with task-relevant interference) were less accurate in the virtual throwing task than participants in the control group, but were not more variable in their throw timing. Future work will include more data collection and analysis, and presenting some participants with beep time intervals of a length incongruent to any aspect of the virtual throwing task.

Madeleine Wang: **Poster #G7**

Home Institution: Swarthmore College

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

Faculty Mentor: Frederike Petzschner, Robert J. & Nancy D. Carney Institute for Brain Science; Caroline McLaughlin, Neuroscience

EEG Artifact Correction for Cardiac Interoception

Perception is the process by which we interpret and organize sensory information, such as vision and audition, from the environment (exteroception). However, there are also internal signals, such as heart rate and pain sensation, that the brain utilizes to form a coherent representation of its internal states (interoception). Therefore, the goal of the present study is to understand how the brain consolidates external and internal information into a single percept.

To explore the integration between exteroceptive and interoceptive information, we implemented a Heartbeat Feedback Task (HBFBK) where auditory-visual stimuli were periodically coupled and decoupled with the participant's heartbeat. We simultaneously measured their heartbeat (ECG) and electrical brain activity (EEG) to observe how brain activity changes in response to their heartbeat. This transient cortical activity, known as heartbeat-evoked potentials (HEPs), serve as markers of internal bodily awareness and signal processing. By comparing HEPs between conditions, we can find evidence of multisensory integration across interoceptive and exteroceptive channels.

Since the EEG signals are subject to environmental noise, electrical activity from eyeblinks and the heart must be cleaned before analysis. We have corrected EEG data (n = 27) for cardiac field artifacts (CFAs) and eyeblink artifacts. We then ran an ERP analysis that compared HEPs during phases of multisensory matching.

Currently, we are validating the preprocessing methods in different healthy datasets, verifying that HEPs are observed in similar neural areas. In the future, we will apply these steps to clinical populations to elucidate the interplay of internal signaling and neurological disorders with impaired perception.

Megan Wang: **Poster #G8**

Home Institution: Brown University

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

Faculty Mentor: Karla Kaun, Bio Med Neuroscience

Investigating the relationship between neuronal morphology and alcohol preference in Drosophila

Alcohol Use Disorder (AUD) is a condition that involves compulsive alcohol administration despite negative consequences. However, the relationship between individual behavior and neuron morphology in conjunction with ethanol preference is still unclear. Drosophila melanogaster is an effective model to study behavioral and morphological differences because we can systematically identify and study individual neurons and use sophisticated genetic tools to localize regions of interest in the fly brain. Additionally, it is possible to generate large sample sizes using Drosophila due to its short breeding cycle. We developed an operant assay (OPEraNt Behavioral Assay for Reinforcement Response; OPEN BARR) to examine how flies choose to engage with intoxicating doses of volatilized ethanol. Flies were allowed to

self-administer 75% volatilized ethanol for 15 minutes per day; one cohort (n=66) of flies did so for one day and another cohort (n=67) self-administered for three days. Flies were separated based on how much time they spent self-administering ethanol, with high preferring flies (HP) spending the most amount of time, and low preferring flies (LP) spending the least amount of time. HP flies display increases in time spent self-administering ethanol over days whereas LP flies reduce ethanol self-administration, and this is dependent on activity of the cholinergic α'3 mushroom body output neuron (MBON). We expressed myristoylated GFP in this neuron and measured its pre- and postsynaptic projections and arborization patterns in HP (n=15) and LP (n=15) flies. We hypothesized we would find morphological differences in the number of boutons and the number and length of branches of cholinergic α′3 MBON between HP and LP flies allowed to self-administer ethanol for 3 days. Overall, this work demonstrates that leveraging Drosophila genetic tools in an operant assay will elucidate the relationship between individuality in alcohol preference and morphology changes in neurons key for encoding alcohol preference. Ultimately, understanding how alcohol alters neuronal morphology could help us understand the transition from alcohol use to abuse.

Mary Claire Warren; Max Newman: **Poster #G9**

Home Institution: Brown University

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

Faculty Mentor: Andrea Simmons, Department of Cognitive and Psychological Sciences; James Simmons, Bio Med Neuroscience

Wild Acoustics

Across the animal kingdom, a myriad of species use sound as a means of communication, and in rare cases, navigation. By analyzing these vocalizations, we can better understand the lives and behaviors of these animals, and how they are affected by their environment and local habitat. The current study set out to record sounds of frogs and bats vocalizing in their natural environment. We employed a novel means of detecting and analyzing these sounds, using an acoustic camera that allows for real-time localization of sound sources. The acoustic recording method also provided a non-invasive means of performing species inventories. In Rhode Island, we identified 5 frog species, including the Green Frog (Lithobates clamitans), American Bullfrog (Lithobates catesbeianus), Spring Peeper (Pseudacris crucifer), Grey Tree Frog (Hyla versicolor), and American Toad (Anaxyrus americanus) and four bat species, including the Big Brown Bat (Eptesicus fuscus), Hoary Bat (Lasiurus cinereus), Silver-Haired Bat (Lasionycteris noctivagans), and Eastern Red Bat (Lasiurus borealis). Our acoustic analyses examined how the presence of conspecifics impacted vocal communication.

Kiayla Washington: **Poster #G10**

Home Institution: Dillard University

Summer Research Program: Leadership Alliance

Faculty Mentor: Patrycja Dubielecka, Bio Med Molecular, Microbiology & Immunology

Delineating the link between the Jak2V617F oncodriver and MKK4 signaling in myeloproliferative neoplasms

Janus kinase 2 (JAK2) is an enzyme that is key for homeostasis of the blood producing system. JAK2V617F is a JAK2 mutation that renders this kinase constitutively active, significantly changing the balance in blood cell production. Presence of JAK2V617F is linked to a person being prone to developing myeloproliferative neoplasms. This is caused by an overproduction of red and white blood cells or

platelets in the bone marrow. Dubielecka group recently identified through advanced proteomics that MAP2K4 (MKK4) kinase is a proximal interactor of JAK2V617F. In this project, it is to be determined how JAK2V617F and MKK4 are mechanistically in the context of myeloproliferative neoplasms. MKK4 is known as mitogen- activated protein kinase kinase 4 and it can activate other proteins in responses to stress on cells, including the effects of inflammatory cytokines. This summer, my data indicate that the JAK2V617F and MKK4 signaling has been linked to one another via a long link of signaling pathways. This research is important because JAK2V617F plays a key role in the origin of various blood cancers and its link to MKK4 signaling has not been reported to date. To get to the desired results, I have tested various proteins through the process of western blots/immunoblotting. This allows us to test the activity (phosphorylation state) of each protein for a link in the pathways between JAK2V617F and MKK4. With this research, we will be able to find a way to block certain proteins and pathways that are known to be involved in cancer, while not shutting down every other protein that happens to be connected.

Dontrel Wilright: **Poster #G11**

Home Institution: Dillard University

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

Faculty Mentor: Peng Zhang, Bio Med Medicine

"Delineation of Right Ventricular Cardiomyocyte Function in Experimental Pulmonary Hypertension Rat Model"

Background: Right ventricular (RV) dysfunction is the primary cause of morbidity and mortality in Pulmonary hypertension (PH). Cardiomyocytes are the main cells determining cardiac contractions. Although both RV systolic and diastolic functions are impaired in PH, the changes in RV cardiomyocytes in PH remain unclear.

Goal: To determine the contractility of RV cardiomyocytes in control and PH rats.

Methods: Sugen/Hypoxia-induced PH model in adult Sprague-Dawley rats together with the control rats were used. RV cardiomyocytes were isolated to determine the contractility using the IonOptix Myocyte Contractility System. Parameters including sarcomere length, peak shortening, departure and return velocity, departure and return velocity-time, and percentage of sarcomere length change were evaluated.

Results: We have successfully recorded data from 20 cardiomyocytes from two control rats and 15 cardiomyocytes from one PH rat. In control rats, the sarcomere length is 1.76±0.03um and the percentage of sarcomere length change is at 13.19±1.52%. While RV cardiomyocytes in PH show similar sarcomere length (1.79±0.03um) and percentage of sarcomere length change (12.84±1.53%), they show significantly increased departure velocity time (0.047s±0.004s vs. 0.037±0.004s) and significantly decreased return velocity time (0.299±0.005s vs. 0.353±0.029s) in comparison to cardiomyocytes in control rats.

Conclusion: Our preliminary data suggest impaired contraction and relaxation in RV cardiomyocytes in the PH rat model we used. Future experiments to increase sample numbers with more rats in both control and PH groups are required to validate our results.

(PHYSICS Project)

Ray Wu: **Poster #G12**

Home Institution: Brown University

Summer Research Program: Space Grant/NASA, SPRINT|Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Rick Fleeter, School of Engineering

3-Axis Helmholtz Cage for Spacecraft Attitude Determination

In the past decade, CubeSat satellites have rapidly become a cost-efficient and accessible method for universities to conduct scientific research in space. Due to their miniature size and low production costs, CubeSats take much less time to construct and launch than normal satellites. However, their small size causes many aspects of the satellite's performance, such as attitude determination and control, to become challenging to manage due to the limited number of sensors/systems onboard.

Consequently, with the addition of an Attitude Determination and Control Subsystem to PVDX, a necessity for a reliable validation method for PVDX's ADCS algorithms and magnetorquers has arisen. Having such a validation method will significantly reduce uncertainties and chance of failure surrounding the ADCS system.

The Helmholtz Cage has been a widely used ADCS testing system in past CubeSat missions such as those from the Air Force Institute of Technology and Carthage College. Helmholtz Cages are made up of three pairs of square Helmholtz Coils, with each pair of coils being capable of generating a uniform magnetic field across a limited area. Assembly of the cage is completed in such a way that the three pairs of Helmholtz Coils can generate uniform magnetic fields in the X, Y, and Z directions, creating a magnetic field similar to that experienced by satellites in Low Earth Orbit (LEO).

Adam Xu: **Poster #G13**

Home Institution: Brown University

Summer Research Program: Biology Undergraduate Education Independent Study

Faculty Mentor: Alexander Jaworski, Bio Med Neuroscience

An inducible system for overexpressing TAG-1 in developing motor and sensory neurons

During nervous system development, spinal motor neurons (MNs) project their axons to various targets in the body periphery. The molecular mechanisms that guide MN axons to their appropriate targets remain incompletely understood. Previously, we have shown that the cell adhesion molecule TAG-1 prevents MNs from misrouting their axons into the dorsal root ganglia (DRG). TAG-1 is expressed both in the sensory neurons of the DRG and in MNs, and global deletion of TAG-1 causes MNs to misproject their axons into the DRG. However, deletion of TAG-1 only in MNs results in fewer misprojections, suggesting that TAG-1 derived from other sources helps guide motor axons past the DRG. One potential source is the DRG itself, and we hypothesize that DRG-derived and MN-derived TAG-1 synergize to guide MNs past the DRGs and to their appropriate targets. In order to test this, we sought to independently manipulate TAG-1 expression in the MNs and DRGs. Here, we use mouse genetics and quantitative immunohistochemistry of embryo tissue sections to evaluate methods for manipulating cell-type specific TAG-1 levels. While we have established methodology to delete TAG-1 specifically in MNs, we demonstrate that several Cre transgenic lines fail to efficiently delete TAG-1 in the DRG. As a solution, we present a doxycycline-controlled Tet-On gene expression system for modulating TAG-1 levels in the MNs and the DRG. Utilizing an optimized version of this system in global TAG-1 knockouts will enable further exploration of cell type-specific TAG-1 functions in motor neuron axon guidance.

Kristine Yang: **Poster #G14**

Home Institution: Brown University

Summer Research Program: Summer Research Assistantship in Biomedical Sciences

Faculty Mentor: Nicola Neretti, Bio Med Molecular, Cellular Biology Biochemistry

3D Imaging and High Throughput Analysis of Human Chromosome Territory Organization

The 3D organization of chromatin has emerged as a key driver in nuclear processes and has transformed the study of gene regulation by shifting the focus from individual genes to the collective regulation of thousands of genes. From the DNA double helix, chromatin is organized into progressively higher levels of organization, including chromatin domains and topologically associated domains, and culminating in the encompassing structures known as chromosome territories. Challenges in understanding the spatial positioning of chromosome territories in their native context arise from the complexities of imaging and analyzing whole-genome territories in a high-throughput manner. Our project uses multiplexed imaging on hundreds of human fibroblasts to visualize the nucleus and its chromosome territories on a high-resolution single-cell basis. The microscopy images are then fed into an end-to-end computational pipeline that performs deconvolution, segmentation, and feature extraction. Using this data, we aim to characterize the 3D spatial relationship of chromosome territories both with respect to each other and to landmark nuclear structures, including the nuclear boundary. Further, we aim to understand the functional relationship between 3D chromatin architecture and gene activity by characterizing the shape and conformation of chromosomes and investigating their correlation to gene expression.

Isabella Yoo: **Poster #G15**

Home Institution: Brown University

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

Faculty Mentor: Judy Liu, Bio Med Molecular, Cellular Biology Biochemistry

Loss of function of SLC13A5 results in high extracellular citrate

SLC13A5 Epilepsy is a rare genetic neurological disorder characterized by severe seizures within the first weeks of life. This disorder is caused by a bi-allelic loss of function mutation in the SLC13A5 gene, which encodes a sodium citrate co-transporter. It is currently unclear how a loss of function in the SLC13A5 protein leads to seizures or neurological symptoms. When SLC13A5 is dysfunctional, citrate accumulates in the extracellular space. Currently, the effect of excess extracellular citrate due to SLC13A5 dysfunction is unknown. Our lab has developed animal models in order to study SLC13A5 dysfunction. My work, during the time supported by this summer UTRA experience, will be to assist in the characterization of these animal models. Specifically, I will use molecular biology techniques to study how expression levels of various citrate transporters change when SLC13A5 is no longer expressed, both locally (in a single tissue type) and globally (in a full-body knockout). I will be extracting RNA from tissues taken from mice with local and global SLC13A5 knockout. Subsequently, I will quantify expression levels of SLC13A5, SLC13A3, SLC13A2, and SLC25A1 (various citrate transporters) using RT-PCR. Our results will reveal potential endogenous compensatory mechanisms that could be exploited for future therapeutic development.

Lucy Yu; Dennis Tai; Marina Zakhary Gad El-Sayed: **Poster #G16**

Home Institutions: Brown University; Brown University; UC RIVERSIDE

Summer Research Program:

Faculty Mentor: Amrita Dosanjh, Department of Pediatrics, Rady Children's Hospital San Diego; Daniel Novak, UCR School of Medicine

Pediatric Pulmonary NTM: An Exploratory TriNetX Cohort Study

Non-tuberculous mycobacteria (NTM) are rare environmental pathogens that cause pulmonary infections in children, particularly those with underlying lung conditions or immunosuppression like bronchiectasis or organ transplant recipients.These infections can present with symptoms similar to tuberculosis, including chronic cough, weight loss, and fatigue. Diagnosis involves clinical assessment, radiographic imaging, and microbiological confirmation, while treatment often requires prolonged and multidrug antibiotic regimens. Minimal research has been done to determine the long term effects of NTM in pediatric populations, especially in stratified age groups. In this study we aim to use the TriNetX research software to shed light on the epidemiology of pediatric NTM infections and investigate patient parameters such as immune profiles among 4 different age groups. TriNetX will help us study NTM among the pediatric population by providing access to a large, de-identified database of patient records, allowing us to analyze the prevalence, demographics, and clinical outcomes of NTM infections. This platform facilitates robust epidemiological research and can help identify trends and risk factors associated with these infections in children. Our inclusion criteria for the TriNetX query consisted of all of the pulmonary NTM species that do not result in cutaneous infection and our exclusion criteria consisted of cutaneous NTM, cystic fibrosis, tuberculosis and smoking patients. Our analysis included 109 NTM cases from 1,870,329 patients aged 0-2 (mean = 2, st. dev. = 0), 401 cases from 3,170,212 patients aged 3-5 (mean = 4, st. dev. = 1), 1,074 cases from 9,582,713 patients aged 6-12 (mean = 9, st. dev. = 2), and 760 cases from 8,946,560 patients aged 13-18 (mean = 15, st. dev. = 2). The five most common comorbidities are: malignancies, acute pharyngitis, asthma, unspecified pneumonia, and immunodeficiencies. Notable demographics among age groups include: an average of 53.31% females and 46.29% among males. For race and ethnicity among all age groups, the weighted averages were: White: 58.16%, Unknown: 21.47%, Black/African American: 8.19%, American Indian: 1.27%, Asian: 3.28%, Other Race: 8.53%, and Native Hawaiian: 1.28%. Additionally, an average of 14.86% identified as Hispanic/Latino. Although not many patients obtained a bacterial culture, the following three NTM species were the most common among those who did obtain culture: Mycobacterium kansasii, Mycobacterium gordonae, and Mycobacterium avium complex (MAC). This study highlights the need for further research about NTM as it pertains to future pulmonary diagnoses and comorbidities.

Yingshen Zhang: **Poster #H1**

Home Institution: Brown University

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

Faculty Mentor: Federica Accornero, Bio Med Molecular, Cellular Biology Biochemistry

AIMP3 impacts reactive oxygen species regulation in cardiomyoblasts

Previous research in the lab identified Aminoacyl tRNA Synthetase Complex-Interacting Multifunctional Protein 3 (AIMP3) as an important factor for cardiac homeostasis in mice. An inducible gene knockout system was used to generate cardiomyocyte-specific AIMP3 knockout mice. The loss of AIMP3 resulted in reduced cardiac function and poor survival of the mice. To explore the molecular mechanism behind the observed cardiac defects in the AIMP3 knockout mice, this project focused on generating AIMP3-null cell lines in rat myoblast cells. AIMP3 knockout cells were successfully generated using the CRISPR-Cas9

system. We found that the loss of AIMP3 generated excessive reactive oxygen species (ROS), detrimental to cell function and characteristic to a failing heart. AIMP3 was also reintroduced into AIMP3 KO cells, and the reintroduction of AIMP3 reduced the level of cellular ROS confirming that the observed cellular ROS increase is indeed AIMP3 dependent. The ability of AIMP3 to regulate ROS production and consequently oxidative stress could be one of the contributing factors to the observed cardiac dysfunction.

Andrew Zhang: **Poster #H2**

Home Institution: Washington University in St. Louis

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

Faculty Mentor: Michael Frank, Department of Cognitive and Psychological Sciences; Alexander Fengler, Department of Cognitive and Psychological Sciences

Likelihood Approximation for Conflict-Based Decision-Making Tasks

Conflict-based decision-making tasks such as the Eriksen flanker task, where individuals identify a target's direction amidst distractors, have been widely interpreted through sequential sampling models (SSMs) to understand how attention modulates decision-making. Despite strong theoretical support, parameter inference on experimental data is rarely applied for such models due to the lack of an analytical solution to tractable likelihood functions. Here we test if likelihood computations are tractable for conflict-based decision-making models using likelihood approximation methods. This study applies a novel feed-forward neural network trained on thousands of simulated samples of SSMs, bypassing any need for costly likelihood-free estimation methods. Using this approach, we demonstrate that likelihood approximation networks (LANs) can approximate the likelihood function of the shrinking spotlight model with efficient Bayesian parameter estimation and inference for conflict-based tasks.

Ruiyang Zhu: **Poster #H3**

Home Institution: Brown University

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

Faculty Mentor: Roberts Thomas, Ecology, Evolution, and Organismal Biology

Soleus Muscle Swelling in Cold Temperatures

When muscle cells are stretched passively, they exert a force on the object stretching it, much like how a rubber band exerts an elastic force when stretched. This force, known as passive muscle tension, can be changed with differing extracellular environments. Under hypotonic solutions, which are characterized by lower solute concentrations relative to the intracellular environment, osmotic pressure drives water into muscle cells, resulting in cellular swelling. As a result of this swelling, hypotonic solutions increase the passive force exerted by the muscle. In addition to changes in solute concentration, previous research has shown that under colder temperatures, muscle volume regulation shuts down by disruption of ion channels, potentially affecting the amount of swelling a muscle undergoes. This study evaluated the mechanism behind muscle swelling when placed under cold temperatures (10 °C) in both isotonic and hypotonic solutions and in an isotonic solution under physiological temperatures (37 ℃). Hypotonic conditions had 50% less solute compared to isotonic conditions and the muscle under investigation was the soleus muscle in mice. In order to see changes in passive force, the soleus was stretched passively in 8 increments of 0.25 mm to a total of 2 mm past its original length. Preliminary results show that while

soleus muscles do swell in colder temperatures in hypotonic conditions, the difference between cold temperature swelling and physiological temperature swelling is negligible. A surprising finding was that under isotonic conditions, passive force was higher at the cold temperature compared with physiological temperature. The reason for a temperature-related change in passive force could be that under colder temperature, the muscle becomes more similar to a muscle that has undergone rigor mortis, resulting in the muscle becoming more rigid and exerting more passive force when stretched. However, further research is needed to determine the causes of this occurrence.

Salena Zhu: **Poster #H4**

Home Institution: Brown University

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

Faculty Mentor: Qian Chen, Bio Med Orthopedics

Investigating The Sex Dimorphism In Osteoarthritis Using A Transgenic Mouse Model

Osteoarthritis (OA) is an age-related degenerative joint disease involving the degradation of articular cartilage and bone structural remodeling in the knee joint. Millions of Americans suffer from OA with a higher risk in women compared to men. Women are more prone to erosive OA and pain, with a female to male ratio of 12:1. However, the fundamental causes behind this sex-related dimorphism are unknown. To understand the mechanisms, Chen lab generated a Col2a1-Cre miR-365-flox transgenic mouse model to mimic aging-related OA. This model induces the overexpression of miR-365, which is a mechano- and stress-responsive microRNA, and leads to early onset of OA. Based on previous work from the Chen lab, this transgenic miR-365 mouse developed OA as early as 6-month of age. Results showed that the female transgenic miR-365 mice had early-onset of joint degeneration at 7-month of age, but not the male transgenic miR-365 mice. Senescence-associated secretory phenotypes (SASPs) including cytokines and chemokines were also increased in female transgenic mice but repressed in male transgenic mice. In contrast, male transgenic miR-365 mice activated extra- and matrix-cellular gene expressions including proteoglycan and collagens. Such opposite responses to the stress-microRNA induction between the female and male mice lead us to investigate the OA mechanisms in greater depths between female and male during different stages of OA development. We compared the gene expressions between female and male during young adult (3-4 months) and mature adult (6-7 months). Due to the potential of miR-365 transiently expressing during development in other tissues, we collected organs including eyes and brains to examine the changes caused by stress-microRNA activation. By comparing the gene expression changes between female and male in multiple tissues, we hope to understand the underlying mechanisms behind the sex dimorphism of aging-related diseases. This not only provides important understanding for early targeted prevention, but also help with developing gender specific precision medicine to achieve better efficacy in treating female and male OA patients.

Nikhil Sonthalia: **Poster #H5**

Home Institution: Brown University

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

Faculty Mentor: Federica Accornero, Bio Med Molecular, Cellular Biology Biochemistry

The Role of the m6A Methyltransferase METTL3 in the Heart

Heart failure is a leading cause of death worldwide. While its development depends on numerous environmental factors, abnormal changes in myocardial gene expression play a crucial role in cardiac dysfunction. However, the importance of mRNA modifications has only recently been introduced.

N6-Methyladenosine (m6A) methylation is the most abundant internal mRNA modification. We have previously shown that cardiomyocyte-specific loss of m6A RNA methylase methyltransferase-like 3 (METTL3) can affect heart function. In this study, we utilized a new cardiac-specific METTL3 loss-of-function mouse model (cKO). Within 3 months of birth (~100 days), all of the cKO mice were dead. At one month of age, a decrease in cardiac function in the cKO mice was seen. These changes were accompanied by increased heart weight, a structural sign of pathologic heart remodeling. A similar trend was observed at 7 days of birth indicating that these cKO mice exhibit cardiomyopathy signs as early as 1 week after birth. While additional studies will be conducted to investigate the mechanistic pathways involved, our study currently cements a central role for METTL3, and thus m6A, in postnatal cardiac development and function.

Peter Ko: **Poster #H6**

Home Institution: Brown University

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

Faculty Mentor: Brett Owens, Bio Med Orthopedics; Li Yue, Bio Med Orthopedics

Mechanisms of the Effect of Relaxin-2 and Its Receptor Antagonists In Vivo

Female athletes have a disproportionately higher risk of developing anterior cruciate ligament (ACL) ruptures in the knee which require surgical reconstruction. High levels of relaxin-2 is associated with increased risk for ACL injuries, particularly in females. We found relaxin-2 and its receptor antagonists through virtual screening of FDA-approved drug library. Our in vitro study shows that relaxin-2 and its receptor antagonists have a significant effect on both male and female patient ACL cells. Additionally, relaxin-2 and its receptor antagonists yielded similar effects in the MMP intracellular pathway within the patient ACL cells. Relaxin-2 antagonist (folic acid) and relaxin-2 receptor antagonist (NADH) are reported to affect some unique signals that lead to activation of intracellular signaling pathways. Folic acid can regulate cSrc/ERK 2/NF-κB/p53 pathway, and cSrc/p190RhoGAP signaling pathway in endothelial cells. NADH is an essential redox cofactor in numerous metabolic reactions and involves in various signaling pathways, which include the sirtuin (SIRT) proteins SIRT1 and SIRT3, the poly (ADP-ribose) polymerase (PARP) proteins PARP1 and PARP2, and COOH-terminal binding protein. However, the mechanisms of the effect of relaxin-2 and its receptor antagonists in vivo remains unclear. In this study, we use rats to analyze the signaling pathways involved in the effect of relaxin-2 and its receptor antagonists in vivo systems. Forty-eight female Sprague-Dawley rats (10-12 weeks old, weighing 250-300g) will be randomly divided into 4 groups (12 rats/group): Group 1: Control group (oral gavage treatment with volume matched saline) for 30 days; Groups 2, 3 and 4 will receive relaxin-2 oral gavage treatment for 10 days. At Day 11- Day 31, rats will receive one of the following treatments: Group 2-Saline group; Group 3-Relaxin-2 antagonist (folic acid) group; Group 4-Relaxin-2 receptor antagonist (NADH) group. Saline, Folic Acid or NADH will be orogastrically gavaged 5 days per week ×4 weeks. After which, the rats will be euthanized for post-mortem analysis including gene expression analysis, western blot, ELISA and immunohistochemical staining. According to existing publications, relaxin-2 and its receptor antagonist could play a more important role in females, therefore, we will carry out a pilot study on female rats at first. If we find the signal pathways regulated by relaxin-2 and its receptor antagonist in female rats, we will continue to do the same study on male rats.

Lizbeth Martinez Contreras; Ansley Ryan: **Poster #H7**

Home Institution: Brown University

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

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

Development of Brain Multisensory Pathways in an Autism Model

Xenopus laevis tadpoles have been used to understand the biological basis for various neurodevelopmental disorders, including Autism Spectrum Disorder (ASD). A prevalent characteristic of neurodevelopmental disorders is the deficits in sensory processing, particularly the ability to integrate multisensory information, such as auditory and visual inputs. This project aims to investigate the development of visual and mechanosensory inputs into the tadpole midbrain using an established autism model developed in our lab. The study involves injecting fluorescent tracer dyes into different sensory pathways of fixed tadpoles and imaging their terminations in the optic tectum using a confocal microscope. The primary objective is to assess the degree of input segregation that occurs during normal development and compare it to our autism model. Our hypothesis is that, in the autism model, inputs from different sensory modalities will exhibit abnormal segregation, leading to deficits in multisensory integration. These deficits will then be evaluated through behavioral assays to understand their functional implications. This research seeks to contribute to our understanding of sensory processing deficits in ASD.

Julian Ramprashad: Poster #H8

Home Institution: Brown University

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

Faculty Mentor: Lalit Beura, Bio Med Molecular, Microbiology & Immunology

Establishment and application of three-dimensional organoids: modeling the epithelial niches along the female reproductive tract

My project seeks to understand how the epithelial lining of the female reproductive tract (FRT) influences immune cell function. Memory T cells that are retained in the FRT mucosal barrier after infection are a primary deterrent to pathogens trying to enter the body through this tissue. However, the factors dictating the establishment and function of these tissue-resident T cells are still largely unknown. We have previously established a murine vaginal epithelial organoid (mVEO) model to explore the role of vaginal epithelial cells in supporting resident T cell differentiation. However, the FRT has multiple distinct epithelial niches. The endometrial and endocervical epithelia constitute type I mucosa, made up of a single layer of columnar cells, while the ectocervical and vaginal epithelia are type II mucosa, containing multiple layers of stratified epithelial cells. To compare the effect these diverse epithelia on T cell differentiation in mice and humans, I established murine endometrial epithelial organoids (mEEOs) as well as human ectocervical (hEctOs) and endocervical (hEndOs) organoids. Furthermore, I modified TGF-B signaling in mEEOs to model the luminal and glandular niches of the endometrial epithelium. I validated the identity of these organoids using immunohistochemistry. Moving forward I aim to further characterize these organoids and their effects on T cell phenotypes.

In parallel, I expanded upon the applications of our established mVEO model. Preformed mVEOs with apical-in polarity were susceptible to HSV1, HSV2, or LCMV infection from surrounding media, and the effect of effector CD8 T cells on infected organoids was observed. I also examined the effect of infection, IFN-gamma treatment, and antigenic peptide treatment on CD8 T cell trafficking towards co-cultured mVEOs. Refining these models will let us examine epithelial-T cell interactions in vitro during infections.

Alex Tomkinson; Michael Medeiros: **Poster #H9**

Home Institution: Brown University

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

Faculty Mentor: Alison DeLong, Bio Med Molecular, Cellular Biology Biochemistry

Let There B Light: Using Fluorescent Protein Fusions to Analyze Activities of Regulatory Subunit B17 in Protein Phosphatase 2A Complexes.

Protein phosphatase 2A (PP2A) is a large protein phosphatase family that is widely conserved across all eukaryotic species. The functions of PP2A complexes have garnered widespread attention in recent years due to their involvement in cell cycle regulation. These protein phosphatase complexes are composed of three subunits, of which the B subunit is responsible for conferring substrate specificity and subcellular localization. The DeLong lab has previously found that the B72 family of B subunit genes plays a critical role in limiting leaf expansion in *Arabidopsis thaliana*, specifically the nearly identical and co-expressed B16 and B17 proteins. Previous researchers in the DeLong lab generated several mutant lines in which these B subunit genes are knocked out; surprisingly, the resulting mutants exhibited larger, flatter leaves than the wild type, meriting further investigation into the mechanism that drives this increased leaf size. We are generating a series of modular plasmids to discern the subcellular localization pattern of the B17 protein using GFP fusions, and to elucidate the tissue-specific B17 expression pattern by fusing the native promoter to fluorescent reporter proteins. Additionally, we are analyzing the functions of two distinct domains in the B17 protein—the variable and unstructured N-terminus and the highly conserved C-terminus— by introducing these constructs into both the wild type line as well as the b16b17 mutant line and assaying for phenotypic complementation. Through this analysis, we will be able to determine the localization patterns and functional domains of B17, which will expand our understanding of the PP2A B72 regulatory subunit family in eukaryotes.

Alexander Zeng: **Poster #H10**

Home Institution: Brown University

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

Faculty Mentor: Judy Liu, Bio Med Molecular, Cellular Biology Biochemistry

Kinetics of Citrate Transport via SLC13A5 in HEK cells

SLC13A5 Epilepsy is a rare genetic neurological disorder characterized by severe seizures within the first weeks of life. This order is caused by a bi-allelic loss of function mutation in the SLC13A5 gene, which encodes a sodium citrate co-transporter. It is currently unclear how a loss of function in the SLC13A5 protein leads to seizures or neurological symptoms. When SLC13A5 is dysfunctional, citrate accumulates in the extracellular space. Currently, the effect of excess extracellular citrate due to SLC13A5 dysfunction, as well as the compensatory mechanisms, are unknown. Our lab has generated HEK cells expressing the SLC13A5 protein for characterization of electrophysiological properties. Specifically, we seek to characterize the kinetics of citrate import via SLC13A5 in HEK cells and compare to kinetics of SLC13A5 with patient-specific mutations. Doing so will allow characterization of transport kinetics while cross-validating against protein expression levels. Our results will aid in our current understanding of the mechanisms behind SLC13A5 dysfunction in epileptogenesis and establish an assay to better understand citrate import kinetics in SLC13A5 Epilepsy.

(Physical Science project)

Mia Kamisato; Angelina Clark: **Poster #H11**

Home Institution: Brown University

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

Faculty Mentor: Vikas Srivastava, School of Engineering, Biomedical Engineering, Mechanical Engineering

Self-Healing Flexible Sensors for Health Monitoring

Human health monitoring is a chief field in biomedical engineering that aids medical professionals in tracking a patient's vitals and other numbers of significance. Wearable health devices allow patients to monitor their health in the comfort of their own homes. At the same time, physicians can continue to track these numbers via a computer system that connects to the monitors. However, these devices are often made of firm materials that are unfixable when damaged. When it comes to orthopedic and sports health monitoring, sensor devices meant to measure impact speed should be durable and able to withstand damage. The present study explores the mechanical properties and health monitoring applications of a soft polymer strain sensor composed of Polydimethylsiloxane (PDMS) and Polyborosiloxane (PBS) with a carbon nanotube (CNT) filler that is both flexible and self-healing. A fundamental aspect of this double network (DN) is its rate dependency, meaning that the magnitude of a sample's response depends on the compressive or tensile strain rate. A mathematical model to calculate strain and strain rate from a change in electrical resistance can be constructed to measure the impact force exerted on the polymer DN. This study aims to quantify strain and strain rate as a function of electrical resistance by observing the change in resistance across varying tensile strain rates (1s-1, 0.1s-1, 0.01s-1, and 0.001s-1).

Morton, Adrianna: **Poster #H12**

Home Institution: Spelman College

Summer Research Program: Brown University Leadership Alliance Summer Research - Early Identification Program

Faculty Mentor: Sheryl Kopel, Psychiatry and Human Behavior and Pediatrics; Daphne, Koinis-Mitchell, Psychiatry and Human Behavior and Pediatrics

Research Participant Recruitment and Retention in an Experimental Study of the Impact of Sleep Duration on Immune Balance and Asthma in Urban Children

Research participant recruitment and retention, the procedures used to identify, enroll, and maintain participants in research studies, are fundamental to successfully implementing human participants research. Culturally and developmentally tailored recruitment and retention strategies and efforts to minimize attrition are critical to ensuring representativeness in research samples to ultimately address scientific questions that benefit the targeted participants of focus. The importance of these practices is underscored by the heightened risk of attrition for populations of color and those historically minoritized in previous asthma-related literature (Burchard et al., 2015; Coutinho et al., 2013). Urban stressors and medical conditions may also present additional challenges to research participation. For example, more severe asthma and higher levels of airway sensitivity can serve as barriers to study attrition (Zebracki et al., 2003; Bender, 1997). The current research focuses on participant recruitment, retention, and attrition in Project AIMS (Impact of Sleep Duration on Immune Balance in Urban Children with Asthma; Daphne Koinis Mitchell, PhD and Gailen Marshall, MD Principal Investigators), an experimental study of the effects of sleep shortening and recovery on immune balance and asthma in urban children. Findings will identify barriers and facilitators to study retention and inform potential support strategies to offer

participating families in the future. Acknowledgments: This research is supported by the Leadership Alliance Program, and the Project AIMS study is supported by grant R01 HL156277-01A1 from the National Institutes of Health (NIH).

SUMMER RESEARCH SYMPOSIUM POSTERS
Friday, August 2nd
Physical Sciences and Social Sciences

Physical Science

Mia Adler; Ford McDill; Will Paz; Tiffanie Ng; Iris Horng; Sam Thomas: **Poster #A1**

Home Institutions: Pomona College; Wesleyan University; Miami University; Kenyon College; University of Pennsylvania; Brown University

Summer Research Program: Institute for Computational and Experimental Research in Mathematics (ICERM)

Faculty Mentor: Amanda Harsy, Lewis University, Department of Engineering, Computing, and Mathematical Sciences; Adam Schultze, Lewis University, Department of Engineering, Computing, and Mathematical Sciences

Money Bull: Analyzing the Application of Ranking Methods to Rodeo.

Drawing millions of fans each year and surpassing even golf and tennis in sporting event attendance in the United States, the rodeo stands as one of North America's most unique and iconic sports. Despite having vast numbers of participants and spectators, there has been little mathematical work published on the rodeo ranking system, strategy, or other common topics covered in sports analytics. In this research, we examine the bareback riding ranking system of the largest rodeo organization in America, the Professional Rodeo Cowboys Association (PRCA). Due to a wide range of rodeo prize pools with no observable pattern for how they are set, the PRCA's use of total earnings as the primary measure of ranking may not accurately represent rider skill. We explore alternative methods of comparing bareback riders by extending classical linear algebraic ranking methods — specifically Colley, Massey, Keener, and PageRank — to rank PRCA bareback riders based on performance data. We assess the effectiveness and predictive power of these standard methods. Ultimately, we find that these linear algebra models serve as a more holistic ranking system, each of which favors aspects such as average earnings, average total score, and average rider score.

Anand Advani: **Poster #A2**

Home Institution: Brown University

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

Faculty Mentor: Leigh Hochberg, School of Engineering

Comparison of Decoding Methods for an Intracortical Brain-Computer Interface

Intracortical brain-computer interfaces (iBCIs) have been successful at decoding motor intention in individuals with sever neuromuscular impairments, enabling such tasks as typing, word recognition, and control of a computer cursor. However, although many different models have been proposed for decoding the high-dimensional neural data, collected from hundreds of electrodes on millisecond timescales, many of these models are forgotten or are not properly compared against other models. This project implements a variety of decoding algorithms for computer cursor control and compares the performance of each on real neural data gathered from an intracortical BCI. Due to the interdisciplinary nature of BCI research, these models have been developed using methods from electrical engineering, applied mathematics, machine learning, and neuroscience, and thus differ in their frameworks. Specifically, this project will examine models of neural state dynamics in a Kalman filter framework, the ultimate output of each model being cursor position at each timestep. The data are from a center-out task performed by an individual with an iBCI. Selecting the best decoding methods allows the field of iBCI research to continuously improve performance in the face of such variables as fluctuations of brain state over time, multiple neurological impairments, and neurodegeneration, and can also translate into quality-of-life improvements for users of iBCIs.

Muhiim Ali; Ariana Azarbal: **Poster #A3**
Home Institution: Brown University

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

Faculty Mentor: Shekhar Pradhan, Data Science Institute; Ritambhara Singh, Computer Science

Semantically Richer Embeddings

The basic thrust of the project is to incorporate world and linguistic knowledge as well as representational knowledge (what linguistic units represent about the world) in the very process of creating embeddings using deep learning methods.
In the first phase of our project, we are focused on instilling a more sophisticated understanding of relations in image embeddings. Many vision-language models, which are able to connect images with texts, rely heavily on detecting objects, rather than understanding the composition of objects into a whole scene or the relation between objects. One such model is CLIP, which was produced by OpenAI and aligns images and text representations in a shared low-dimensional embedding space. We are finetuning CLIP on a novel dataset which we call ‘weakly contrastive’ in order to force the model to learn the visual and textual relations. In other words, we hypothesize that the model will not be able to succeed at the training task we present without encoding the relationships present between entities in an image/caption.

We utilized large language models (LLMs) like ChatGPT to reformat our captions into the structure "a R b," where "a" and "b" are noun phrases, and "R" is either a relational term (e.g., 'holding' in 'man holding flowers') or a positional term (e.g., 'next to'). To create weakly contrastive data, we generated a weakly contrastive set for each anchor caption in the form "a R b" by including expressions of the form "a S b," where "S" is different from "R." For example, if our dataset contains an image-caption pair P1 with the caption "cat sitting on a chair," and we also have image-caption pairs P2 and P3 with the captions "cat sitting under a chair" and "cat sitting behind a chair," respectively, then these two captions would be part of the weakly contrastive set for "cat sitting on a chair."

Jamiley Avila: **Poster #A4**

Home Institution: Brown University

Summer Research Program: Presidential Scholars Program (PSP)

Faculty Mentor: Anita Shukla, School of Engineering

Effect of Lipid Nanoparticle Composition on Metabolic Reprogramming of Macrophages

Immune cells play an important role in regulating host immune responses to foreign pathogens. During an infection, bacterial biofilms can hijack immune cells to upregulate the secretion of anti-inflammatory cytokines. As a result, bacterial infections and subsequent formation of biofilms can cause chronic infections by evading the immune system and gaining greater resistance to antibiotic treatment. This decrease in efficacy of common antibiotics has prompted the need to develop novel therapies such as immunomodulatory biomaterials to treat infections. Macrophages are one of the key immune cells involved in pathogen clearance and their functionality is regulated by cellular metabolic pathways. We hypothesize that polarization of macrophages from an anti-inflammatory state (M2) to a pro-inflammatory state (M1) will achieve bacterial clearance. Lipid nanoparticles (LNPs) are an effective nucleic acid delivery system that can facilitate efficient drug delivery to modulate macrophage phenotype. This project aims to develop an LNP library by altering the molar ratio of each structural component. The developed metabolite-based LNP formulations provide insight into how phenotype determination is modulated by activation of cellular metabolism. We chose cholesteryl hemisuccinate, N-palmitoyl-L-aspartate, 18β-glycyrrhetinic acid, palmitic acid, and 4-octyl itaconate as the metabolites to further assess due to their structural and chemical properties. Initial formulations were created through a small-batch protocol to test successful formation of nanoparticles. These small-batch formulations were made by altering the ionizable lipid, helper lipid, and then molar ratios of each LNP component. LNPs that showed a polydispersity index (PDI) less than 0.2 were then produced through a large-batch protocol. These metabolite-based nanoparticles were characterized for hydrodynamic diameter, PDI, and ζ-potential via dynamic light scattering (DLS). All LNP formulations exhibited a hydrodynamic diameter of ~100 nm with a PDI of less than 0.2, and a neutral ζ-potential. The formulations of interest were then tested for cell viability by conducting a cytotoxicity assay (CCK-8). Increasing the molar ratio of metabolites induced greater stimulation of bone marrow derived macrophages (BMDMs) to express M1 or M2 phenotypes determined by M1/M2 Mϕ ratios. Metabolic quantification assays were used to characterize the BMDM phenotype focusing on nitric oxide production, arginase activity, and glycolysis activity. Further metabolic characterization and analysis of all metabolite-based LNP formulations is needed to assess which formulations lead to effective macrophage modulation from M2 to M1 phenotype, including extracellular flux assays and single-cell energetic metabolism by profiling translation inhibition.

Mina Bahadori: **Poster #A5**

Home Institution: Brown University

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

Faculty Mentor: Minki Kim, School of Engineering; Daniel Watkins, School of Engineering

Revealing Arctic Sea Ice Dynamics Under Cyclones Using Numerical Simulations

The Arctic is entering a new era characterized by thinner ice, decreased ice extent, and changing weather. Even during extreme events, such as Arctic cyclones, these dynamics exhibit significant variations. Such variations will induce notable changes in sea ice dynamics, including sea ice motion,

transport, and distribution, resulting in new trends in sea ice melting. This study investigates the effects of Arctic cyclones on sea ice motion through simulations and observations. We first employed ERA5 data to examine Arctic cyclone structure and dynamics, comparing them to the Rankine vortex model. The retrieved idealized cyclone velocity fields were then used to estimate the upper ocean velocity fields beneath the sea ice. Numerical simulations of sea ice with the wind cyclone and upper ocean fields were conducted using the Subzero discrete-element sea ice model to examine sea ice trajectories under cyclones. The size of the ice floe and the turning angle between the ice and wind field affect the trajectory. The model simulates the motion of pieces of sea ice in response to the wind and ocean currents. This study provides insights into how cyclones influence sea ice motion and ocean dynamics and their potential contribution to sea ice melting.

Charlotte Bain: **Poster #A6**

Home Institution: Brown University

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

Faculty Mentor: Ming Xian, Chemistry

Exploring Novel Detection Methods for Hydropersulfides

Reactive sulfur species (RSS) are sulfur-containing molecules which play a crucial role in biological signaling and physiological processes. Certain RSS, especially hydrogen persulfide (H2S2) and hydropersulfides (RSSH), are important redox regulators with diverse physiological functions including the vasodilation of smooth muscles, and antioxidant and anti-inflammatory effects. It is thus necessary to develop probes for the detection of these species in biological systems. TEMPO-9-Ac is a fluorescent probe that has been previously used to detect hydroxyl radicals, ascorbate, and reactive nitrogen species including nitric oxide and nitroxyl (HNO). In this work, we determined the potential of TEMPO-9-Ac to detect H2S2 and RSSH. The sensitivity of the probe towards H2S2 and RSSH was evaluated, the limit of detection was determined, and selectivity and inhibition studies were performed to determine the applicability of the probe in more biologically relevant conditions. This work will guide us to develop more specific probes for RSS in the future.

Brandt Bechtel: **Poster #A7**

Home Institution: University of Houston

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

Faculty Mentor: Greg Hirth, Earth, Environmental, and Planetary Science; Monica Barbery, Earth, Environmental, and Planetary Science

Investigating The Mechanical Behavior Of Fault Gouge Through Shearing Experiments At Shallow Conditions

Understanding the role of friction in earthquakes requires constraints on the strength evolution with slip of the rocks present. In the Bartlett Springs Fault Zone (BSFZ), serpentinite, a soft rock, is abundant, but the role of natural microstructures and fabrics on the frictional behavior and earthquake mechanics is not well understood. Here, the frictional properties of BSFZ gouge are explored in tandem with lab-generated fabrics using rotary shear deformation experiments. Two types of experiments were used: stress step experiments (using a constant velocity of 100 μm/s and 2 MPa steps in normal stress from 2 to 10 MPa)

and velocity step experiments (where sliding is initiated at 1 μm/s then increased to 100 μm/s). Friction typically increased, or strengthened, following steps in stress or velocity. However, the magnitude of strengthening diminished in normal stress step experiments and frictional strength became nominally independent of normal stress. We performed a composite, high-slip experiment on BSFZ gouge using 70 velocity steps and without disturbing the developing fabric between successive steps. Initially, the BSFZ gouge exhibited velocity weakening behavior, but with increased displacement it transitioned to velocity strengthening behavior. The quasi-static friction coefficient decreased with increasing displacement, peaking in the first experiment. After ~40 mm of slip, consistent mechanical behavior for up to 1 m of slip is observed, suggesting rapid fabric development and the reactivation of lab-generated fabric and slip surfaces in later steps. These results suggest that, in nature, earthquake slip and deformation may take advantage of preexisting natural fabrics and microstructures.

Ailani Bonilla: **Poster #A8**

Home Institution: University of Southern California

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

Faculty Mentor: Emily H.G. Cooperdock, Earth, Environmental, and Planetary Science

Unveiling Hosts for Nitrogen Transportation and Storage in Meta-Serpentinites

Nitrogen (N) is the most abundant element in the atmosphere and is ubiquitous in Earth's surface environments from oceans to soils to the bases that make up DNA. Subduction of oceanic crust and serpentinized lithosphere delivers N into the mantle, which is volumetrically the largest N reservoir on Earth. However, the mechanisms of N delivery and the amount present in lithospheric reservoirs are uncertain. Previous studies reveal that N concentrations and δ15N of oceanic serpentinites overlap with those of subducted low- to high-grade meta-serpentinites, suggesting significant N retention during prograde metamorphism. This retained N may then be transported into the mantle. While these data support bulk-rock serpentinites as a N host, the mineral residency of N in these rocks is unknown and has implications for how deeply it is recycled during subduction. Serpentine minerals are a likely host due to their phyllosilicate structure, where N can be adsorbed onto the mineral structure. In this study, we explore whether common phyllosilicates in serpentinites (i.e., serpentine, talc, and chlorite) are the primary hosts of N. Nine bulk rock samples and 18 mineral separates from ultramafic mélange matrix units in Syros, Greece, and New Caledonia were characterized by petrography and X-ray diffraction (XRD). Mineral separates are variably intergrown with differing proportions of serpentine (antigorite and lizardite), talc, chlorite and, in one sample, carbonate. Bulk-rock N concentrations range from 25 to 102 ppm and δ15Nair ranges from -0.2 to +6.9‰. Phyllosilicate mineral separates have N concentrations from 8 ppm to 176 ppm and δ15N from -1.2 to + 7.0‰. On an individual sample basis, the mineral separates show varying N and δ15N enrichment or depletion relative to the bulk-rock. These data indicate that, for the majority of our samples, N must be hosted in minerals or sites within the bulk rock other than the sheet silicates that are present. These results suggest that the stability and sites for N of minerals other than phyllosilicates may be important to consider for deep N cycling at subduction zones.

Benjamin Bradley; Sofia Tazi: **Poster #A9**

Home Institution: Brown University

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

Faculty Mentor: Richard Gaitskell, Physics

Physics-Informed Proximal Policy Optimizer for Space Game navigation

We modified a framework for testing a competitive algorithm capable of piloting a ship in the gravitational field of a black hole for the purpose of a Machine Learning Challenge for students at a Brown's Winter School for the Fundamental Physics of the Universe / Student Machine Learning Initiative. As a part of this process we built up a environment to simulate the physical effect of thrusts from a spacecraft and how that would realistically effect the path of orbit around a black hole, cutting off the game when the spacecraft either hit the blackhole or flung too far outside of the game space. The thrust of our research was to search through and iterate on potential Reinforcement Learning systems to approach this problem and settled on a PPO with a reward function oriented around navigating towards a optimal angular momentum, radius, and minimizes thrust used along the way. We show that this algorithm, despite the inherent complexity / nonlinearity of the game space's dynamics was able to learn a policy capable of surviving indefinitely in orbit.

Alexandra Coia: **Poster #A11**

Home Institution: Brown University

Summer Research Program: Undergraduate Research in the Robinson Group (Chemistry)

Faculty Mentor: Jerome Robinson, Chemistry

Progress towards accessing novel lanthanide reactive oxygen species (ROS)

Lanthanide-based reactive oxygen species (ROS) have been proposed as reactive intermediates involved in critical industrial and biomedical applications, including the 3-way catalytic convertor, oxidative hydrocarbon coupling, fine-chemical synthesis, and delivery agents for managing cellular stress. Despite the implied importance of these species, little is known with respect to the structure, properties, and reactivity of well-defined lanthanide ROS. In this poster, I will present my recent progress in identifying systems which can support the isolation of novel lanthanide ROS. Design strategies will be shared alongside preliminary synthesis and reactivity studies, as well as perspectives on avenues to isolate these elusive species.

Eleanor Buchanan: **Poster #A12**

Home Institution: Brown University

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

Faculty Mentor: Jim Head, Earth, Environmental, and Planetary Sciences

The Moon In 3D: Using Modeling Software To Better Understand The Age And Formation of The Ina Crater Irregular Mare Patch

Irregular Mare Patches (IMPs) are small, irregularly shaped dark areas on the lunar surface, typically found within larger lunar mare regions. IMPs are intriguing because they offer a window into specific geological processes on the Moon, shedding light on its volcanic history, and elucidating the thermal evolution of the entire solar system. Ina Irregular Mare Patch, a 3 kilometer by 2 kilometer summit pit crater discovered by Apollo 15, is a site whose age and formation continues to be a subject of debate. DIMPLE (Dating an Irregular Mare Patch with a Lunar Explorer) is a multi-pronged research effort with the

goal of determining the true nature of Ina.

The superposed impact crater size-frequency distributions (CSFDs) at Ina suggest an age of approximately 33 Ma, which aligns with evidence of sharp contacts between different units on Ina's floor. This finding implies ongoing mare volcanism which continues presently. However, models for the terminal stages of volcano summit pit crater activity propose a much older origin, dating back to around 3.5 Ga. These models suggest that the CSFD age and sharp contacts observed on Ina's surface are due to an extremely porous lava lake floor and the extrusion and solidification of magmatic foams. These conflicting theories continue to be reviewed by the Brown DIMPLE team in the context of Shape from Shading (SfS) imagery developed by PI Dr. Jim Head and lab member Dr. Benjamin Boatwright.

However, Ina is difficult to understand visually through top-down satellite imagery and flat elevation maps. Blender, a 3D modeling software, can be used to turn these maps into fully customizable 3D terrain models of the lunar surface. This DIMPLE project uses elevation maps produced by Dr. Jim Head and Dr. Ben Boatwright to more understandably portray Ina's topography with Blender. The software allows viewing at various different angles of the crater, can be used to map out potential traverse routes, and allows an accurate simulation of the movement of shadows as the Moon rotates away from the Sun. This kind of visualization of Ina allows for far better display of its terrain, and is increasingly important as NASA discusses plans to take samples at this crater in future Artemis missions, and solve the mystery of its age and formation.

Thor Burkhardt: **Poster #A13**

Home Institution: Brown University

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

Faculty Mentor: Matthias Kuehne, Physics

Nanofluidic Charge Transport for Osmotic Blue Energy Harvesting

It is estimated that 2TW of potential electrical power can be harvested by mixing fresh water and sea water; and as more communities rely on desalination for clean water, the demand for efficient harvesting of osmotic energy grows. Individual nanotubes have demonstrated many order increases in efficiency compared to traditional membrane approaches, but suffer from a lack of scalability. This work takes advantage of the highly tunable nature of van der Waals heterostructures to probe nanofluidic charge transport in scalable many-channel devices through experiment and experimentally informed refinement of existing theoretical models. In particular, we selectively stack nanometer-scale flakes of bulk material to construct nanofluidic devices with rectangular channel arrays (~60 per device). Devices are characterized using AFM and (for few layer devices) Raman spectroscopy, with channel heights on the order of nanometers. We measure devices' electrical properties in flow cells under varying concentrations, number of pores, and channel geometries. We are particularly interested in a (somewhat novel) experimental comparison between materials with high surface charge mobility (graphene) and those with near-zero charge mobility (hBN); the former have been shown theoretically to display exotic charge transport even in the absence of dissolved ions (Coquinot et al, 2024). We continue to work towards channel geometries on the scale of a few Angstrom.

Lázaro Cabán: **Poster #A14**

Home Institution: University of Puerto Rico, Río Piedras

Summer Research Program: The Leadership Alliance, PROBE

Faculty Mentor: Kemp Plumb, Physics

Searching for 'Fractons' in a Disordered Antiferromagnet Near Percolation

When magnetic ions are removed from a magnetic material the resulting vacan- cies can give rise to distinct regions of magnetic alignment. These regions, or magnetic domains, can have fractal dimension. We look for excitations, called ‘fractons’, in such domains in an antiferromagnetic lattice of MnF2. The lattice was simulated with 0-spin sites between regular atoms to reduce the interactions between neighboring sites. The proportion of vacancies to magnetized sites was carefully changed in order to bring the system near the percolation threshold, where a fractal pattern of magnetic domains predominates over a homogenized or granular phase. Inelastic neutron scattering was simulated on the lattice to show the underlying excitations of the system. The objective is to find inten- sity spikes in the high end of the energy spectrum of spin waves in the system which would hint at the presence of fracton excitations in the crystal. These may provide greater insight into the properties of novel magnetic materials and guide future experimental investigations.

Keywords: Fracton, fractal, spin wave, percolation, neutron scattering

Alice Cannon: **Poster #A15**

Home Institution: Brown University

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

Faculty Mentor: Kenny Breuer, School of Engineering

Wind turbine performance under turbulence using fractal based turbulence grids.

Wind turbines constantly face turbulent conditions caused by atmospheric changes such as weather patterns, pressure differences, and wakes from adjacent turbines. As global reliance on wind energy increases, the need to study the performance of wind turbines in these turbulent conditions becomes increasingly important. In order to produce these conditions in a laboratory setting, a grid can be placed in a wind tunnel, which creates blockage that generates turbulence. The goal of this turbulence grid is to generate Homogeneous Isotropic Turbulence (HIT). Traditional grids are usually a rectangular pattern, but recent research has suggested that a fractal design may generate HIT quicker, as it generates turbulence on different length scales. Therefore, a fractal design was chosen for this project with the goal of reaching HIT within the span of the 2m wind tunnel test section. A previous iteration of the fractal grid did not meet all the design requirements, as Particle Image Velocimetry results showed a large jet in the center, with HIT theoretically occurring at a distance of 8m. This exceeds the test section’s length of 2m, requiring a redesign. The new design will achieve HIT at a distance of 1.75m, span a greater area of the test section, and will be manufactured from stainless steel, a significantly stronger material that can withstand higher wind speeds. To test the base performance of the wind turbine, a scaled down turbine was set up in the wind tunnel, and the coefficient of power and the tip speed ratio were measured across 12 different resistive loads and 4 different wind speeds. This initial test conducted without a turbulence grid will serve as a baseline to compare turbine performance once the fractal grid is manufactured.

An Cao: **Poster #A16**

Home Institution: Brown University

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

Faculty Mentor: Eric Larson, Mathematics

Normal Bundles of Rational Curves in Grassmannians

Projective spaces parameterize 1-dimensional subspaces of a vector space, and more generally, Grassmannians parameterize k-dimensional subspaces of a vector space. Sacchiero's Theorem states that the normal bundle of a general nondegenerate rational curve in projective space is balanced. This statement does not always hold for Grassmannians. In certain cases, the structure of the restricted tangent bundle as a tensor product prevents the normal bundle from being balanced. In other cases, the fact that the rational curve is contained in a smaller Grassmannian prevents the normal bundle from being balanced. In this project, we are trying to prove that these are the only counterexamples, starting with low dimensions.

Diego Delgado: **Poster #B1**

Home Institution: Brown University

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

Faculty Mentor: Nils Tack, School of Engineering

Building a new generation of bioinspired underwater vehicles employing metachronal propulsion

Many of the most abundant and active marine invertebrates display metachronal swimming by sequentially beating closely spaced flexible appendages. This swimming mode is so ubiquitous because coordinating the movements of several appendages enable high energy efficiency and hydrodynamic performance compared with single-propulsor systems. For instance, small organisms like shrimp employ metachronal swimming to navigate complex habitats and migrate vertically twice a day across hundreds of meters in only a few hours. The realization, that nature's designs can inspire innovative solutions for pioneering more efficient underwater robots has recently ignited the field of bioinspired engineering. While traditional thruster-based underwater vehicles generally have high performance, they suffer from comparably low agility and power efficiency. This project seeks to develop the first metachronal bioinspired autonomous underwater vehicle (BAUV) to address these shortcomings. Building from our previous shrimp-inspired metachronal test platform, we used an iterative process employing fast prototyping (i.e., 3D printing) to simplify and miniaturize the design, and increase its reliability, modularity and versatility. The new hardware-free design employs robust ligament-based (active) and compliant (passive) hinges to offer three degrees of freedom per appendage (pleopod). We also improved the design of the flexible pleopods to enhance asymmetrical bending during a beat and improve performance. Kinematics testing of individual pleopods showed this new design can operate at least 55,800 continuous beat cycles without any wear, compared to only ≈2000 with previous versions. The compliant hinges also act as the muscle-tendon system in shrimp pleopods, such that the motion of the passive joints accurately match natural observations. Achieving natural motions was critical to maintaining the highest performance during swimming. These notable advances form the basis of the subsequent integration phase of a self-contained, free-swimming prototype fitted with on-board power and microcontrollers for autonomous motion control, sensing, and navigation. In parallel to leading the development of a novel bioinspired underwater vehicle, this project will serve as a key test platform to explore force production and fluid-structure interactions to answer biological questions such as how metachronal swimmers perform complex turning maneuvers.

Natalie DeVito: **Poster #B2**

Home Institution: Brown University

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

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

Investigating Late Quaternary paleoclimate of the eastern Amazon with a brGDGT temperature reconstruction

Anthropogenic warming, the result of continual increase in atmospheric carbon dioxide through combustion of fossil fuels, may exceed 4º Celsius above pre-industrial levels by 2100 regardless of what actions we take now to curtail our fossil fuel emissions. We are already seeing the consequences of rapid warming for both human and ecological communities, but it is difficult to predict the profound ecological implications of a further three degrees of warming, especially for specific ecosystems of great concern such as the Amazon rainforest of South America. Besides being a stronghold of nearly 10% of the planet's biodiversity, the Amazon also sequesters enough carbon to prevent atmospheric CO2 levels from rising by 10%, an increase which would be disastrous for human life. Ecological changes occurring in the Amazon today as a result of human activities are directly and measurably impacting the Amazon rainforest's ability to sequester carbon. A possible ecosystem transition from rainforest to grassland, induced by climate change, threatens to flip regions of Amazonia from sinks to sources of atmospheric carbon.
To this end, we are working to develop our understanding of Amazonian ecosystem responses to warming temperatures by investigating past periods of rapid and pronounced warming in the Amazon. I analyzed biomarkers preserved in lake sediment from the Amazon basin and constructed a record of mean annual temperature in eastern Amazonia over the past 72,000 years, working with a sediment core from Lake Maicuru, eastern Brazil to understand regional temperature change over global glacial-interglacial cycles. To do so, I used a class of organic compounds called branched Glycerol Dialkyl Glycerol Tetraethers (brGDGTs) as a proxy for temperature. BrGDGTs are compounds found in the membranes of bacteria. These organisms adjust the structure of the lipids found in their membrane in order to maintain a consistent membrane viscosity throughout changes in external conditions such as temperature. I use the first meter of the Maicuru core to construct a temperature record which encompasses the Holocene, the period of warming after the most recent ice age, and perhaps the preceding glaciation as well. Our temperature record from the Maicuru core is one of the first records of terrestrial temperature from the Amazon Basin. Together with biomarker reconstructions of vegetation and plant community succession, this temperature record will help us answer how the Amazonian ecosystem responded to past fluctuations in climate.

Siming Feng; Jonathan Zhou: **Poster #B3**
Home Institution: Brown University

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

Faculty Mentor: Ugur Cetintemel, Computer Science; Duo Lu, Computer Science

Fast Similarity Search over Vector Streams for AI Workloads

Vectors have quickly become the de facto standard in modern search-oriented applications due to their ability to represent complex data in a structured and effective manner. We are developing VectraFlow, a stream processing system to support scalable and low-latency monitoring over vector streams, targeting a large suite of applications such as continuous prompts, copyright infringement detection, and anomaly detection. While vector processing has garnered much recent attention, we highlight the unique challenges of streaming settings with continuous processing.

We focus our initial design on supporting filtering and top-k searches over vector streams and introduce a new clustered vector indexing structure to support these two key operations at scale. We also explore automated optimizations that use alternative data representations such as quantization and show that significant performance gains can be obtained while retaining high quality responses.

Eads Fouché: **Poster #B4**

Home Institution: Brown University

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

Faculty Mentor: Samuel Birch, Earth, Environmental, and Planetary Science

A Final Global Database of Surface Changes on Comet 67P/Churyumov–Gerasimenko

Comets are some of the oldest objects in our solar system and preserve elements from early in its life span. By understanding the chemical composition of comets, we can significantly improve our understanding of the formation and early evolution of our solar system. The Rosetta mission to Comet 67P/Churyumov–Gerasimenko provided a unique opportunity to study surface changes on these small, low-gravity bodies by becoming the first spacecraft to track a comet on its explosive journey through the inner solar system. Rosetta documented hundreds of changes across the surface of 67P including erosion and deposition of smooth terrain, cliff collapses, and outbursts happening on yearly to monthly time scales (Barrington et al. 2023). That said, the temporal and spatial distribution of these changes is poorly understood. Here, we provide a new, complete database of all changes occurring across the entirety of 67P's surface. We document multiple new areas of erosion and deposition of smooth terrains, analyze how these areas evolve monthly and yearly, and find these regions are more active than previously recorded. We observe multiple new cliff collapses, providing further constraints on the dynamics of outburst events. This database highlights the complexity of surface evolution on the comet and how localized analysis is necessary to understand the comet's long-term dynamics. This database is saved on a cell by cell basis using an existing global 3D shape model (Preusker et al., 2017), permitting easy access to the broader community. These data can be used for a host of follow up studies that address major outstanding post-Rosetta questions including: constraining 67P's non-gravitational accelerations, dust to ice ratio, mass loss rates and dynamics, and for sample site selection for upcoming sample return missions such as CAESAR.

Tommy Frank: **Poster #B5**

Home Institution: Brown University

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

Faculty Mentor: Mara Freilich, Earth, Environmental, and Planetary Sciences and Applied Mathematics

Climate Modeling Course Lab Development

We aim to develop three lab assignments for an upcoming Brown course in climate modeling, open to all students and with both a quantitative and qualitative track. These labs, each of which lasts three weeks, grow in complexity. The first lab works with energy balance models that ignore variation across latitude and longitude. The second lab introduces gridded data through the three-dimensional climate state estimate ECCO. The third lab introduces statistical analysis through ensemble models. Students will gain familiarity with climate modeling software, produce data plots, evaluate hypotheses through the models, and write about their implications for climate research.

Each lab must be developed to accommodate students in the quantitative and qualitative tracks. While quantitative students will interact more directly with the software and connect model output with the mathematics of atmosphere and ocean dynamics, qualitative students will focus on interpreting the model output and considering its implications. The labs also aim to include collaboration between these two groups, so that qualitative students can interpret the findings of quantitative students, and quantitative students can be guided in their exploration by qualitative students.

Sofia Gilroy: **Poster #B6**

Home Institution: Brown University

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

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

North Pacific oceanography and circulation during the warm Miocene

The Early Miocene, about 23 million to 16 million years ago, may be a suitable analog for future anthropogenic climate change as global temperatures and CO2 levels were higher than the present day. Determining what conditions existed in the deep ocean of the North Pacific during the Early Miocene furthers our understanding of this potential climate analog. Here, we present a record of stable isotopes of benthic foraminifera from ODP Site 884 in the subpolar Northwest Pacific from 16.8 to 18.2 Ma. Benthic foraminiferal carbon and oxygen isotope data are used to reconstruct changes in ocean circulation and a combination of bottom water temperature and global ice sheet extent, respectively. The percentage of calcium carbonate present in samples is utilized to determine the availability of benthic foraminiferal data and bottom water carbonate chemistry. The current conditions of deep North Pacific waters are corrosive to calcium carbonate. In our record, we observe oscillations from 0% $CaCO_3$ to over 50%. These oscillations in the percentage of $CaCO_3$ and the benthic foraminiferal isotope record indicate large variations in the deep ocean circulation of the North Pacific.

Josh Ginzburg: **Poster #B7**

Home Institution: Brown University

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

Faculty Mentor: Matthias Kuehne, Physics

Progress Towards Measuring Thermal Properties of Ultralong Carbon Nanotubes Filled With Water

This project aims to set up a means to measure the thermal properties, such as heat capacity and thermal conductivity, of individual ultralong carbon nanotubes (CNTs) filled with water by using an electrothermal method. CNTs are a model system of nanopores with single digit nanometer diameters. When filled with water or other fluids, these systems have a wide range of potential applications including desalination, nano-filtration, and energy harvesting. In addition, it has been proposed that exotic ice phases may emerge in nanotubes. However, thermal properties of these systems have not yet been reliably measured, something which this project aims to achieve.

To grow ultralong CNTs, a chemical vapor deposition process was used. A catalyst consisting of iron(III) chloride was applied to either a silicon dioxide or silicon nitride substrate. The substrate was then heated in a tube furnace while a mixture of nitrogen, hydrogen, and methane flowed over the sample. This led to the nucleation of CNTs around the catalyst. The products were then analyzed using scanning electron microscopy to visualize the nanotubes.

The electrothermal method used to determine thermal properties was the 3-omega method, by which AC joule heating of a resistor at frequency omega induces a third harmonic voltage that is sensitive to thermal properties of the sample. We first considered an established geometry in which a strip heater is fabricated on top of a SiO2-terminated silicon substrate. The strip acts as both a heater and a thermometer. The third harmonic of the voltage response can be used to determine the thermal conductivity and heat capacity of the sample.

In order to produce a driving current and retrieve the resulting 3-omega voltage response, a lock-in amplifier was used. The sample was loaded into a cryostat to control sample temperature and maintain a vacuum environment, and the lock-in amplifier was used to measure the 3-omega voltage at a variety of current frequencies and temperatures. As of now, only the silica thin film on silicon bulk substrate sample has been tested for thermal conductivity. Future work involves refining the ultralong CNT growth process, applying the 3-omega method procedure to CNTs, and then applying the 3-omega method to CNTs that have been filled with water.

Caitlin Gong; Clara Fee: **Poster #B8**

Home Institutions: Vassar College; Bryn Mawr College

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

Faculty Mentor: Daniel Ritchie, Computer Science

Spatially Localized Visual Concept Learning for Few-Shot Generative Modeling

Current visual concept learning systems often fail to achieve effective concept decomposition. They lack the ability to learn highly granular concepts or concepts found in common between multiple images, and can only generate new images as opposed to editing existing ones. Our project proposes a new method of spatially localized visual concept learning. Building on previous work in language-informed visual concept learning, we integrate a spatially informed loss step to improve learning when training concept encoders within text-to-image (T2I) models.

Our method of learning relies on decomposing the image into pairs of masks and semantic anchors. We leverage multimodal language models to develop a semantic segmentation pipeline, which is then used to construct a training dataset of {mask, anchor} pairs where each pair is associated with a concept. Currently, the concepts are predetermined, but we hope future work will allow an LLM to determine concepts by identifying parts in common from sample images, before training the encoders to learn each visual concept. Preliminary results of our segmentation pipeline show promising improvements in concept decomposition accuracy and granularity over previous models. We hope to use these results to achieve fine-grained and spatially localized visual concept learning, which has several promising applications including few-shot generative modeling with fine-grained concepts.

Zhanxian Gong: **Poster #B9**

Home Institution: Brown University

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

Faculty Mentor: Emily Sprague-Klein, Chemistry

Surface enhanced Raman spectroscopy of metalated and unmetalated tetraphenyl porphyrin on copper nanowire system

Certain materials are capable of coherent oscillation of surface conduction electrons (plasmons) when excited by electromagnetic radiation, a phenomenon known as surface plasmon resonance (SPR). When these materials are smaller in size compared to the incident wavelength, plasmons oscillate locally around the nanoparticle, known as localized surface plasmon resonance (LSPR). LSPR enhances the local electromagnetic field around nanoparticles, which in turn amplifies electronic transitions in molecules adsorbed near the particle surfaces, leading to intense Raman scattering. This principle underlies the electromagnetic enhancement in Surface Enhanced Raman Spectroscopy (SERS), a powerful technique for chemical and biological sensing that is widely used in biomedical detections. In this research, we selected tetraphenyl porphyrin (TPP) and copper TPP as molecules of interest due to their potential as photocatalysts and possible applications in cancer therapy. To further understand their structure and optical properties, we designed hotspots around high-dimensional copper nanowires, which are cheaper and more accessible for inducing LSPR compare to other metal substrates. When TPP and copper TPP are adsorbed on the nanowire system, UV-vis spectra and TEM images are used to study the absorbance and general structure of these copper nanowires. SERS spectra of the system are then taken at different laser wavelengths and concentrations of adsorbates to study the enhancement factor (EF) of this nanowire system. Additionally, photochemistry reactions are designed to explore possible reactions of these molecules under plasmonic enhancement.

Margaret Gonzalez: **Poster #B10**

Home Institution: Loyola University Chicago

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

Faculty Mentor: Mara Freilich, Earth, Environmental, and Planetary Sciences and Applied Mathematics

Ocean robots reveal the role of Antarctic Winter Water in the carbon cycle

While global oceans as a whole play a large role in the carbon cycle, the Southern Ocean in particular stands out for its disproportionate role in the uptake of atmospheric carbon. Numerous studies have revealed the importance of the eddy subduction pump (ESP), localized subduction caused by small-scale circulation events, to this process. However, the link between localized eddy subduction and large-scale circulation remains unconstrained. In particular, Antarctic Winter Water, masses of cold water trapped between the relatively warm mixed and Circumpolar Deep layers, is found across the Southern Ocean and contributes to global overturning circulation. Here we use data collected from Biogeochemical-Argo floats deployed across the Southern Ocean to identify and characterize ESP features and Winter Water, as well as the relationship between the two. We find a correlation between both the physical and geographical characteristics of Winter Water and ESP anomalies. Roughly ⅔ of ESP anomalies are identified as Winter Water. We see a cluster of ESP anomalies bounded by the Polar Front which is the northern extent of Winter Water. This indicates formation of subsurface Winter Water is a critical part of the ESP process. Our findings reveal the importance of Winter Water to the global carbon cycle, allowing for improved accuracy in climate modeling.

Alex Greve: **Poster #B11**

Home Institution: Belmont University

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

Faculty Mentor: Srinath Sridhar, Computer Science

Exploring 3D Gaussian Splatting with Multi-Camera Systems for 3D Scene Reconstruction

Methods for 3D scene reconstruction have gained immense popularity in recent years, with the emergence of Neural Radiance Fields(NeRFs) for novel view synthesis. However, existing NeRF methods prove to be slow and computationally expensive, inhibiting the possibility of real time 3D scene reconstruction. A newer, alternative method for reconstruction uses 3D Gaussian Splatting for scene reconstruction. This method is a rasterization technique that draws multiple ellipsoid-like structures, or 3D Gaussians, on the screen to accurately represent a scene from minimal input images. 3D Gaussians are described by their position in space, covariance, color, and opacity. This method proves to be less computationally expensive while maintaining much faster rendering times than previous reconstruction methods. Here, we present a method for a live demonstration of 3D scene reconstruction using 3D Gaussian Splatting. The data for this live demonstration is captured using the Brown Interactive Capture System(BRICS) Studio data. BRICS Studio is a multi view capture system created at Brown University, utilizing 90 different camera angles for accurate scene reconstruction. Future implications for 3DGS on BRICS Studio include the analysis of human-environment interactions, robotics, fast rendering for VR applications, and more

Abnelis Guzmán Román: **Poster #B12**

Home Institution: University of Puerto Rico, Río Piedras campus

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

Faculty Mentor: Ian Dell'Antonio, Physics

Finding the faintest features in galaxy collisions.

Tidal features are key indicators of the dynamic interactions between galaxy clusters and evolutionary processes. Investigating these features enhances our understanding of galaxy formation and evolution. This study aimed to identify tidal features in colliding galaxies to provide direct evidence of these interactions. We utilized deep archival images of galaxy clusters from the Subaru, Canada-France-Hawaii, Kitt Peak, and Blanco 4m telescopes. We successfully detected and analyzed these features using the Gaussian kernel filter on carefully selected images. The Gaussian kernel filter was chosen for its effectiveness in enhancing faint structures, allowing us to identify various tidal features that might otherwise be overlooked. These tidal features reveal the history and ongoing processes of galaxy interactions and mergers within clusters. The findings are significant because they provide a clear picture of the complex dynamics within galaxy clusters. This research highlights the value of imaging techniques able to uncover the processes that shape galaxy clusters and their behavior, and sets the stage for future studies to explore their interactions.

Jade Hardwick: **Poster #B13**

Home Institution: Brown University

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

Faculty Mentor: Yongsong Huang, Earth, Environmental, and Planetary Sciences

Tracking Paleofires in the Seward Peninsula Through the Detection and Quantification of Levoglucosan: Recent Progress and Perspectives

The Arctic is experiencing accelerated warming compared to the current global average, with forecasts suggesting heightened wildfire frequency and intensity. To accurately predict future fire trends and understand their feedback mechanisms, robust knowledge of paleofire activity is essential. However, sedimentary hiatuses have limited the availability of long-term records in this region. This study focuses on levoglucosan, a biomarker produced during cellulose thermal decomposition in biomass. Levoglucosan serves as a proxy for historical biomass burning events, offering insights into paleofire activity and long-term vegetation changes. This research examined a sediment core from Alaska's Seward Peninsula, producing a continuous fire record dating back to Marine Isotope Stage 7, a first for the region. Before analysis, sediment samples underwent derivatization to enhance volatility and suitability for study, modifying levoglucosan's structure to optimize detection. Utilizing GC-MS technology, which combines gas chromatography for compound separation and mass spectrometry for structural analysis, this aim is to detect and quantify levoglucosan. Despite the study's findings of minimal levoglucosan content, which suggests limited data trends, further research is needed to establish more robust patterns and draw definitive conclusions.

Richard Cheng: **Poster #B14**

Home Institution: Brown University

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

Faculty Mentor: Leigh Hochberg, School of Engineering

Toward neural control of a wearable soft robotic arm using an intracortical brain-computer interface

In the Unites States, more than 5 million people suffer from forms of paralysis, with stroke accounting for 33.7% of cases, followed by spinal cord injury (27.3%), multiple sclerosis (18.6%), and cerebral palsy (8.3%). An additional 30,000 people are also affected by amyotrophic lateral sclerosis (ALS), which eventually leads to tetraplegia. We seek to use intracortical brain-computer interfaces (iBCIs) to restore mobility and agency to individuals living with tetraplegia and other forms of paralysis, enabling them to independently perform daily activities. Previous work shows that patients can control external robotic limbs with iBCIs to perform reach and grasp movements, though this approach comes with challenges: high cost, confinement to clinical settings, and failure to restore control over one's own limbs. Therefore, here we present the integration of an iBCI system with a wearable soft robotic arm (SRA). The SRA, designed and fabricated by Harvard's Biodesign Lab, is a clothing-like device that enables motor restoration through inflatable actuators on the shoulder, elbow, and hand. Its wearability leverages residual proprioceptive feedback pathways, a feature that most iBCI systems currently don't have. As an UTRA student in the BrainGate lab, I characterized IMU sensor performance, quantified SRA range of motion using motion capture, and developed virtual environments that enable isolation of neural decoding and full control of virtual arm dynamics. These efforts are important stepping stones toward full integration between BrainGate's iBCI system and the SRA.

Dalia Heikal: **Poster #B15**

Home Institution: Brown University

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

Faculty Mentor: Kareen Coulombe, School of Engineering; Mark Daley, School of Engineering

Investigating the Dynamic Response of Human IPSC Cardiac Microtissues to Doxorubicin-Induced Cardiotoxicity

Chemotherapy plays a vital role in cancer treatment, yet its effectiveness is frequently compromised by its cardiotoxic effects, especially with anthracyclines like doxorubicin. Despite its efficacy against cancer, doxorubicin can lead to cardiomyopathy and heart failure, effects that often manifest only after significant cardiac damage has occurred, increasing the risk of permanent heart dysfunction and mortality. However, current in vitro models neglect the investigation of long term, post-exposure effects such as recovery or sustained toxicity, which are crucial for a comprehensive understanding of clinical observations. This study aims to investigate the dynamic dose- and time-dependent response of human induced pluripotent stem cell-derived cardiomyocyte microtissues to doxorubicin-induced cardiotoxicity. Ventricular cardiac microtissues were exposed to different concentrations of doxorubicin, ranging from 0.003 μM to 3 μM, over a 3-day period, followed by a 6-day recovery phase, during which continuous contractility measurements were recorded, with LIVE/DEAD staining performed to assess viability and functional changes at the end of the experiment. Preliminary results, evidenced by extensive cell damage and impaired contractility observed through LIVE/DEAD staining, show higher concentrations of doxorubicin inducing severe and persistent toxicity, while lower concentrations worsened progressively over time. These findings underscore the critical need for effective cardioprotective strategies against doxorubicin-induced cardiotoxicity. Ongoing research aims to investigate strategies to protect cardiac microtissues post-doxorubicin treatment, offering a potential avenue for mitigating these adverse effects and improving patient outcomes.

Adriana Hernández Vega: **Poster #B16**
Home Institution: University of Puerto Rico Rio Piedras

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

Faculty Mentor: Jay Tang, Physics

Simulating emergence of dynamic packs in a monolayer of swarming bacteria

The swarming motility of the bacterium Enterobacter sp. SM3 has been shown to alleviate intestinal inflammation in mice. It has been observed in experiments that SM3 swarmer cells form dynamic packs of bacteria when confined to a monolayer on the surface of a soft agar. The formation of these packs and their interactions with one another presents an intriguing system to simulate. With the use of MATLAB, we wrote a 2D simulation consisting of a customizable number of capsule-shaped bacteria. Each of the bacteria has varying parameters such as aspect ratio, direction, and speed. The initial phase of the simulation aims to explore the interactions resulting from collisions between cells that approach each other, resulting in a torque force between them treated in simplified test models. The results of these simulations shall provide us insights on the most essential physics that might explain how the dynamic packs form and interact.

Journey Keen; Anh-Thai Le; Sam Thomas; Iris Horng: **Poster #C1**
Home Institutions: University of Tennessee, Knoxville; Yale University; Brown University; University of Pennsylvania

Summer Research Program: Institute for Computational and Experimental Research in Mathematics

(ICERM)

Faculty Mentor: Amanda Harsy, Lewis University, Department of Engineering, Computing, and Mathematical Sciences; Adam Schultze, Lewis University, Department of Engineering, Computing, and Mathematical Sciences

Local and Global Approaches for Improving American Football Rankings

We explore improvements in football rankings, via tools from linear algebra, probability, and combinatorics. Even though ranking methods by Massey and Keener are mathematically rigorous and simple to compute, it can be difficult to extend such models to predict football rankings which consistently beat the Vegas point spread. This research first takes a "global" approach, modifying the Massey method to predict week-to-week NFL rankings, using HodgeRank to analyze the confidence of pairwise rankings of the teams. We then implement a "local" approach, applying individual player ratings to incorporate weights for overall team strength.

Katharina Kuehr: **Poster #C2**

Home Institution: Minerva University

Summer Research Program: Engineering Research Center Intern - Harris Lab

Faculty Mentor: Daniel Harris, School of Engineering

Droplet rebounds on a flat solid surface: Experiments, modelling and simulations

We study a water droplet's non-wetting impact and rebound onto a horizontal rigid surface. Controlled experiments are carried out using a piezo-electrically actuated droplet generator, which provides reproducible results. A linearized fluid model is used to predict droplet deformations and trajectory, which is solved with spectral methods on a spherical geometry. In our model, the droplet is assumed to have a perfectly spherical shape until the moment of impact. The contact mechanics of the droplet impact are solved using a method that imposes only natural geometric and kinematic constraints and provides the evolution of the contact area and pressure distribution as part of the solution of the resulting system of equations. We give special attention to the dependence of the coefficient of restitution, contact time, and minimum height of the center of mass on dimensionless parameters such as the Bond and Weber number. Predictions of our model are validated against experiments and direct numerical simulation results. Our predictions for the pressure distribution will be used to inform the design of reduced models that are less computationally expensive.

Damir Kulzhanov: **Poster #C3**

Home Institution: Brown University

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

Faculty Mentor: John Simeral, School of Engineering

Integration of the Redis key-value database with the embedded system for iBCI applications.

This research project explores programming the embedded ARM processor in a hybrid System-on-Chip (SoC) device, the Xilinx Zynq-7000, for intracortical brain-computer interface (iBCI) applications. The SoC is the core of "ESPA", a novel hardware platform being developed to enable low-power, high-performance neural signal processing for a mobile, wheelchair-based neural interface system. Here, we focus on the integration of Redis, a fast in-memory database, with the existing embedded system Xilinx Zynq 7000.

Currently, there are many hardware components that comprise a modern iBCI. In an effort to reduce system size and power and simplify the user experience, ESPA was designed as an all-in-one solution for receiving neural data (from a wireless signal transmitter connected to cortical implanted electrodes), processing neural signals, and generating decoded outputs to control assistive technologies. Running a Redis server on ESPA would allow for the transfer of precomputed coefficients from an external computer for neural decoding and would simplify inter-process communication (IPC) between processes running on the ARM processor. In sum, the project to date consists of database integration, gaining familiarity with the Linux environment, and shell scripting. Future work required for the project would include programming an audio codec, programmatic management of battery and power controller ICs, and C programming to enable real-time data streaming from on-board FPGA hardware to external devices.

Ruoning Lan; John Lockwood: **Poster #C4**

Home Institution: Brown University

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

Faculty Mentor: Ian Dell'antonio, Physics

Dark Matter in the Northern Sky

The Local Volume Complete Cluster Survey (LoVoCCS) is a survey program mapping the dark matter distribution and galaxy population in nearby galaxy clusters. As part of this survey, our project adapts a software developed by the group to use on clusters observed by the Canada France Hawaii Telescope (CFHT) and Hyper Suprime-Cam (HSC) on the Subaru Telescope. The original survey focuses on southern hemisphere clusters observed by the Dark Energy Camera (DECam), while for our project, CFHT and HSC focus on northern ones. By limiting our northern targets to those overlapping with DECam, we develop a right ascension and declination comparison algorithm to extract the photometric redshift of those overlapping clusters, and then use shape measurements from CFHT and HSC to derive their dark matter distributions. Further, for the northernmost clusters beyond the DECam view range, we propose a solution to estimate their photometric redshifts through vast random g-r value (color magnitude difference) comparisons with the COSMOS survey. We're currently testing the accuracy of this algorithm on the overlapping clusters. From the comparison of dark matter mass estimates, we could measure the consistency of lensing measurements across different telescopes and identify areas for science pipeline improvement.

Xavier Lee: **Poster #C5**

Home Institution: Brown University

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

Faculty Mentor: David Borton, School of Engineering

Benchtop and in-vivo evaluation of xDev: A software-defined neurotechnology development platform

The development of implantable neurotechnology is throttled by the pacing disconnect between clinical studies and benchtop demonstrations. In almost all cases, neurotechnology devices are composed of several subsystems with various roles, including sensing, processing, and stimulating. The subsystems of neurotechnology systems are also rapidly developing, but verifying that system redesigns, the integration of new manufacturer devices, and different electrical components meet safety and performance

requirements before design finalization can often be expensive and time consuming. Retaining system modularity throughout the development process would alleviate the described bottleneck by permitting users to design, evaluate, and iterate on a single hardware platform, without needing to design and test all of their subsystems in a single step. Here, we describe our design and validation of a real-time, cross-development platform (xDev). The xDev platform simplifies the design process for neurotechnology devices by providing a benchtop, software-controlled signal routing fabric utilizing an analog crosspoint multiplexer (AD75019). This enables neurotechnology system designers to rapidly prototype their systems before transitioning to a final design.

A custom printed circuit board was designed to enable power and control of the analog crosspoint multiplexer. An Arduino-based driver for the multiplexer was written, enabling control of the multiplexer from a host PC. Finally, a battery of external modules were developed to 1) validate the xDev mainboard, and 2) deploy the xDev in experimental scenarios.

Frequency response, cross-talk performance, noise, differential impedance, charge injection, and high-speed digital communication, have been evaluated, and the coordination between the xDev evaluation platform, neural stimulators, and an ovine spinal target has been successfully demonstrated. An in-house breakout module for the RHS2116 neural stimulator/amplifier was controlled through xDev using a custom Arduino driver to stimulate the ovine spinal cord. The results were compared to those achieved when a commercially available stimulator (Ripple Neuromed Summit) was routed through the xDev, simulating testing an “experimental” stimulator chip.

Our results demonstrate successful, flexible routing of simultaneous digital and analog signals by xDev in its intended prototyping application. When combined with the known performance characteristics of the current device, designers could ostensibly even use this evaluation platform to begin prototyping neurotechnology systems. Further work should include the characterization of the long-term effects of charge injection and signal coupling on the electrode contact and the performance of cascaded multiplexer channels.

Heon Lee: **Poster #C6**

Home Institution: Brown University

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

Faculty Mentor: Pedro Felzenszwalb, School of Engineering

Symmetries and Fixed Points of Iterated Linear Optimization on the Elliptope

Optimization tasks seek the best value or configuration within given constraints. Exact algorithms can be time-consuming, so we use efficient approximation methods like Semidefinite Programming (SDP) by relaxing the conditions. Once we obtain an SDP solution, it is rounded to a feasible solution for the original problem.

Elliptopes are specific regions over which SDP can optimize and are important for tasks like clustering. A seminal example is the Max-Cut problem, where the goal is to partition a graph's vertices to maximize the number of edges between partitions. Goemans and Williamson demonstrated the effectiveness of SDP on elliptopes for Max-Cut in 1994. They used a random method to approximate the solution. In 2021, Felzenszwalb et al. introduced a deterministic rounding method based on iterated optimization over the elliptope. The attractive fixed points of this process correspond precisely to feasible Max-Cut solutions.

Our research continues this work in studying the dynamics of these iterations. By examining the behavior of fixed points under elliptope symmetries, we aim to understand the underlying structure of the process. In particular, we prove the preservation of symmetries throughout the iterative procedure.

Yareli Macias-Sanchez; Campbell Thomas: **Poster #C7**

Home Institution: Brown University

Summer Research Program: Summer Research Assistantship in Biomedical Sciences

Faculty Mentor: Kimani Toussaint, School of Engineering; Rutendo Jakachira, Physics

PPG Device Development for Accurate Blood Oxygen Measurement Across Skin Tones

This project focuses on developing a more accurate photoplethysmography (PPG) device, particularly for individuals with darker skin pigmentation, who often experience less accurate readings from conventional PPG devices such as pulse oximeters. Our goal is to enhance the precision and reliability of pulse oximeter measurements by exploiting different states of polarization. The current iteration of our device makes use of cross polarization.

Constructing the PPG devices involves three main steps; 1) Soldering electrical components onto printed circuit boards (PCBs), 2) encapsulating the device with silicon to improve the contact of the device with the skin and 3) implementation of signal processing techniques using MATLAB.

Shivangi Manel; Kylie McCombs: **Poster #C8**

Home Institution: Brown University

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

Faculty Mentor: James Tompkin, Computer Science; Are Oelsner, Humans2Robots Lab

Virtual Reality Teleoperation: GHOST User Interface

Virtual Reality Robotic Teleoperation can enable users to complete complex tasks from a distance but can be limited by the steep learning curve of potentially complex control systems. Creating an interactive user interface (UI) is essential to guide users through the technology and utilize its full potential. Using Unity, we developed a VR UI specifically tailored to the needs of our GHOST system, providing users with essential information to execute tasks efficiently. Our approach helps flatten the learning curve for inexperienced users using VR for teleoperated tasks.

Abrielle Mannino: **Poster #C9**

Home Institution: Rollins College

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

Faculty Mentor: Christopher Horvat, Earth, Environmental, and Planetary Science

Enhancing Climate Resilience in the South Pacific using Artificial Intelligence Models of Tropical Cyclone Impacts ("EMPIRIC_TC")

As carbon emissions continue to fuel anthropogenic climate change, single model initial-condition large ensembles (SMILEs) are valuable tools for projecting climate risk. These models, however, lack

human-relevant outputs, which can limit stakeholders in areas that will be affected from accessing this information. This is particularly salient in regions such as the South Pacific where countries at high risk of disaster face estimated increases in extreme cyclone activity, threatening vital human infrastructure. The main research question we seek to answer is how we can leverage climate modeling data in interpretable ways for stakeholders. Our three-pronged approach will directly address this concern. First, we produce machine learning estimates of tropical cyclone landfall using a U-net trained on a stochastic cyclone track model called STORM (N. Bloemendaal et al., 2020). Second, using python's geospatial capabilities we visualize this data and the likelihood cyclones will threaten vital healthcare infrastructure in the region. Third, through direct communication and collaboration with members of the South Pacific Community (SPC), we will adapt model outputs to stakeholder needs, developing a framework for how best to translate model information. We find that the use of artificial intelligence through STORM both enhances the efficiency of model results, and the ease of translating those results into human-related outputs. Moreover, by making an effort to translate these results into human-related output government agencies can utilize this information to inform climate resilience projects. This seeds a long-term collaborative effort between climate scientists and public health stakeholders around the future impacts of climate change.

WaTae Mickey: **Poster #C10**

Home Institution: Brown University

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

Faculty Mentor: Jim Head, Earth, Environmental, and Planetary Science

Lunar Hadley Rille Origin Theories: Theory Evaluation and Hypothesis Testing

One of the most common topographic features on the lunar mare are sinuous rilles, continuous channels widely agreed to be of volcanic origin. Sinuous rilles span various areas on the lunar surface, including the mare, highlands, and craters, and one rille, the Hadley Rille, served as a key scientific objective and major deciding factor for the Apollo 15 landing site. With advancements in satellite imagery resolution shedding new light on old papers and recent research on the origin of sinuous rilles, a detailed study of Hadley Rille's origin is essential. We consider 5 major theories of origin: Surface Lava Channel, Collapsed Lava Tube, Thermal Erosion, Drained Lava Lake, and Lava Filled Fault. Using topographic data and geology of the Hadley Rille and surrounding Apennine-Hadley Region we will determine the plausibility of each proposed origin.

Olivia Miller: **Poster #C11**

Home Institution: Brown University

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

Faculty Mentor: Ben McDonald, Chemistry

Salt driven assembly of polymers into membraneless organelles in organic solutions

Membraneless organelles are important within cells to compartmentalize macromolecules within cells to assist in and perform cellular functions. These biomolecular condensates form through liquid-liquid phase separation (LLPS) as the molecules interact slightly more with each other than with the solvent. LLPS within non-aqueous solvents is not well characterized. This project focuses on forming coacervates within aprotic solvents and elucidating the parameters that allow LLPS within these solvents. Through using different anions at varying concentrations, we can tune the level to which the cation-aromatic polymers

phase separate out of solution. Levels of hydrogen bonding and polymer concentration are also parameters that are explored and can be used to tune the sensitivity of the polymer to these anions. Results show that great hydrogen bonding and polymer concentration both increase sensitivity to anions, and more kosmotropic anions result in greater phase separation than more chaotropic anions. This work will allow stimuli responsive materials to be made in a wider range of solvents.

Katie Min: **Poster #C12**

Home Institution: Brown University

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

Faculty Mentor: Yongsong Huang, Earth, Environmental, and Planetary Sciences

Expanding the Upper Range of the Alkenone Paleothermometer in the Pacific Warm Pool

It is debated whether or not global warming could result in permanent El Nino-like conditions, as previous attempts to reconstruct past Pacific sea surface temperatures have yielded conflicting results. Studies using Mg/Ca ratios find that during past warm periods there was not a significant temperature gradient across the Pacific, indicating permanent El Nino-like conditions during the Pliocene warm period. Conversely, studies using the TEX86 paleothermometer do find a significant temperature gradient, indicating that La Nina intervals still occurred. Sustained El Nino conditions would have direct impacts on global climate due to the weakening of the Pacific temperature gradient and atmospheric circulation above the Pacific. The alkenone biomarker is commonly used to reconstruct sea surface temperatures, utilizing the relationship between unsaturation (double bonds), and temperature. During warm intervals, however, the western Pacific reaches temperatures above the limit of saturation and temperatures cannot be calculated with this method. This study aims to develop a method which does not rely on unsaturation to extend the paleothermometer temperature range of the alkenone proxy. Using a newly discovered relationship between C38:2 Et and C38:2 Me alkenones, we aim to utilize the alkenone proxy to help resolve the debate regarding the possibility of sustained El Nino conditions. Here we present lipid biomarker results from ODP core 806B over the Mid-Miocene and Pliocene consistent with other temperature proxies from the core.

Matthew Moser: **Poster #C13**

Home Institution: Brown University

Summer Research Program: Sam Birch Lab

Faculty Mentor: Sam Birch, Earth, Environmental, and Planetary Science

KABOOM: Storage and Release of Cometary Volatiles Through Outbursts

Comets are the most primitive objects in the solar system, and hold crucial insights into the early solar nebula. These icy bodies store volatiles that are periodically released, providing a window into their composition and internal processes. Among the various mechanisms of volatile release, outbursts represent the most extreme and energetic events. Such outbursts have been observed across a variety of cometary bodies, including Jupiter-family comets (JFCs), centaurs, and dynamically new comets. These phenomena occur under a range of conditions: during local night and midday, at perihelion and aphelion. The Rosetta mission provided unprecedented observations of comet 67P/Churyumov–Gerasimenko, documenting numerous outbursts and their locations. Despite these observations, the subsequent effects on the comet's surface have remained unexplored. In this study, we present a comprehensive analysis of the surface changes induced by these outbursts, showing that cliff collapses are a dominant mechanism.

These observations will prove critical to follow-up modeling studies that seek to understand the physical release process, such as via avalanching.

Kaleb Newman: **Poster #C14**

Home Institution: Brown University

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

Faculty Mentor: Chen Sun, #N/A

Why Do Vision-Language Models Struggle With Object States?

To comprehend the physical world through cause and effect, vision-language models (VLMs) must first grasp the temporal dynamics of our visual environment, such as the transformation of object states over time (for example, from a whole apple to a sliced apple). Our study examines whether VLMs trained on extensive web data can effectively encode object states, which can be extracted with zero-shot text prompts. We introduce an object state recognition dataset named ChangeIt-Frames and assess its impact on five open-source VLMs, including the OpenAI GPT-4V API. Our findings indicate that while these cutting-edge models excel at object recognition, they uniformly struggle to discern the physical states of objects, GPT-4V included. Through detailed experiments with the CLIP model, we pinpoint three areas where VLMs can improve their ability to encode object states: enhancing object localization accuracy, refining the architecture that associates concepts with objects, and tailoring the learning objectives to foster more discriminative visual and language encoders for object states.

Asmita Niyogi; Shirui Li: **Poster #C15**

Home Institutions: University of Cambridge; Mount Holyoke College

Summer Research Program: Churchill College Cambridge Exchange Program

Faculty Mentor: Brenda Rubenstein, Chemistry

Investigating strongly correlated reactions with transfer learning and electronic structure methods

Enzymatic biomolecular processes like ATP hydrolysis are challenging to study via classical electronic structure methods as they involve rearrangement of multiple bonds and strongly correlated reactions. Quantum computation has the potential to exactly calculate these reactions, but this is inhibited by factors like high computational cost for simulating large systems and noisy hardware. A hybrid approach that combines classical and quantum computational methods using machine learning has the potential to overcome the shortcomings of each of the methods. Previous work has shown that a transfer learning methodology that initially leverages low-cost DFT-based learning, despite its inherent inaccuracies, and subsequently refines predictions using a smaller quantum-computed data set, can give accurate potential energy predictions for water monomers and dimers. However, these are small systems with weak electron correlation. In this work, we explore the viability and effectiveness of this transfer learning methodology for strongly correlated reactions by using it to train Behler-Parrinello neural networks to predict bond breaking. Optimising this training method for correlated reactions opens up the possibility to obtain accurate molecular dynamics simulations of relevant biological systems with a hybrid classical-quantum approach.

Naomi L. Núñez Altagracia: **Poster #C16**

Home Institution: University of Puerto Rico, Río Piedras

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

Faculty Mentor: Jay Tang, Physics

Annotating and Tracking of Moving Bacteria in a Dynamic Swarm

Understanding the dynamics of bacteria in an expanding swarm is crucial to decipher their behaviors and intercellular interactions. In this project, we observe under an optical microscope Enterobacter sp. SM3 at their swarm front following on site dilution and equilibration, forming dynamic packs in a monolayer of cells. We then acquire movies, annotate and track individual bacteria in those movies. Cellpose, a specialized program for cell annotation, is utilized to train models capable of identifying bacteria and track their rapid movement. Due to the high cell density and large field of view, each frame is divided into sixteen cropped segments to better process and train our models. Processed by Cellpose, each segment creates individual labels for the bacteria that are imported into TrackMate for tracking and visualization of their individual trajectories. In the future, we hope to minimize manual annotations and attain automatic annotations of most bacteria within entire frames without cropping them into individual segments. If successful, the project outcome is a microscopic level account of highly motile bacteria at the swarm front, such as the dynamic packs they form, leading to physical insights on the intercellular interactions that give rise to their collective behavior.

Madeline Oh: **Poster #D1**

Home Institution: Brown University

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

Faculty Mentor: Jay Tang, Physics

Biofilm Formation of Enterobacter Sp. SM3

Biofilms are dense, three-dimensional communities of bacteria embedded in a protective matrix of secreted polymers. This mode of bacterial growth has garnered increasing interest in the field of biophysics due to its complex physical properties and relevance to human health. In this project, we investigate the biofilm formation of Enterobacter sp. SM3, a novel bacteria species found to alleviate intestinal inflammation in mice. SM3 has robust swarming behavior, such that it moves quickly and efficiently across a solid surface as a dense population of cells. However, not much is known about its ability to grow as a biofilm. In our studies, we use phase contrast and fluorescence microscopy to visualize SM3 biofilm structures and matrix components. We find that SM3 can form biofilms on both plastic and agar surfaces, growing as microcolonies scattered across a flat layer of cells. Further study is required to determine the properties of SM3 biofilms, both physical and biochemical, as well as their roles in human gut physiology.

Julia Patterson: **Poster #D2**

Home Institution: Brown University

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

Faculty Mentor: Anita Shukla, School of Engineering

Polymer-coated Gelatin Nanoparticles as an Antibiotic-free Treatment for *Staphylococcus epidermidis* Infections

Staphylococcus epidermidis is a major healthcare-associated infectious agent that primarily causes infections related to implanted medical devices like catheters and prostheses. Traditional methods for infection control include washing hands, wearing personal protective equipment, or disinfecting surfaces; however, due to increasing evidence of antibiotic resistance and tolerance, novel treatment methods are needed to target resistant bacterial infections. The use of nanotechnology and nanomaterials shows potential in treating these recalcitrant bacterial infections. In this study, we developed an antibiotic-free nanoparticle (P-GNP) formulation for the treatment of *S. epidermidis* infections. The nanoparticle (NP) is made by coating a gelatin nanoparticle (GNP) core with pH-responsive co-polymer, methoxy PEG-benzoic-imine-branched polyethyleneimine (mPEG-b-i-PEI). We hypothesized that P-GNP can enhance bacterial inhibition compared to the free co-polymer, ultimately eradicating the infection.

The P-GNPs were synthesized through a two-step process. First, the GNPs were synthesized via a desolvation method and crosslinked using glutaraldehyde. The pH-responsive co-polymer, mPEG-b-i-bPEI, was synthesized as previously reported. The successful synthesis of mPEG-b-i-bPEI was verified with Fourier-transform infrared spectroscopy (FTIR) and nuclear magnetic resonance spectroscopy (NMR). mPEG-b-i-PEI co-polymer was conjugated to GNP via a coupling reaction using 1-ethyl-3-(3-dimethylamino)propyl carbodiimide hydrochloride (EDC) and N-hydroxysuccinimide (NHS), and the amount of co-polymer conjugated was monitored via optical density measurement and quantified using a standard curve. The morphology of the NPs at each step was assessed using transmission electron microscopy (TEM) and dynamic size scattering (DLS) analysis. The in vitro minimal bacteria inhibitory concentration to inhibit 80% of bacteria growth (MIC_{80}) was examined with microdilution assays against *S. epidermidis* 12228. Finally, the cytotoxicity of the NP was monitored via cell count kit-8 using murine fibroblast cells (NIH3T3).

DLS data showed an increase in the size and polydispersity index of the NP after the co-polymer was conjugated. TEM images indicate the NPs have uniform spherical shapes. The antibacterial activity of P-GNP was assessed and compared to that of free bPEI, mPEG-b-i-PEI, and blank GNP. Free bPEI, PEG, and GNP did not show bacterial inhibitory effects at any test concentrations, whereas mPEG-b-i-PEI exhibited an MIC_{80} of greater than 25.6 μg/mL, and P-GNP further showed an improved antimicrobial efficacy with MIC_{80} of 25.6 μg/mL. Furthermore, the GNPs and P-GNP were not cytotoxic to fibroblast cells. In this research, we synthesized an antibiotic-free NP formulation and demonstrated its ability to inhibit *S. epidermidis* growth. Our NP formulation serves as a promising alternative approach for combating antibiotic-resistant infections.

Gregorio Posada Pardo: **Poster #D3**

Home Institution: Brown University

Summer Research Program: NSF funded Research

Faculty Mentor: Christian Huber, Earth, Environmental, and Planetary Science

Urcunina: Using numerical modeling of large long-lived silicic magma chambers to replicate the evolution of polycyclic caldera systems

Several large long-lived silicic volcanic centers (Yellowstone, Campi Flegrei, Aso to name a few) have shown cyclic behaviors with large catastrophic caldera-forming events (CCF) interspersed with smaller eruptions during recovery periods. Recovery is often characterized with early drier and hotter magmas transitioning to colder and wetter ones before the next CCF event. In an effort to provide further insights into the factors that control the evolution of these magma chambers, we utilize numerical modeling to identify the appropriate conditions required to replicate the evolution of a polycyclic caldera system. An

idealized box model that solves for mass, momentum, and enthalpy conservation in a magma chamber was adapted to include CCF eruptions, taking into consideration the evolution of the aspect-ratio (width/thickness) of the active chamber over time. Our results demonstrate that the conditions needed for a silicic caldera system to successfully carry out its post-collapse recovery and regain its size are quite limited and severely dependent on its cooling, injection, and viscous relaxation timescales.

Tarek Razzaz: **Poster #D4**

Home Institution: Brown University

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

Faculty Mentor: Brenda Rubenstein, Chemistry

Reducing the Sign Problem in Quantum Simulations via the Accessible Entanglement Entropy

The sign problem is one of the most significant challenges faced when simulating many-electron systems with numerical techniques. This problem arises when the probabilities of quantum states are allowed to be negative, which results in exponentially longer runtimes in order to obtain meaningful averages of observables. Some have suggested that the severity of the sign problem may be related to the entanglement present within the quantum system. This entanglement is usually quantified using the total Rényi-2 entanglement entropy, which includes contributions from both electron-electron interactions and particle number fluctuations. However, we hypothesize that the sign problem is only dependent on the entanglement related to electron-electron interactions, which we quantify using the accessible entanglement. Here, we test this hypothesis by studying the relationship between the sign problem and the accessible entanglement in Auxiliary Field Quantum Monte Carlo simulations of the two-dimensional repulsive Hubbard model. Establishing this correspondence would enable us to reduce the severity of the sign problem by predicting and potentially mitigating the accessible entanglement in our systems.

William Roberts: **Poster #D5**

Home Institution: Brown University

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

Faculty Mentor: Lai-Sheng Wang, Chemistry

Vibronic Photoelectron Spectroscopy of Cryogenically Cooled Anions

This project focuses on the investigation and characterization, via photoelectron spectroscopy, of atmospherically and astrochemically relevant chemicals. Using a PES apparatus coupled with a cold trap and time-of-flight mass spectrometer, we are able to gain photoelectron spectra of molecules at an extremely high resolution, allowing us to clearly and confidently map the vibrational transitions of the molecule of interest. By cooling our molecule to 4.5 K, then exciting an electron to a dipole bound state (an electronic state present in molecules with a large dipole moment), we are able to determine the energies and number of its vibrational levels. For my individual research project within the group, I have focused on the nitro-phenol family of molecules, which play a major role in the creation of NO radicals, which are of extreme importance in understanding atmospheric chemistry. Using our machine, I work on mapping the vibrational levels of these molecules, as well as their photo-fragmentation patterns, in order to help scientists better understand its behavior in our atmosphere.

Sergio Rodriguez: **Poster #D6**

Home Institution: University of Puerto Rico, Rio Piedras Campus

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

Faculty Mentor: Ian Dell'Antonio, Physics

Galaxy Cluster Masses from Images, not Catalogs

Understanding the masses of galaxy clusters is crucial for various astrophysical studies. Traditionally, this information is derived from detailed catalogs that require extensive observational data and the use of algorithms for source detection and shape measurement that are imperfect. Our research aims to develop a system that can infer galaxy cluster masses directly from telescopic images, bypassing the need for these catalogs. To achieve this, we need a dataset large enough for training a neural network. Given the limited availability of galaxy clusters with known masses to use as labeled images, we utilize jedisim, a software tool that simulates gravitational lensing in galaxy clusters, to create our dataset. We optimize jedisim for this task by enhancing its runtime efficiency through memory management and multithreading techniques in C. This approach allows us to generate a substantial and diverse dataset for future neural network training. By streamlining dataset generation, we aim to facilitate more efficient mass estimation methods in astrophysics, laying the groundwork for subsequent model training and validation.

Santiago Romo: **Poster #D7**

Home Institution: Brown University

Summer Research Program: Presidential Scholars Summer Research

Faculty Mentor: Kenny Breuer, School of Engineering

Aerodynamic Loads and Power Optimization in Ornithopter Flight: Insights from Varying Wingbeat Frequency, Pitch Angle, and Wind Speed

Studies of live animal flight are often tedious, from the handling and training of the animals to the extensive processes needed just to acquire them. Thus, using a robotic flapper that bypasses at least some of these limitations is highly appealing for studies of animal flight.

To address these challenges, we are exploring the use of a commercially available ornithopter (flapping wing drone), the MetaBird, to gain insights into the flight mechanics of similarly sized birds and the power requirements of similar ornithopters. To accomplish these goals, we measure the forces and moments on the ornithopter during tethered flight in a wind tunnel, as well as the voltage and current powering it. In our experiments, we vary three conditions: pitch angle, wind speed, and flapping frequency. By varying these conditions, we aim to quantify their effects on flight stability and power requirements, providing insights into how flapping frequency impacts flight dynamics and informing the optimization of power usage for ornithopters and similar devices.

Tyler Rose: **Poster #D8**

Home Institution: Brown University

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

Faculty Mentor: Megan Kizer, Chemistry

Engineered Heparosan Synthase and Functionalized Monosaccharide Initiators Enable Controlled Chemoenzymatic Synthesis of Disease-Specific Heparan Sulfate Therapeutics

Heparan sulfate (HS) proteoglycans are ubiquitously expressed on all cell surfaces and in the extracellular matrix where they serve as important mediators of cellular interactions. A wide range of developmental and homeostatic disorders, as well as disease phenotypes, are associated with changes in HS expression, suggesting disease state abnormalities may be exploited by novel therapeutic agents to specifically disrupt HS-protein interactions. Such agents would require a homogeneous sample of HS oligosaccharides of defined length and sulfation pattern to accurately mimic the empirically-determined characteristics of their respective disease states. However, the chemical synthesis of HS oligosaccharides poses challenges, necessitating precise control over linkage stereochemistry and regiochemistry, degree of polymerization, and domain-based residue modification. Chemoenzymatic methodology utilizing Heparosan Synthase 2 from Pasteurella multocida (PmHS2), a bifunctional enzyme which catalyzes the formation of glycosidic linkages in a growing HS-precursor chain, is a promising alternative for efficient, size-controlled synthesis. Our research investigates the catalytic activity of engineered PmHS2 mutants towards functionalized glycosyl acceptors and natural glycosyl donors. We functionalize monosaccharides N-acetyl D-Glucosamine (GlcNAc) and D-Glucuronic Acid (GlcA), which constitute the repeating disaccharide backbone of HS, in a stereospecific condensation reaction with an azide-terminal linker. These functionalized monosaccharide initiators are thus equipped for immobilization onto alkyne-modified solid surfaces via click chemistry, improving chemoenzymatic reaction and analysis efficiency. Techniques in molecular biology are used to generate a library of engineered PmHS2 mutants based on existing literature, each with improved stability and unique catalytic capability. These mutants are tailored for oligosaccharide polymerization upon our functionalized glycosyl acceptors with similar substrate specificity but greater control over oligosaccharide chain length. The catalytic activity of each PmHS2 enzyme will be determined for initiators in solution and on solid support. Ultimately, the optimal variants will be leveraged in a full chemoenzymatic pipeline to generate a library of HS oligosaccharides with distinct lengths and sulfation patterns, enabling a cost-effective and streamlined platform to generate carbohydrates for therapeutic applications.

Christopher Sanchez Jr: **Poster #D9**

Home Institution: Brown University

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

Faculty Mentor: Benjamin McDonald, Chemistry

Dispersing Carbon Nanotubes in Water for Stimuli-Responsive Nanocomposites

Previous research on the dispersion and debundling of multi-walled carbon nanotubes (MWCNTs) in water has primarily relied on sonication. However, this often causes the breaking and fragmentation of CNTs, resulting in dispersions with suboptimal physical characteristics. Largely inspired by the hierarchical organization of biomaterials, such as spider silk and a mussel's byssal threads, which respond to stimuli like changes in pH and salinity, our project focuses on dispersing and functionalizing multi-walled carbon nanotubes. By using high-speed stirring as opposed to sonication, we reduce CNT fragmentation. Using our cationic polymer, A1M1, to coat the carbon nanotubes, we achieve stable and debundled MWCNT dispersions in water. The functionalization of our MWCNT with the cationic polymer enables stimuli-responsive nanocomposites that facilitate the investigation of the phase behavior when introduced to salt solutions of different concentrations and anion identities. The material properties of

these CNT-polymer composites can be further studied to understand mechanical strength, electrical conductivity, and other functional properties and potential applications.

Austin Sarker-Young: **Poster #D10**

Home Institution: Brown University

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

Faculty Mentor: Ming Xian, Chemistry

The unique application of carbohydrate / amino-acid-based reactive sulfur species donors

Hydrogen sulfide (H2S) is a gasotransmitter associated with many physiological processes including vasodilation, inflammation modulation, and antioxidant function. Although there are numerous small-molecule H2S donors available, these often produce toxic byproducts. To avoid this limitation, our group has begun examining novel H2S donor models that are carbohydrate or amino-acid-based. An example of this would be our recently developed thioglucose tetrasulfide (TGS4), which demonstrated efficient H2S release and low toxicity. Here, we seek to investigate thiosaccharides, tetra-O-methyl gluconothiolactone (MGTL), and amino-acid-based polysulfurating agents. We begin by taking a fundamental approach to examine a hydrolysis-driven H2S release from a catalog of thiosaccharides. We then look towards using MGTL as a highly efficient, quick-releasing H2S donor. Lastly, we seek to use a phthalimide-based sulfurating agent to generate polysulfides in situ from biological thiols. Altogether, this work will diversify our H2S donor toolbox to help fit an equally diverse set of physiological H2S functions.

Emma Slaght; Julia Granato: **Poster #D11**

Home Institution: Brown University

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

Faculty Mentor: Nora Ayanian, Engineering and Computer Science

Simultaneous Localization and Mapping in the Context of Humanitarian Demining

In areas with past or active conflict, Unexploded Ordnances (UXO) pose a threat to civilians and humanitarian workers. This project aims to increase the safety of regions with hidden landmines, such as Cambodia and Vietnam, by using robots to aid in the process of humanitarian demining. Simultaneous Localization and Mapping (SLAM) is a class of robust perception algorithms that enables robots to explore and map unknown areas. Applying this algorithm to the context of demining, we wish to develop novel techniques for aerial and ground robots to detect and map out dangerous ordnance in a designated yet unexplored area. We have implemented FastSLAM 1.0, as previously developed by Montemerlo et. al. (2002), an improvement on the original SLAM algorithm that has been experimentally proven to be capable of accurately generating information about the number and locations of landmarks. Light Detection and Ranging (LiDAR) scans from a Slamtec RPLIDAR-A1 sensor, mounted on a Create3 ground robot, captured landmark measurement information to generate a map of landmarks in our experimental setup. This was validated by a comparative analysis of the generated map with the ground truth as observed by a Vicon Valkyrie motion capture system. Currently our research limits the generated map to showing only the location of a landmark. We aim to continue our adaptation of the FastSLAM algorithm to generate an occupancy grid map which would allow us to gain complete information about the environment layout, and help to distinguish which landmarks are actually landmines. We are potentially partnering with the Demining Research Community, a nonprofit organization dedicated to research that utilizes technology such as robotics to increase safety and efficiency of demining, with the

goal of testing our technology in an area with landmines.

Aino Smith: **Poster #D12**

Home Institution: Brown University

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

Faculty Mentor: Jerome Robinson, Chemistry

Synthesis of Novel, Multi-functional, and Earth-Abundant Catalysts for Biodegradable Polymers

With over 4.9 GTons of plastic in the environment, most of which will take hundreds of years to degrade, there is an urgent need to develop sustainable alternatives. This requires the discovery of catalysts which could enable access to novel biodegradable polymers, where these are ideally (i) highly active, (ii) highly selective, (iii) non-toxic, and (iv) earth abundant. Towards these goals, we have identified bis(phosphine-oxide)methanides as multi-functional chelates which enable unprecedented levels of activity and selectivity in lanthanide-based catalysts. Despite these observations, examples of more earth-abundant metal complexes supported by these chelates (e.g., Mg, Zn) remain unknown. In this project, we have synthesized and characterized different metal complexes supported by bis(phosphine-oxide)methanides and explored their reactivity in the synthesis of biodegradable polymers. This project involved the synthesis and characterization of air-sensitive inorganic compounds and their reactivity in small and macromolecular synthesis in an oxygen and water free environment. Characterization techniques pertinent to inorganic molecules included NMR and single-crystal X-ray diffraction, while polymer characterization will include NMR and size-exclusion chromatography.

Jared Sonkin: **Poster #D13**

Home Institution: Brown University

Summer Research Program: SPRINT|Undergraduate Teaching and Research Awards (UTRA), Volunteer Undergraduate Research Assistant in Dr. Shukla's Lab

Faculty Mentor: Anita Shukla, School of Engineering

Development of an Esterase-responsive Hydrogel for Treatment of Topical Wound Infections

In 2014, there were 8.2 million Medicare patients with wound infections in the United States, costing the healthcare system an estimated $32 billion. Previously, Alkekhia et al. designed a hydrogel dressing that degrades in the presence of β-lactamase enzymes, allowing drug delivery in response to antibiotic-resistant bacterial infections. This project aims to develop an esterase-responsive hydrogel wound dressing to degrade and deliver therapeutics for both drug-resistant and non-resistant bacterial skin infections. Esterases, along with lipases, are enzymes that hydrolyze ester bonds to produce a carboxylic acid and an alcohol. Lipases act on larger, more lipophilic substrates, while esterases act on smaller substrates. Esterases are produced by most bacteria, making them a suitable stimulus for the release of therapeutics. This stimulus-triggered release could increase the specificity of antibiotic treatments, reducing the risk of developing antibiotic-resistant infections. First, we measured the esterase activity of a library of bacteria species and clinical isolates by extracting intracellular fluid and measuring its esterase activity by conducting a p-nitrophenyl acetate colorimetric assay. Bacterial cells were isolated from their growth medium, resuspended in sodium phosphate buffer, and lysed through sonication. The cells were centrifuged, and the supernatant was collected and incubated with p-nitrophenyl acetate, a chromogenic substrate that contains an ester bond, to measure its hydrolytic activity. From the library of tested bacteria, Staphylococcus aureus 25923 was among the lowest producers of esterases, while Vibrio

cholerae 39315 and Pseudomonas aeruginosa clinical isolates from blood were among the highest producers of esterases. Next, we fabricated and optimized esterase-responsive hydrogels using polyethylene glycol diacrylate (PEGDA) (molecular weight = 575 Da) and 10% (w/v) 4-arm polyethylene glycol (PEG) thiol (molecular weight = 20 kDa). We added photoinitiators to crosslink the hydrogel via free radical polymerization. Optimization parameters to form the hydrogel such as varying the pH of the buffer (2, 2.5, 3) and varying the concentration of triethanolamine (TEOA) used as a co-initiator (0.05x, 0.5x, 1x) were examined. The hydrogels were then incubated in a buffer with and without esterases to confirm degradation during each optimized formulation. Future research plans include measuring hydrogel mechanical properties, estimating hydrogel mesh size, assessing degradation in bacterial esterases and additional enzymes, and inclusion of nanoparticle therapeutics in the hydrogel formulations.

Jasmine Sun: **Poster #D14**

Home Institution: Brown University

Summer Research Program: Space Grant/NASA, SPRINT|Undergraduate Teaching and Research Awards (UTRA)

Faculty Mentor: Jim Head, Earth, Environmental, and Planetary Science

Distribution of Irregular Mare Patches on Lunar Shield Volcanoes in Mare Serenitatis

Irregular mare patches (IMPs) are enigmatic lunar features understood as volcanic in origin; however, predictions for their ages differ drastically. Recent studies dated most IMPs to be less than 100 million years old based on its low crater count, optical immaturity, and steep slopes. The “young hypothesis” of recent emplacement that followed is surprising given the belief that lunar volcanism ceased 1 billion years ago. The “old hypothesis” suggests that IMPs are summit pit craters formed over 1 billion years ago through typical processes of lunar volcanism, negating the need for recent volcanic activity. We study the distribution of IMPs in summit pits of shield volcanoes, which can help refine the old hypothesis. We survey over 200 shield volcanoes in Mare Serenitatis for class 1 IMPs (with mounds and pits) in summit pit craters, which are rare. We identify some class 2 IMPs (with pits only) on volcano flanks. We also find that while larger volcanoes correlate with larger pit craters, these do not predict frequent IMP formation. The rarity of IMPs may need to be addressed through improved theoretical understanding, while finding more IMPs associated with volcanoes can strengthen the old hypothesis. Using SLDEM2015 topological data, we observe that the volcano summit pits are typically V-shaped rather than U-shaped, suggesting rapid cooling that creates a lid, preventing the further venting of magma and gases. We hypothesize that most volcanoes remain IMP-less because of their small size, causing dikes to close before the IMP-forming stages of eruption could begin. Determining the conditions that make IMP formation likely is crucial for differentiating the young and old hypotheses, thus giving insight on one of the most important problems in lunar thermal history of when volcanic activity ceased.

Isabella Szabo: **Poster #D15**

Home Institution: Brown University

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

Faculty Mentor: Yongsong Huang, Earth, Environmental, and Planetary Sciences

Development of a GC-MS Data Pipeline and Library for Machine Learning Discovery of Biomarker Proxies

Biomarkers, molecular or chemical fossils, are essential for reconstructing past climate and environmental conditions. Long chain alkenones are an example of a biomarker proxy used to reconstruct past sea-surface temperatures. Such paleoenvironmental reconstructions have proven invaluable for the projection of future climate change. However, discovering novel biomarkers often happens by chance, suggesting that many useful biomarkers could potentially remain undiscovered. Additionally, existing biomarkers are known to have biases that may limit their ability to accurately reconstruct past climate and environmental conditions. The purpose of this project is to discover more biomarkers using artificial intelligence and machine learning to reduce bias in climate reconstruction.

In order to computationally discover new biomarkers, the first stage of this project was the development of a GC-MS data processing pipeline to automatically identify peaks in samples. Current GC-MS software is limited in its ability to identify peaks due to background noise and the need for manual identification of each peak. To address these limitations, a GC-MS pipeline was developed to clean up GC-MS data through baseline subtraction, and two neural networks were employed to distinguish peaks from background noise and to fit a Gaussian curve to the identified peaks. Data was then matched against a library for spectral similarity and stored in a SQL database, creating a robust repository of compound information.

The biomarker identification stage of this project will continue through the Fall. For this stage, several machine learning algorithms, such as regression and random forest analysis, will be employed on the aforementioned repository of compounds taken from samples in areas with known environmental conditions. The ultimate goal is to determine if any compounds can accurately predict any environmental conditions, thus serving as a biomarker.

Ashton Szarnicki: **Poster #D16**

Home Institution: Morehouse College

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

Faculty Mentor: Kareen Coulombe, School of Engineering; Mark Daley, School of Engineering

Evaluating Dexrazoxane's Role in Modulating Doxorubicin Toxicity in Human Cardiomyocytes Models

Chemotherapy remains the most prevalent form of cancer treatment today with Doxorubicin (DOX), a widely used anthracycline chemotherapeutic due to its potent anti-cancer properties. However, the clinical use of DOX is significantly hindered by its cardiotoxic side effects, which can lead to cardiomyopathy and is a major contributor to the incidence of chemotherapy-related heart disease. Heart attacks remain a leading cause of mortality globally, and the risk is amplified in cancer patients receiving cardiotoxic drugs like doxorubicin. This study investigates the protective role of dexrazoxane against doxorubicin-induced toxicity in human cardiomyocyte models. In our experiments, we varied the concentrations of doxorubicin and dexrazoxane to systematically explore their impact on cell viability, as measured by MTT assays, but also on cardiomyocyte contractility. Preliminary results from the viability assays indicate that dexrazoxane showed limited effectiveness in mitigating the acute reductions in cell viability caused by doxorubicin. Challenging previous assumptions of its efficacy in chemotherapy protocols involving doxorubicin, particularly short-term metabolic and oxidative stress changes in treated cells. The findings call into question the reliability of dexrazoxane for cardiac protection in the 2D cell culture model and suggest the need for further investigation in more complex models. Ongoing studies are further investigating these interactions in 3D cell cultures to better simulate the cardiac microenvironment, aiming to refine our

understanding of dexrazoxane's cardioprotective potential and optimize dosing schedules that maximize patient outcomes while minimizing cardiac risk.

Nicolas Valencia: **Poster #E1**

Home Institution: UC Berkeley

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

Faculty Mentor: Karen M Fischer, Earth, Environmental, and Planetary Science

Investigating Antarctic Ice Layer Properties Using Ps Seismic Phases

Measuring changes in the mass of the Antarctic Ice Sheet is crucial to understanding how the ice sheet is evolving in the warming climate and predicting its impact on future sea levels. In addition, accurate information on the thickness and internal properties of the ice layer is key to accounting for its effects in geophysical data that are used to measure the structure of the Earth's crust and mantle in Antarctica. In turn, the structure is essential for understanding the complex interactions between the solid earth, ice sheet, and climate.
Since current ice thickness surveys of Antarctica have limited spatial and temporal resolution, this project focuses on improving ice sheet data using Ps receiver functions. Receiver functions are a technique that analyzes seismic waves propagating from distant earthquakes and how they interact with local structure at the location of the seismometer. We calculated receiver functions at stations in different locations across the Antarctic Ice Sheet, using seismic waveforms with high frequency content that resolves distinct seismic phases associated with the ice layer. We compared synthetic seismic waveforms from ice models to the observed receiver functions to constrain ice thickness and seismic wave velocities within the ice. Variations in the receiver functions and modeling enable us to observe how ice layer properties change across the Antarctic continent. Further exploration of our initial results will help discern the ice layer's contribution to seismic waveforms in future geophysical studies, and will better constrain ice layer properties for use in climate modeling.

Oren Van Allen: **Poster #E2**

Home Institution: Brown University

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

Faculty Mentor: Kurt Pennell, School of Engineering

Polymer Addition for Improved Removal of Short-Chain PFAS by Dissolved Air Flotation

Per- and polyfluoroalkyl substances (PFAS) are a complex group of synthetic chemicals that are commonly used in consumer products. PFAS have been shown to accumulate in our bodies and are extremely slow to break down in the environment due to their characteristic chain of linked carbon and fluorine atoms which forms a very strong bond due to the electronegativity of fluorine. PFAS can migrate in the soil, water, and air, which can then enter the body through ingestion of contaminated food and water. Very small doses of PFAS have been linked to cancer, reproductive and immune system damage, and other diseases, creating the need to remove these chemicals from the environment.

PFAS-impacted groundwater is often managed using adsorbents such as granular activated carbon (GAC) or ion exchange resin (IXR). These processes are costly and often operate for long periods of

time. One potential approach to extend the lifetime and reduce the cost of GAC or IXR is to first apply foam fractionation to efficiently remove a majority of the PFAS. This process takes advantage of the surfactant-like properties of PFAS, which results in their tendency to accumulate at the air water interface. The approach involves injecting air into contaminated liquid, creating bubbles in order to concentrate PFAS in a foam which can be collected and then incinerated or recycled. Although foam fractionation holds promise as a cost-effective treatment technology for PFAS impacted waters, very low removal efficiencies have been reported for short-chain PFAS. Thus, the overall objective of this project is to investigate the use of polymers and other additives to improve the removal efficiency of short-chain PFAS during foam fractionation, and to advance our fundamental understanding of PFAS behavior in air-water systems. Additionally, other experimental variables for foam fractionation optimization will be examined, including bubble size, air flow rate, type of polymer, and background matrix ionic strength/pH.

Skylar Walters: **Poster #E3**

Home Institution: Brown University

Summer Research Program:The Emerging Infectious Disease and HIV Scholars Program (H-EIDS)

Faculty Mentor: Katherine Siddle, Bio Med Molecular, Microbiology & Immunology

Developing Deep Learning Methods to Catalyze Viral Discovery and Identification from Metagenomic Datasets

As infectious diseases increase in prevalence, the need for advanced methods to promote the discovery and identification of viruses is critical. However, current kmer- and protein-based approaches for identification from metagenomic datasets struggle to identify highly-divergent viral variants due to their dependence on known viral reference genomes. As part of an NIH R25 project with Brown's H-EIDS program, we are developing a novel algorithm centered around an autoencoder with convolutional elements. This autoencoder-based approach will identify and amplify elements of viral genomes that are key to taxonomic classification. The resulting representations can then be clustered to match contigs to a species or broader group. The pipeline takes in a genetic sequence, then converts this sequence into a matrix of 4mer and 6mer counts. This representation is passed into a dense layer to learn preliminary patterns before going into the autoencoder. Ultimately, the model will also convolve over amino acid sequences to better capture spatial protein relationships between contigs.

The second phase of this project involves applying this model to a metagenomic dataset from Senegal, which includes over 500 samples from cases of undiagnosed acute fever collected across three regions over four years. Previous analyses using conventional methods yielded few viral infections (<5% of cases), indicating that viral divergence may hinder pathogen detection. By utilizing our deep learning framework, we aim to uncover a more comprehensive viral landscape in Senegal, potentially identifying novel viral strains and significantly enhancing viral detection and understanding, thereby contributing to improved global health outcomes.

Alex Wang; Anoop Kiran: **Poster #E4**

Home Institution: Brown University

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

Faculty Mentor: Kenny Breuer, School of Engineering

The Effect of Ground Proximity in Dynamic Quadrotor Flight

Quadrotors have seen a surge in recent years, specifically tied to applications related to search-and-rescue, safety inspections, autonomous product delivery, and 3D mapping. Their everyday use requires them to dynamically approach the ground, boundaries, and walls, where their flow structure can be altered. Understanding the characteristics of flow near these surfaces and its effect on vehicle dynamics can inform drone stability, control and flight endurance.

Previous studies on the ground effect seek to optimize flight efficiency based on the increased lift experienced near ground planes purely based on static measurements. However, realistic flight near the ground requires varying the rate of descent. Our setup uses a linear motor to actuate a dynamic traverse housing a Crazyflie quadrotor to approach a ground plane with sinusoidal position profiles. For a range of drone throttles and stopping distances, we modulate rate of descent by varying the amplitude and frequency of traverse cycles. By phase averaging lift of the vehicle near the ground plane and subtracting the response generated inertially, we can measure and plot the lift generated by the drone with respect to surface distance.

Future outlook for this work involves analyzing various quadrotor configurations and the presence of multiple quadrotors. By making adjustments to the ground plane placement, we also plan on measuring the effect of ceiling and walls on stability. Configurations involving two Crazyflie quadrotors are also of interest—running two quadrotors side by side, simulating flybys, or measuring the force on a stationary drone as a second quadcopter approaches. Lastly, upgrades to the dynamic traverse could allow us to attain faster motion and further differentiate between dynamic and static results.

Fan Ze Wang: **Poster #E5**

Home Institution: Brown University

Summer Research Program: Royce Fellowship

Faculty Mentor: Jonghwan Lee, School of Engineering

Instrumentation design for remote activation of retinal neurons in rabbits

Retinal degenerative diseases such as retinitis pigmentosa, age-related macular degeneration, and Stargardt disease lead to incurable blindness through the loss of photoreceptors. Retinal prostheses aim to restore sight by implanting electronic hardware to stimulate the retinal neurons. Retinal ganglion cells are one target of stimulation as they remain intact in retinal degenerative diseases. Current research suggests the potential of gold nanorod-enhanced near-infrared (NIR) lasers in stimulating intact retinal neurons to regenerate vision. This project seeks to develop instrumentation capable of emitting NIR laser pulses to stimulate retinal neurons while measuring neural activity from the visual cortex in vivo via electroencephalograms. Following validation of our system in rodent eye models, we seek to expand experimentation to rabbit eye models due to feasibility in delivering well-controlled, patterned laser stimuli as well as anatomic similarities with human eyes.

The proposed design is a functional fundus microscope system capable of imaging the retina in rabbit eye experiments. Using an optical model of the rabbit eye, we designed a system capable of imaging the retina across a ±45° field of view. The addition of this imaging system to a scanning laser system for NIR stimulation and a visible laser for controlled stimulation to mimic natural visual stimuli will yield a pilot system for in vivo validation. The next steps in our project include optimization of imaging performance and experimental validation of our proposed design in rabbits.

Alan Wang: **Poster #E6**

Home Institution: Brown University

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

Faculty Mentor: Daniel Watkins, School of Engineering; Monica Wilhelmus, School of Engineering

Uncertainty Quantification for Satellite Observations of Sea Ice Motion

Sea ice motion observations are crucial for studying climate processes, including ocean circulation, atmosphere-ocean fluxes, and Arctic change, as well as providing vital information for marine operations. Typical satellite-based observation methods struggle to measure sea ice drift behavior in the summer due to difficulty differentiating melting ice and liquid ocean water. Optical imagery from satellites has potential for high resolution and shows promise for working in summer, but is limited due to cloud cover. In this project, we investigate the bias introduced by non-uniform sampling of sea ice drift due to only recording observations under clear conditions.

Wind stress is known to be a dominant factor driving sea ice motion. We investigate variability in the drift speed ratio as a function of cloud cover throughout the seasonal cycle. One full year of drift data was collected by ice-tethered buoys from the 2019-2020 MOSAiC drift expedition. Wind speed was taken from the ERA5 (an observation-constrained weather model) and interpolated to buoy positions. We found that when wind speeds are low, sea ice demonstrates similar behavior regardless of clouds. At higher wind speeds, there is a tendency toward higher drift speed ratios in cloudy conditions, though there is significant overlap between distributions. This tendency was especially prominent during winter and spring months. Approximately 90% of observations year-round with winds stronger than 10 m/s were observed under cloudy conditions, highlighting the need to account for biases introduced by non-uniform sampling when interpreting cloud-limited sea ice motion observations.

Claire Xu: **Poster #E7**

Home Institution: Brown University

Summer Research Program: Sponsored research with the Department of Earth, Environmental, and Planetary Sciences (DEEPS)

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

Pliocene δ18O and δ13C Climate Reconstructions from Site 846 Benthic Foraminifera

Reconstructing Earth's past climate can give insight into the long-term effects of anthropogenic global warming. One proxy used in climate reconstructions is benthic foraminifera: single-cell microorganisms living in the deep ocean that preserve the oxygen (δ18O) and carbon isotope (δ13C) ratios of surrounding water in their calcium carbonate shells. These values correlate with climate characteristics such as deep sea temperature, global ice volume, and deep-water age on the thousands-of-year timescale. The Pliocene (5.3-2.6 million years ago) is especially relevant for climate projections since simulations indicate the Pliocene as a likely analog of climate in 2030, with similar carbon dioxide concentration but no permanent Northern Hemisphere ice sheet, higher sea levels, and increased global temperatures. Here we reassess the δ18O and δ13C curves Shackleton et al. 1995 made using benthic foraminifera from Site 846 in the Eastern Equatorial Pacific Ocean, which currently serve as a foundation for assembling other global deep water isotope records and interpreting climate in the past 6 million years.

We present new δ18O and δ13C curves for the late Miocene to Pliocene period (6.2-4.5 million years

ago) constructed from two benthic foram species, Cibicidoides sp. and Uvigerina sp., from Site 846. Our δ18O record demonstrates a significantly more regular glacial-interglacial pattern that aligns with the 41 kyr orbital pacing and shows half the variance in δ18O values compared to the older record. Moreover, our δ18O record more strongly resembles other existing δ18O records over the same time period; for example, Shackleton et al. 1995 depict a sudden starting warming at 5.5 million years ago not present in our curve or that of U1338, another Pacific Equatorial site. While our and Shackleton et al. 1995's δ18O curves have notable differences, our δ13C curves are in strong agreement. Reconciling discrepancies between the historic and newly generated isotope records is crucial to understanding how Earth's climate adjusts to changes in CO2 levels, allowing for more accurate projections of future climate.

Iris Yang: **Poster #E8**

Home Institution: Brown University

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

Faculty Mentor: Ming Xian, Chemistry

A comprehensive analysis of resazurin and its application for the detection of hydrogen polysulfides

Resazurin, a non-fluorescent dye, can be reduced into the highly fluorescent compound resorufin, and it has been used for detecting reductive activities, cell viability, and cytotoxicity in biological systems. Resazurin may also be used to detect certain sulfane sulfur species, such as hydropersulfides (RSSH) and hydrogen polysulfides (H2Sn), which are involved in the redox signaling of various physiological and pathological processes. In this work, we describe the physical properties of resazurin and examine its fluorescence sensitivity under different conditions. Through fluorescence analyses of resazurin, we also determined its selectivity for hydrogen polysulfides. Our findings provide insights into the potential applications of resazurin and suggest modifications to enhance its selectivity for hydrogen polysulfides.

Lingwen Zhang: **Poster #E9**

Home Institution: Brown University

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

Faculty Mentor: Alexander Zaslavsky, School of Engineering

Fabrication of a Ge Quantum Dot Photodetector Prototype on an Oxide-covered Si Wafer

Pioneering a versatile near-infrared photodetector array, this research project continues developing the unique design featuring germanium topped with Indium Tin Oxide (ITO) and an intermediate layer of SiO2 quantum-dotted with Ge. Leveraging their distinct bandgap energies of approximately 7 eV and 0.7 eV, respectively, this innovative configuration enables electrons to tunnel through the quantum-dotted Ge in the presence of light, directly influencing its quantum efficiency. The anticipated result is a device with photoresponsivity spanning a wide wavelength range from 200 nm to 1700 nm, covering both visible light and a broad spectrum of near-infrared (NIR) wavelengths. The potential applications of such a device include medical imaging, environmental monitoring, search and rescue operations, telecommunication, and beyond. This project will prioritize testing the device's compatibility with Si CMOS.
As part of this large project, the undergraduate researcher will fabricate simpler structured devices in the cleanroom, germanium on top of aluminum on an oxide-covered silicon wafer (a stand-in for a

prefabricated Si CMOS chip), in order to test the conductivity of the deposited polycrystalline germanium and its compatibility with transparent ITO contacts. In this phase, the germanium layer may be doped with n-type dopants to increase its conductivity. After the material's I/V characteristics are measured in Professor Zaslavsky's lab and analyzed, a prototype device will be fabricated to test its compatibility with silicon based transistors under photoexcitation conditions.

PengCheng Zhu: **Poster #E10**

Home Institution: Brown University

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

Faculty Mentor: Shouheng Sun, Chemistry

Efficient Epoxidation of Olefins with Bimetallic Nanoparticles

Olefin oxides are highly useful in many synthetic pathways, particularly in the production of fine chemicals and biological molecules. However, current industrial methods of epoxidizing olefins mostly rely on the halohydrin method or other homogenous catalysts with harmful oxidants such as peracids, which generates toxic waste on a stoichiometric scale. Therefore, epoxidation reactions involving heterogenous catalysts and greener oxidants such as hydrogen peroxide or molecular oxygen with good yield and selectivity would be benefit both industry and environment, since the waste from the oxidant is less problematic and the heterogenous catalyst could be re-used over multiple reaction cycles. This research project seeks to do just that by investigating the potential of AuAg alloy nanoparticles as a high-performing catalyst for olefin epoxidation. Building on previous research on the activity of both Au and Ag nanoparticles for selective epoxidation, and our research group's previous recipe for the facile synthesis of AuAg alloy nanoparticles, this research project seeks to elucidate whether synergistic effects exist between Au and Ag in context of epoxidation reactions as well as the effects of the support on which the nanoparticles are deposited on.

Adrián Duchesne: **Poster #E12**

Home Institution: University of Puerto Rico Rio Piedras Campus

Summer Research Program: Leadership Alliance SR-EIP

Faculty Mentor: Kemp Plumb, Physics

Investigating the effects of magnetic dilution on the frustrated magnet K2IrCl6

This investigation explores the impact of magnetic dilution on the frustrated magnet K2IrCl6. Magnetism arises when microscopic magnetic moments minimize their energy by spontaneously aligning. In frustrated magnets, the magnetic moments cannot simultaneously minimize their energy leading to a large degeneracy among lowest energy states and the inability to form a unique magnetic structure [1]. K2IrCl6is a material known for its strong spin-orbit coupling and frustration-induced magnetic properties, provides an ideal framework for examining the interplay between magnetic dilution and frustration effects. We chemically modify the compound K2IrCl6, replacing a fraction of magnetic Ir, x, with non-magnetic Sn with respect to the following formula K2Ir(1-x)SnxCl6. By substituting iridium with tin at various concentrations, we aim to dilute the magnetic lattice and study how these changes affect the magnetic interactions and overall properties of the compound.

[1] Billington, D., Ernsting, D., Millichamp, T. E., Lester, C., Dugdale, S. B., Kersh, D., ... & Takatsu, H.

(2015). Magnetic frustration, short-range correlations and the role of the paramagnetic Fermi surface of PdCrO2. Scientific reports, 5(1), 12428.

Additional Physical Sciences Projects are located in Column G

Josh Brown; Audrey Bu; Zachary Cheesman; Benjamin Orman; Sam Thomas; Iris Horng: Poster #G1

Home Institutions: Ursinus College; Emory University; Bowdoin College; Grinnell College; Brown University; University of Pennsylvania

Summer Research Program: Institute for Computational and Experimental Research in Mathematics (ICERM)

Faculty Mentor: Amanda Harsy, Lewis University, Department of Engineering, Computing, and Mathematical Sciences; Adam Schultze, Lewis University, Department of Engineering, Computing, and Mathematical Sciences

Predictive Modeling of English Club Soccer Using Ranking and Forecasting Methods

In this research, we examine the capabilities of different mathematical models to accurately predict various levels of the English football pyramid. Existing work has largely focused on top-level play in European leagues; however, our work analyzes teams throughout the entire English Football League system. We modeled team performance using weighted Colley and Massey ranking methods which incorporate player valuations from the widely-used website Transfermarkt to predict game outcomes. Our initial analysis found that lower leagues are more difficult to forecast in general. Yet, after removing dominant teams from analysis, we observed that this disparity was diminished. We also extended our findings using data from multiple German and Scottish leagues.

Andrea Jimenez Moreno: Poster #G2

Home Institution: University of Puerto Rico - Mayaguez

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

Faculty Mentor: James Dottin III, Earth, Environmental, and Planetary Sciences

Triple Oxygen Isotope Evidence for Crustal Recycling Within the Samoan Mantle Plume

Crustal recycling influences the availability of oxygen on Earth's surface.The Sr-Nd-Pb isotope composition of Samoan lavas indicates that distinct groups of islands at Samoa erupt distinct flavors of mantle and that the Samoan mantle plume may, therefore, be geochemically zoned (Jackson et al., 2014). Whether oxygen is also zoned in the Samoan mantle plume is unknown. Zoned oxygen would imply that distinct flavors of mantle have distinct oxygen isotope compositions associated with surface oxygen reservoirs and as such could possibly be used to identify various recycled components among Ocean Island Basalts globally.
Here, we present the triple-oxygen isotope composition of 2-3 mg of olivine and quartz separated from Samoan lavas (n=21) using laser fluorination and dual-inlet gas source mass spectrometry to place detailed constraints on the constituents that have erupted at Samoa throughout its history. With the exception of TGA 1457 ($\delta^{18}O$ = 13.66±0.23) and U14 ($\delta^{18}O$ = 9.11±0.23), most $\delta^{18}O$ values mimic mantle values (ranging from 3.01 to 6.66 (±0.23 2σ)). The $\Delta^{17}O$ values from all samples range from -0.029 to -0.083 (±0.008 2σ). The $\delta^{18}O$ positively correlates with $^{87}Sr/^{86}Sr$ and $\Delta^{17}O$, and confirms that

the samoan mantle plume has a strong influence from low temperature continental sediments (Workman et al., 2008;Jackson et al., 2009). Neither δ18O nor Δ17O values reveal distinct oxygen isotope compositions with respect to Sr-Nd-Pb. Such a lack in geochemical zonation of oxygen is possibly due to its wide distribution among minerals that are precipitating out of samoan melts relative to other elements like Pb and S. Furthermore, the data possibly indicates that the plume is not zoned but rather samples distinct overriding plate components.

Jay O'Neill: **Poster #G3**

Home Institution: Brown University

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

Faculty Mentor: Robert Hurt, School of Engineering

Limiting the Impact of Ionic Strength and pH on Graphene Oxide-based Films as a Novel Controlled Release System

This work focuses on the use of graphene oxide-based films as a matrix for controlled release applications. The controlled release field is generally dominated by polymers and ceramics that host molecular agents for use in drugs, fertilizers, antimicrobial agents and more. The goal of these systems is to mitigate burst release that can exceed or fall short of required dosing's for a given application. In our study, a model dye was intercalated within a graphene oxide (GO)-based film and then exposed to a receiving fluid. The dye concentration in the receiving fluid was monitored over time to determine the total mass released. Our findings show that the rates of release are affected by the intercalated agent/host interactions and the confinement applied by the host 2D material. These aspects are influenced by various environmental conditions such as ionic strength and pH. When increasing ionic strength, a decrease was observed in the release rate and total mass released from the film. Decreasing pH showed a more drastic drop in these categories as well but not in sequential order as observed in the ionic strength experiments. This can be equated to the diminishing steric interaction between oxygen functional groups on GO's surface in combination with our model dye picking up available protons. To lessen the impact of ionic strength and pH, we have created a crosslinked GO-methyl cellulose (MC) film to host our intercalated molecule; specifically with glutaraldehyde, allowing connection to be made between MC and the hydroxyl functional groups on GO. As the GO-MC films are placed into the receiving fluid, it was observed that the effects of pH and ionic strength diminish, supporting the notion that the diffusion rate of the active agent was only marginally influenced by these environmental factors. This work results in a new controlled release mechanism that is different from the others by means of surface interactions and molecular confinement; and the potential applications, and good follow-up studies, range from impregnating gauzes with GOMC and rehabilitation promoting active agents, to creating reusable transdermal patches.

Alejandra Torres: **Poster #G4**

Home Institution: Southern Methodist University

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

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

Hydroclimate variability in Glacial Lake Mojave: A high-resolution record across the last

deglaciation

The water balance in arid regions is particularly sensitive to climate change. Accordingly, understanding hydroclimatic processes in these environments is essential for predicting water availability under future climate warming. The Great Basin region in the western U.S. is a key area to study rapid changes in water availability, as it was once occupied by lakes during the last deglaciation but is currently arid. Existing hydroclimate models rely on conflicting explanations for this change in water balance. One limitation of existing studies is the absence of high temporal resolution in records from southernmost sites that would clarify model outputs. In this study, we focus on Glacial Lake Mojave, now Silver Lake, which served as the terminus for the Mojave River watershed, which drains the San Bernardino mountain range and captures broadscale atmospheric variability in response to climate change. We utilize two distinct records of lake chemistry – ostracods from the lake depocenter and shoreline tufa – to determine lake conditions from Last Glacial Maximum to present. Overall decreasing trends in the carbon and oxygen isotope timeseries generated from tufa and ostracods describe shallower lake levels in the LGM, lake deepening across Heinrich Stadial 1 leading up to the previously inferred lake high stand at ~15 ka, and finally, desiccation in the early Holocene. These findings, when incorporated with other existing records, will assist in refining hydroclimate models for the forcing mechanisms responsible for rapid deglacial changes in water balance in the Southwestern U.S. region.

Natsuka Hayashida; Priscilla Doran; Kristen Joyner; Grace Moberg; Matthew Senese;

Austin Kind; **Poster #G5**

Home Institutions: Brown University; Bryan College; University of Tennessee, Knoxville; Colby College; Lewis University; Lewis University; Lewis University

Summer Research Program: Institute for Computational and Experimental Research in Mathematics (ICERM)

Faculty Mentor: Cara Sulyok, Lewis University, Department of Engineering, Computing, and Mathematical Sciences; Brittany Stephenson, Lewis University, Department of Engineering, Computing, and Mathematical Sciences

A Mathematical Model of *Clostridioides difficile* Transmission in Long-Term Care Facilities

Clostridioides difficile, also known as *C. difficile*, is a prevalent cause of infectious diarrhea in United States healthcare facilities. Spread through the fecal-oral route and primarily through contact with spores on contaminated surfaces, *C. difficile* can cause severe diarrhea, stomach pain, and colitis. Most individuals can mount an effective immune response, but older populations, immunocompromised individuals, and those taking antibiotics have a higher risk of being colonized by *C. difficile*. While extensive research has been conducted in hospital-based settings to improve understanding the transmission of this bacteria, few studies apply mathematical models in the context of long-term care facilities.

This work introduces a mathematical model using a system of ordinary differential equations to represent *C. difficile* transmission dynamics in assisted living facilities, with their interactive nature and high risk factors. The equations include four resident classes (susceptible, colonized, diseased, and quarantined) and three pathogen environmental reservoirs (high-traffic areas, low- traffic areas, and healthcare worker hands) to simultaneously capture the movement between classes and track the number of spores on these environmental reservoirs, including how they contribute to disease spread. Data from the Emerging Infections Program at the Centers for Disease Control and Prevention was used for parameter estimations, and sensitivity analyses were performed to quantify the impact of varying these parameters

and their impact on incidence. Ultimately, this work will provide insight into possible mitigation tactics to help reduce the incidence of *C. difficile* in long-term care facilities.

Shayaan Chaudhary: Poster #G6

Home Institution: Brown University

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

Faculty Mentor: Kimani Toussaint, School of Engineering

Light sheet optical tweezers as a force transducer for biological tissues

The mechanical properties of cells, such as stiffness and elastic modulus, can provide valuable insight into various biological processes, including adhesion, locomotion, and angiogenesis. Further, analyzing the dynamic changes in these properties can provide further insight into more complex processes such as tissue development, morphogenesis, and pathological developments. Currently, these mechanical properties are measured and analyzed through atomic force microscopy (AFM). However, AFM, due to its fine-point probe and high force noise, can cause cell deformation and inaccurate measurements. Additionally, it limits cell analysis as its use prevents concurrent activities, such as imaging or fluorescence microscopy. In contrast, optical tweezers (OT), acting like a Hookean spring, bypass these limitations of AFM, presenting the opportunity to exert sup-piconewton forces on microscopic particles and measure displacements with nanometer precision. Thus, OT present the leading method of measuring minute forces in situ. While conventional OT have been used as force transducers for microparticles, their low throughput and necessity for high laser power not only limit it to single indentation events, but also induce heat and phototoxicity which can damage the biological particles being trapped or indented. In this study, we instead use pulsed femtosecond lasers and a cylindrical lens to implement light sheet OT under the Hertz model to mitigate these limitations. These indentations can then be analyzed using a videography algorithm to track particles and displacements. This novelty enables simultaneous side-by-side force transducers with meticulous accuracy, allowing for the characterization of local and average mechanical properties of biological tissues. With this advancement, we can enhance our understanding of tissue mechanics with the help of improved spatial resolution and throughput.

Lauren Hogan; Lucie Johnson: Poster #G7

Home Institution: Brown University

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

Faculty Mentor: Jerome Robinson, Chemistry

Bridging Structure with Function – Decoding the Blueprints in Catalyst Design to Access High Performance Biodegradable Copolymers

Plastics (polymers) have enabled critical advances in nearly every aspect of modern life. However, our society's reliance on the enormous volumes of environmentally persistent polyolefins is contributing to one of the greatest environmental concerns for current and future generations. Biodegradable polymers, such as poly(lactide) (PLLA), poly(caprolactone) (PCL), and poly(3-hydroxybutyrate) (P3HB) are promising candidates as a sustainable alternative, but in isolation, each material suffers from significant limitations. Copolymerization is a common strategy to access materials with properties that include and often surpass their individual components. However, access to a wide range of block copolymers has remained limited.

In this poster, we will share our recent progress on decoding the blueprints in catalyst design for block copolymerization, specifically for triblock copolymers composed of PLLA, PCL, and P3HB. To access these copolymers, we synthesized a family of new zinc-based catalysts and assessed their reactivity in the ring-opening homo/copolymerization (ROP) of PLLA, PCL, and P3HB. Using one of these zinc-based catalysts, we managed to synthesize a series of triblock copolymers with different ratios of the three blocks. We then assessed their distinct composition-specific thermal and morphological properties.

Keyan O'Donnell: **Poster #G8**

Home Institution: Brown University

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

Faculty Mentor: Andrew Peterson, School of Engineering

Quantum Chemical Effects at the Iron Electrode in an Iron-Air Battery

Iron-air batteries are a promising solution for mass grid storage due to their long-term energy storage stability and ultra-low material cost. However, the hydrogen evolution reaction (HER) during the charging cycle compromises battery efficiency (by reducing round-trip efficiency) and longevity. Modifying iron electrodes with sulphur presents a cost-effective strategy to reduce HER, leveraging sulphur's potential to alter the electronic environment of iron surfaces. This study employs state-of-the-art atomistic calculation methods, specifically the Solvated Jellium Method (SJM) developed in the Peterson lab, to investigate sulphur's impact on iron electrodes. In doing this, the viability of sulphur as an 'anti-catalyst' in reducing the material's work function will reduce the parasitic HER to a meaningful degree such that it could in future be deemed commercially viable. By advancing iron-air battery performance, this research promotes the integration of renewable energy sources into the grid, fostering a cleaner and more resilient energy infrastructure.

Jessica Tingley; Deepa Mahesh: **Poster #G9**

Home Institutions: University of Rhode Island; Smith College

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

Faculty Mentor: Nora Ayanian, Engineering and Computer Science

Quadcopter Swarms: Precision Localization with Minimal Motion Capture

Teams of drones have become a unique tool for tasks like disaster relief, wildfire containment, and entertainment where one drone alone may not be effective. Many localization techniques are used to achieve successful swarming, such as GNSS, motion capture, and computer vision. However, these approaches tend to take a centralized approach and often fail to achieve scalability and cost efficiency. In this work, we conduct a comparative study across multiple types of low-cost sensing systems specific to the Crazyflie drone. These sensing systems use expansion boards, some of which communicate with external anchoring systems, allowing for localization to be done on-board in a decentralized fashion. We discuss how these various sensing systems perform, providing financially accessible options to implement swarming architectures.

SOCIAL Projects are Posters #G10 through #G11

Andrew Cabrera: **Poster #G10**

Home Institution: University of Maryland, Baltimore County

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

Faculty Mentor: Anna Aizer, Economics

Wealth and Intergenerational Mobility: The Role of Land Ownership

While past literature has largely examined the role of parental income in shaping child outcomes, the influence of parental wealth is not as well understood. To further our knowledge on this topic, this work explores the impact of land ownership on intergenerational mobility, focusing on how parental wealth, distinct from income, affects child health and development. This project leverages the 1937 Bankhead-Jones Farm Act, which enabled tenant farmers to purchase land through low-cost, 40-year mortgages provided by the Farm Security Administration. By 1947, this program had spread nearly $300 million in loans to 47,000 families. Starting in 1941, Congress tied loans to average farm values in each county, which meant that poor counties were less likely to gain eligibility after this date. The aim of this project was to develop estimations of the impacts on land ownership from 1930 to 1950, differences in ownership by race, and outcomes across generations, including mortality, education attainment, occupation, mobility, marriage, and earnings. The sample used for analysis is comprised of tenant farmers in the American South in 1930. An instrumental variable regression analysis will be used, with the duration of loan eligibility as the instrument, to measure the impact of land ownership on these outcomes. This approach depends on the assumption that longer eligibility increases the likelihood of obtaining a loan, and accordingly land ownership, providing a framework for assessing the effects of land ownership on intergenerational mobility.

Max Cook: **Poster #G11**

Home Institution: Tufts University

Summer Research Program: National Institute on Drug Abuse Summer Research Internship Program

Faculty Mentor: Justin Berk, Bio Med Medical Education

Knowledge and Perceptions of Injectable Buprenorphine in a Carceral Setting

Background: Providing medications for opioid use disorder (MOUD) in correctional facilities can significantly increase community treatment engagement and reduce the risk of overdose post-release. Despite these benefits, most jails and prisons fail to offer any form of MOUD. Extended-release buprenorphine (XR-B), a novel MOUD formulation, has several feasibility advantages over traditional MOUD and can address social and operational barriers to MOUD uptake in correctional settings. Understanding the feasibility and acceptability of XR-B from the perspectives of incarcerated patients and organizational stakeholders can inform efforts to expand access to life-saving treatment for a highly marginalized population.

Methods: In-depth, semi-structured interviews were conducted with 10 organizational leaders and 19 incarcerated individuals enrolled in the MOUD treatment program at the Rhode Island Department of Corrections (RIDOC). Interviews were guided by the integrated-Promoting Action on Research Implementation in Health Services (i-PARIHS) framework, which interprets successful implementation through four constructs: Facilitation, Innovation, Recipients, and Context. Interviews with organizational leaders had greater emphasis on Facilitation and Context items concerning organizational and policy

infrastructure, while interviews with incarcerated patients focused on Innovation and Recipients items concerning patients' experiences. Qualitative analysis of interview data was conducted using Dedoose research software.

Results: Three key preliminary themes were identified: (1) patients valued convenience of XR-B and the added privacy which reduced stigma, (2) lack of knowledge for the novel treatment prompted distrust in starting the medication in a prison setting, and (3) XR-B had the potential to improve facility climate from a security perspective. Limited knowledge of XR-B as an available treatment option post-release was also highlighted.

Discussion: XR-B offers a way to increase convenience, reduce stigma to patients, and has potential to improve facility operations. However, there is limited knowledge and significant medical distrust that likely decreases uptake in these settings. With a growing number of states enacting mandates for jails and prisons to provide access to MOUD, the specific themes identified in this study can inform wider XR-B implementation and enhance continuity of care post-release. Future studies should investigate the role of XR-B in optimizing MOUD delivery in correctional settings.

Alli Brophy; Andrés Castellanos Hernandez; Bryce Iversen; Danielle Murphy; Austin Kind: Poster #G12

Home Institutions: Winthrop University; Sonoma State University; Sonoma State University; University of California, Berkeley; Lewis University

Faculty Mentor: Brittany Stephenson, Lewis University, Department of Engineering, Computing, and Mathematical Sciences; Cara Sulyok, Lewis University, Department of Engineering, Computing, and Mathematical Sciences

Stochastic Simulations of C. difficile Spread in Assisted Living Facilities

Clostridioides difficile, also known as C. difficile, is a bacteria commonly found in healthcare settings that spreads through touch and within the environment through colony forming units of spores found on surfaces. Studies have shown individuals with an advanced age are more likely to become colonized or diseased with C. difficile. The death rate from C. difficile has been reported to be 1 in 11 people, and furthermore, mortality in relation to the disease has been shown to increase with age.

Multiple mathematical models, including agent-based models (ABMs), have been used to study the spread of C. difficile primarily in hospital settings while very few models have examined this transmission in long-term care facilities, such as assisted living facilities (ALFs). Residents in ALFs require care from staff for many activities of daily living, but often have a more social and active environment than in hospitals since residents may stay in their private rooms or visit common areas, especially during meal times. Due to the increased level of social activity in an ALF, model simulations of the spread of C. difficile will vary greatly when incorporating shared common spaces and how residents interact with them, and each other.

Our ABM accounts for these social behaviors and the assistance needs of residents in an ALF, the contamination on various surfaces, and the impact of healthcare workers and visitors as transmission vectors. In particular, we study how residents in ALFs are exposed to C. difficile, and how cleaning and staff protocols can be leveraged to mitigate the spread of this disease.

Social Science

Amina Anekwe: **Poster #E13**

Home Institution: New York University

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

Faculty Mentor: Andrea Flores, Education; Katherine Mason, Anthropology

"My parents came here to give me a better life": Familial Closeness, Identity Formation, and the Dynamics of Expectation among Immigrant Origin First-Generation College Students of Color

As the first to attend college in their families, immigrant-origin First Generation College Students (FGCS) face a distinctive weight of responsibility to trailblaze a path of upward mobility and financial success for their families in their new nation of settlement. FGCS's internalization of this responsibility and its relationship to their emergent sense of self hinges on the strength of their familial bonds. Drawing from data collected by the Pandemic Journaling Project (PJP) with FGCS and their families, this study hypothesizes that FGCS with tighter-knit familial ties internalizes their filial responsibility through self-imposed pressure to succeed. Consequently, they develop an interdependent sense of self, aligning their life goals with perceived familial needs and desires. Conversely, FGCS with more distant familial relationships, while still experiencing higher degrees of responsibility for their families, maintain an independent sense of self and pursue goals distinct from their familial expectations. This research underscores the crucial role of family dynamics in shaping both the academic and personal trajectories of FGCS, aiming to contribute valuable insights for educators, counselors, and policymakers aiming to support this student population more effectively.

Marlena Brown: **Poster #E14**

Home Institution: Brown University

Summer Research Program: Voss Fellows

Faculty Mentor: Kim Cobb, Earth, Environmental, and Planetary Sciences

Central Pacific coral tracks climate across the 1815CE Tambora eruption

Recent coral-based reconstructions document regional warming and freshening in the central tropical Pacific over the 20th century (Nurhati et al., 2011; Hitt et al., 2019), as well as an increase in ENSO variance in recent decades (Grothe et al., 2019). However, the early 19th century–the period prior to the onset of greenhouse gas emissions during the Industrial Revolution–marks a critical gap in coral-based reconstructions of tropical Pacific climate. While some studies document an early phase of warming during the early 19th century in this region (Abram et al., 2016), the prevalence of large volcanic eruptions during this period complicates the detection and attribution of temperature trends during this period. Chief among these eruptions is the 1815 Tambora eruption, the largest volcanic eruption in recorded history. This class of eruptions is associated with global-scale cooling in the 1-2yrs following the eruption (Robock, 2000), and may increase the probability of an El Niño event, according to some studies (Robock et al., 1995; Adams et al., 2003; Mann et al., 2005; Stevenson et al., 2017). Building on decades of work reconstructing climate in the central tropical Pacific (Cobb et al., 2013; Hitt et al., 2021; Grothe et al.,

2019), we present a monthly-resolved d18O record from Kiritimati Island (2°N, 157°W) spanning 1800 CE to 1824 CE. Early results document interannual coral d18O ENSO variability in line with mid-20th-century interannual coral d18O variability. However, mean coral d18O from the 19th century coral is significantly lower than mid- to late-20th century values, implying cooler and/or drier conditions during this period. The new coral d18O record shows no clear indication of year-on-year cooling nor a strong El Nino event in the years immediately following the Tambora eruption. However, more definitive findings await the application of coral Sr/Ca analysis to distinguish temperature versus hydrological signals associated with the mega-eruption, as they may mask each other in the coral d18O record.

Angelica Autman: **Poster #E15**
Home Institution: Tougaloo College

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

Faculty Mentor: Katie Biello, Public Health-Epidemiology; Jennifer Olson, Center for Health Promotion and Health Equity

Transforming Health Together: The Journey of Community-Engaged Research

Two studies being conducted by the FRESH team at Brown University School of Public Health, PrEPare for Work (P4W) and ATN170: Project IMPACT, are testing the efficacy of interventions to reduce risk of HIV acquisition and tranmission among vulnerable populations. The P4W intervention aims to increase the uptake, adherence, and persistence of HIV pre-exposure prophylaxis (PrEP) among male sex workers (MSWs) by providing personalized case management and adherence counseling support using principles of motivational interviewing and cognitive-behavioral therapy. The P4W study involves a two-stage randomized controlled trial with participants receiving either standard care or enhanced support through strength-based case management and personalized text messaging reminders. The ATN170 intervention focuses on reducing stimulant use and unprotected anal sex (i.e., sex without a condom and not protected by PrEP or ART), among young sexual minority men (YSMM) aged 16-24. Both studies utilize diverse outreach approaches to ensure diversity in enrollment and the inclusion of a broad spectrum of experiences, including connecting with participants through events, street outreach, community based partnerships, and social media campaigns. By addressing the unique challenges faced by MSWs and YSMM, these interventions aim to improve strategies for reducing HIV transmission and improving health outcomes in these vulnerable groups.

Madison Byrd; Shokria Sakhi: **Poster #E16**
Home Institutions: Claflin University; Brown University

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

Faculty Mentor: Cara Murphy, Public Health-Health-Behavioral & Social Sciences

Exploring the Relationship Between Weight-Based Stigma and Frequency of Fast Food Consumption

The “overconsumption” of fast food (i.e., mass-produced foods low in nutritional value that are readily available for purchase) is a growing concern in the public health community, given its association with

rising obesity rates. Factors such as income, socioeconomic status, and food environment can impact one's ability to choose "healthier" health behaviors. Furthermore, health behaviors can influence stigma. This study explores the relationship between internalized stigma (i.e., internal acceptance of negative societal beliefs), income, and varying degrees of fast food consumption. The study utilizes a cross-sectional design with data from a multi-health-behavior intervention focused on smoking cessation and weight gain prevention among individuals who smoke cigarettes who met the criteria for overweight or obesity. Participants (n=55) completed a baseline assessment including self-reporting their eating habits, including their consumption of fast food (i.e., the Diet and Behavior Questionnaire (DBQ)), experiences of stigma and biases due to weight (i.e., the Weight-Based Internalization Scale (WBIS)), and demographic characteristics. Bivariate correlations examined possible associations between stigma, demographics, and income. We hypothesized that higher scores of weight-based self-stigmatization would be associated with increased fast-food consumption. There were no significant associations between stigma, fast food consumption, and income (all p's>0.05) . It may be that factors such as food availability may influence fast food consumption more than income or stigma. Moreover, including a large and more diverse sample may help provide information on fast food consumption and may help provide additional information on the possible role of stigma on eating behavior.

Asiah Donahue: **Poster #F1**

Home Institution: Xavier University of Louisiana

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

Faculty Mentor: Meredith Hastings, DEEPS/IBES

Incorporating Lived Experience from Residents of Providence, Rhode Island into the Scientific Method

Many people in the United States feel disconnected from the scientific process and with climate change leading to more extremes, the public wants to both understand the science and be informed about how to protect their health. While many scientific outlets provide public facing information, most scientific studies speak to using the public as participants not as a means of collaboration.

The Breathe Providence project is a hyperlocal air monitoring study in Providence, Rhode Island. The air monitoring network focuses on areas of the city where asthma rates are very high and air quality data has historically been very limited. In addition to monitoring common air pollutants, the project has participated in collaborative data generation with residents. A key concern were odors from the Port that residents associate with pollution and harm. Through a variety of methods, we encouraged residents to document their experiences related to air pollution. Via an app called Smell My City (created by CMU's CREATE Lab), that allows for self-reporting by residents when they encounter odors, what they "smell like" and how they feel. We will present findings from the residents, how this has influenced investigations of the air pollutant data and reflect knowledge gained via a collaborative data sharing process.

Ultimately, our work is dedicated to raising awareness of solutions that meet residents' concerns based on a reciprocal research process that incorporates residents' data into the scientific process.

Coda Dunn: **Poster #F2**

Home Institution: Northeastern University

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

Faculty Mentor: Roman Feiman, Cognitive, Linguistic, and Psychological Sciences; Amanda Martino, Department of Cognitive and Psychological Sciences

Buckets, Blickets, and Baby Logic: Domain-General Reasoning by Exclusion

Negation, or the capacity to think about what is not, is an essential component of human reasoning. Infants begin to correctly use the language for negation around 24 months, but it is not yet known whether infants have the capacity to think abstractly about negation before this age. We used a cross-task priming design, aimed to uncover whether infants possess domain-general logic before developing the language to articulate this cognitive ability. Participants, aged 18 to 24 months, engaged in two tasks designed to assess reasoning by exclusion, a process which requires thinking about negation (A or B; not A; therefore B). The first task, known as the "blicket detector task," required them to use blocks to activate a detector. To choose the correct block, children needed to reason by exclusion, eliminating the inert block from consideration. The second task, the "bucket and truck hiding game," involved concealing a ball in one of two containers. Participants were placed in two conditions, the inference (primed) group and the no-inference (control) group. If infants primed with the inference task perform better on the bucket truck hiding game, this could provide evidence for shared mental capacities underlying both tasks. If priming has no effect, we might conclude that infants instead rely on domain-specific strategies to succeed at the tasks. We compared the performance of the inference (primed) group and the no-inference (control) group using a logistic regression analysis. Finding evidence for domain-general exclusion reasoning in infants who have yet to understand the language for negation could help us to understand how children learn complex, logical concepts, which might lead to more effective educational strategies to support and foster cognitive development in young children.

Petros Engelhardt; Anny Nelzy: **Poster #F3**

Home Institutions: Brown University; State University of New York at Plattsburgh

Summer Research Program: NIDA Summer Internship Program, and the Brown University UTRA Program

Faculty Mentor: Cara Murphy, Public Health-Health-Behavioral & Social Sciences

Discrimination, Social Status, and Stigma: The Role of Psychosocial Factors in Determining Smoking Cessation Success

Background: Smoking cessation is a vital public health objective, yet many individuals face significant barriers to quitting. Subjective social status (SSS), experiences of everyday discrimination (EDS), and stigma have been shown to influence health behaviors and outcomes, including smoking cessation. However, research investigating the effects of these factors on smoking cessation outcomes within a multiple health behavior change intervention is lacking. **Aim**: This analysis aimed to investigate the effects of SSS, EDS, and both perceived and internalized smoking stigma on smoking cessation outcomes in a multiple health behavior change intervention. **Methods**: Longitudinal data from a 21-week multiple health behavior change intervention for individuals who smoke cigarettes and have overweight or obesity were

used (n=55). SSS, EDS, Internalized Stigma of Smoking Inventory (ISSI), and Perceptions of Smoking-Related Stigma Scale (PSRSS) were assessed at baseline. A Timeline Follow-Back (TLFB) was used at baseline and month two to assess daily use of substances, including smoking behavior, measured through self-reported cigarettes smoked per day (CPD). Carbon monoxide (CO) level was measured at baseline and month two as an objective measurement of smoking behavior. Regression analyses were used to determine whether SSS, EDS, ISSI, and PSRSS predicted change in CPD and CO levels from baseline to the end of the intervention. ANCOVAs were used to evaluate statistically significant differences in CO and cigarettes/day outcomes in participants who did or did not endorse weight, race, and gender as reasons for everyday discrimination. **Result**: Smoking stigma (PSRSS, ISSI), SSS, and EDS did not significantly predict average cigarettes smoked per day and CO at month two, controlling for CO and number of cigarettes/day at baseline (all p-values >.05). There were also no statistically significant differences in month two cigarettes/day and month two average CO between people who did and did not endorse weight, race, and gender as an attribution for experiences of everyday discrimination, controlling for baseline cigarettes/day and CO level (all p-values > .05). **Discussion**: No significant associations between psychosocial factors and changes in CPD and CO levels were found. Additionally, weight, race, and gender as attributes for everyday discrimination showed no significant impact on smoking outcomes. It is important to consider the limitations of our study including the reliance on self-reported data, and a relatively small sample size. Future research may consider specializing interventions to specific demographic groups to improve success rates for populations with less success in smoking cessation.

Masoumah Haidari; Amanda Lee Molina: **Poster #F4**

Home Institution: Brown University

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

Faculty Mentor: Ju Park, Bio Med Medicine

Socioeconomic Intersectionality and Psychologic Comorbidities Influence Sleep Disruption in Patients Receiving Medications for Opioid Use Disorder: A Review of Literature

Background:
An estimated 6 million people suffer from Opioid Use Disorder (OUD) in the United States, in which their bodies and lives are significantly disrupted by opioids such as heroin, oxycodone, and fentanyl. Opioids tap into multiple reward circuits of the brain, creating physiological changes in patients resulting in dangerous and oftentimes fatal effects. In 2023, opioid overdose claimed over 80,000 lives in the United States alone. Sleep disturbances are a recognized but undertreated health issue in this population. In this literature review, we explore an often overlooked aspect of the sleep-MOUD relationship: the intersectionality that comprises patient age, gender, race, psychiatric comorbidities, and other socioeconomic factors that affect both access to care and patient physiology.

Methods:
We conducted a narrative review of the scientific literature published since 2010 utilizing Pubmed MeSH terms. Full-text review and data extraction were performed to explore the treatment implications.

Results:
There is a critical underrepresentation of gender-specific literature in OUD research, despite new evidence that the number of women seeking treatment for OUD is equal to or greater than that of men. Women are more likely to seek benzodiazepine prescriptions for MOUD-related sleep disturbances, despite evidence of contraindication for sedative/hypnotic drugs while on MOUD. Moreover, older adults

aged over 65 were excluded from over 16 studies, creating a gap in understanding how MOUD interacts with the often multiple chronic illnesses prevalent in this population.

There is a critical gap in OUD-insomnia research focused on racially and ethnically diverse populations. Most studies did not analyze the relationships between MOUD, sleep, and race, even though many studies recorded their participants' race. That said, one study found that obstructive sleep apnea was associated with non-Caucasian race. The relationships between MOUD, sleep, and other socioeconomic factors, namely education, employment status, and marital status, were also analyzed in some studies.

Additionally, over 30 studies reported patients on MOUD with mood disorders, such as anxiety and depression, with multiple participants reporting that these psychiatric illnesses further contributed to disrupted sleep.

Conclusions:
There is an expressed absence of literature investigating how social determinants of health—such as age, gender, race, psychiatric comorbidities, and socioeconomic factors—intersect and impact the trajectory of OUD treatment. We argue that these factors could pose barriers to care and influence potential physiological responses to MOUD. Future research should focus on more inclusive approaches to improve the effectiveness of treatment programs and the patient's overall well-being.

Mary Rose Khamfong: **Poster #F5**

Home Institution: University of Maryland - Baltimore County

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

Faculty Mentor: Jennifer Sullivan, Center for Gerontology and Health Care Research

Identifying Contextual Factors Affecting Long-Term Services and Supports Program Implementation in the U.S. Department of Veterans Affairs: A Rapid Scoping Review

Background:
Implementing evidence-based practices within Long-Term Services and Supports (LTSS) programs in the Veterans Health Administration (VHA) is complex and influenced by various contextual determinants. This scoping review aims to systematically identify and categorize these factors to understand their influence on program implementation within LTSS programs.

Methods:
We conducted a scoping review using four databases, including studies from their inception to July 31, 2024. We screened for 146 abstracts after the removal of duplicates using Covidence software. Two reviewers independently applied inclusion/exclusion criteria, with discrepancies resolved by a third reviewer. We reviewed the full texts of the included articles, and extracted data on the LTSS setting type, intervention type, study design, theoretical frameworks, and contextual determinants. In total, we reviewed 37 full-text articles.

Results:
Preliminary findings from the 29 included articles span publication years from 1993 to 2024. Key determinants were most often found for the Community Living Center (34%), Home-based Primary Care (28%), and Geriatric Patient-Aligned Care Team (13%) settings. We identified 108 instances of

determinants being documented within the studies. The contextual determinants were categorized using the five domains of the Consolidated Framework for Implementation Research framework. The Inner Setting domain had the highest percentage of identified determinants (51%), followed by Innovation (21%), Individuals (19%), Process (5%), and Outer Setting (4%). The most often identified determinants within these domains were: available resources (15%), networks and communication (15%), structural characteristics (7%) (Inner Setting); and staff access to knowledge or need training (11%) (Individuals).

Conclusion:
This scoping review highlights the contextual determinants that affect evidence-based program implementation in VHA LTSS settings. This review found several commonly identified determinants that could target strategy identification prior to the implementation phase. Understanding these factors is crucial for developing strategies to improve the implementation and effectiveness of LTSS programs, ultimately enhancing care for older veterans.

Keywords: Long-Term Services and Supports, Veterans Health Administration, contextual determinants, scoping review, program implementation.

Ishita Khurana; Ebubechukwu Anaevune: **Poster #F6**
Home Institution: Brown University

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

Faculty Mentor: Ramu Kharel, Emergency Medicine

Background and epidemiology of rural trauma in Nepal

Trauma is a leading cause of morbidity and mortality across the globe. However, the burden of injury falls disproportionately on low and middle-income countries such as Nepal. Our research aims to improve trauma care in rural Nepal through three tangential projects. The first project entailed a literature review assessing the state of trauma care in Nepal, reviewing the available resources, training, and research on the subject, with a particular focus on rural areas. Building upon findings from the literature review, our work on the second project is in partnership with Nyaya Health Nepal, a healthcare-based nonprofit, and Bayalpata Hospital, a rural primary hospital. We are contributing to a more comprehensive understanding of the prevalence and characteristics of trauma in a rural primary hospital context, which will help inform other rural primary hospitals, public health initiatives, resource allocation, and infrastructure development. Our last project specifically aims to address snake bites, which are a major injury concern in rural Nepal. We are creating a website that serves as a resource for healthcare providers and patients looking to access facilities with available local resources to treat snake bites. The website will also contain an interactive map displaying these facilities. The interactive aspect of the map will allow users to not only locate facilities, but also to easily access crucial information such as contact details and the available amount of antivenom at each facility. Each of the three detailed projects leads to valuable insights on the trauma burden and its management in rural Nepal, informing future interventions.

Thiên Nguyễn: **Poster #F7**
Home Institution: Emory University

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

Faculty Mentor: Andrea Flores, Education; Kate Mason, Anthropology

Taking Up Space and Place: How do First-Generation College Students Make Sense of Their Identities in Friendship-Making

When historically underrepresented groups enter universities that once barred them from admission, allies will often tell them to “take up space” and “find their place” within them. One way they accomplish both is through forming meaningful friendships that can help them cement themselves as a part of the university. This research project explores how first-generation college students (FGCS)—those whose parents have not attained a bachelor’s degree—make sense of their first-generation status and its intersection with other identity markers, such as class and race, in forming collegiate friendships. Employing a qualitative methodology, this study draws from journals and interviews with four students at elite private universities collected by the Pandemic Journaling Project team over a period of 16 months. We analyze how race/ethnicity, socioeconomic status, and institutional support affect friendship and identity formation. Preliminary findings suggest FGCS will approach friendships through “identity work.” These students will “work,” or transform themselves, to socialize according to their most salient identity—be it race, ethnicity, or class—depending on their social location. This approach can limit or expand their ability to make friends as particular identities could be viewed as a “plus” or a “minus” to their character. As institutions open their hallowed gates to disadvantaged students, they must acknowledge that it takes more than acceptance to cultivate an inclusive community that allows FGCS to seek out and establish meaningful friendships.

Rocío Quintana: **Poster #F8**

Home Institution: University of Puerto Rico at Mayagüez

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

Faculty Mentor: Jennifer Primack, School of Public Health

From Victimhood to Survivorship; The Potential Utility of Imagery Rehearsal Therapy to Reduce Suicide Risk

Veteran suicide is a critical public health issue with 17 Veterans dying by suicide daily. Despite collective efforts to combat the phenomenon, suicide rates in the United States have continued to escalate, suggesting a need for innovative interventions to target suicide and its risk factors. Sleep disturbances, and in particular nightmares have been associated with increased suicidality. Research indicates that nightmares are associated with increased risk for suicide above and beyond insomnia or other sleep impairments. Veterans may have elevated suicide risk since they have higher rates of PTSD and report a higher prevalence of nightmares (7-11%) compared to the general population (3.5%). Targeting nightmares as a primary treatment, it could prove to be a promising strategy to reduce Veteran suicide. Imagery Rehearsal Therapy (IRT) is Cognitive Behavioral therapy that has been found to reduce nightmare severity and frequency in patients with PTSD. This systematic review will provide an overview of the link between suicide and nightmares and will examine evidence for use of IRT to reduce suicide risk.

Yanuel E. Ramos López: **Poster #F9**

Home Institution: University of Puerto Rico, Río Piedras Campus

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

Faculty Mentor: Whitney L. Mills,

LGBTQ+ Veterans mental health outcomes: Making visible an underrepresented population

LGBTQ+ Veterans are a distinct population with unique mental health needs and outcomes. Structural and systemic stigma increases the risk of health disparities and, thus, poor outcomes. For this study, we analyze the literature on mental health outcomes among LGBTQ+ Veterans. The populations focused on in this review were LGBTQ+ Veterans and the non-LGBTQ+ Veterans, as one of our interests was to compare the difference of mental health outcomes in these two types of populations. Literature from the last 10 years was included in the review. Main results suggest that LGBTQ+ veterans have statistically more negative mental health outcomes than their non-LGBTQ+ counterparts. Outcomes including depression, anxiety, rates of trauma, and levels of alcohol and drug use were higher in LGBTQ+ veterans than in non-LGBTQ+ Veterans. We found that transgender Veterans individuals were the most vulnerable population, with increased risk for suicidal ideation history, post-traumatic stress disorder, depression, substance disorders, schizophrenia, and bipolar disorder compared to other LGBTQ+ individuals. To conclude, LGBTQ+ Veterans experience more negative mental health outcomes than their non-LGBTQ+ Veterans peers. Exposure to discrimination, childhood abuse, and military sexual trauma were potential reasons for these gaps in mental health outcomes. Also, the policy of “Don’t Ask Don’t Tell” was a potential factor on the development of health disparities in this population. To address this disparity, more research about the etiology behind these results and the differences in mental health outcomes between LGBTQ+ Veterans and non-LGBTQ+ Veterans needs to be conducted.

Cyntia Roig; Lily Randell; Jacqueline Zhang: **Poster #F10**

Home Institution: Brown University

Summer Research Program: SPRINT|Undergraduate Teaching and Research Awards (UTRA), LaidLaw

Faculty Mentor: Sarah Gamble, Pembroke Center for Teaching and Research on Women

Reproductive Justice Connections Across Rhode Island

This summer UTRA research project aims to identify and map reproductive justice related organizations and advocacy efforts at Brown, and in Providence, in Rhode Island, and across New England. During the project, we will collaborate with faculty, student organizations, and community partners to develop a comprehensive database of regional reproductive justice resources for use by students, scholars, and community members. This project grew out of work done by the Brown Reproductive Justice Collaborative, a research-focused working group led by faculty from the Pembroke Center, the department of Behavioral and Social Sciences, and the Population Studies and Training Center, and is led by Dr. Sarah Gamble at the Pembroke Center.

Anayah Sanders: **Poster #F11**

Home Institution: North Carolina Agricultural & Technical State University

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

Faculty Mentor: Kate Rieke, Veterans Affairs

Heroes in Need: The Impact of Homeless Patient-Aligned Care Teams on Homeless Veterans

Experiencing homelessness or being at risk of homelessness is a prevalent issue among the veteran population. Many veterans who face homelessness are in positions where they lack substantial resources and or such resources are inaccessible to them. To address this widespread issue of homelessness among the veteran community, select Veterans Health Administration (VHA) facilities implemented medical homes named Homeless Patient Aligned Care Teams (HPACT), which are primary care teams meant to provide interdisciplinary services to the homeless veteran population. Through analyzing and synthesizing current research, this project aims to examine the effectiveness and perceived benefits of HPACT in the lives of homeless veterans or at-risk veterans.

Raven Shaw: **Poster #F12**

Home Institution: Howard University

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

Faculty Mentor: Tarika Sankar, University Library

Being a System Impacted Survivor: The Effects of Responsibility in “Response-Ability” on Children with Incarcerated Parents

This project explores the lived experiences of children with incarcerated parents who have committed themselves to social service work and community building in their adulthood. By analyzing firsthand narratives from Brown University's Mass Incarceration Lab alongside secondary sources, this study identifies these individuals as "system impacted survivors," emphasizing their resilience despite the pervasive influence of the carceral system. Using grounded theory methodology, this qualitative assessment uncovers an overarching theme in the collective memory of these children which is the effects of responsibility in “response-ability.” Coined from Bakhtin’s philosophy of “answerability” and drawing on scholars such as Britany Gatewood, this study enriches current discourse on parental incarceration by examining the intricacies of trauma in a new way. This research contributes to the broader scholarship on mass incarceration by highlighting a distinct lived experience to promote a holistic view and nuanced insight into the carceral system’s continual impact on individuals' lives and relationships.

Talia Sherman; Luca Iallonardi: **Poster #F13**

Home Institution: Brown University

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

Faculty Mentor: Jaime Benheim, Linguistics Program

Persona construction and societal change: a diachronic analysis of Rhode Island politicians

Accents can communicate aspects of identity such as political affiliation, geographic origin, gender, and so on. By virtue of speaking, all individuals have an accent and an apparatus to construct identity through language use. However, politicians may have extra motivations to utilize dialect to their advantage by indexing particular aspects of identity through language. In the past, there has been limited sociolinguistic research on real-time sound change during adulthood, especially in regards to politicians. This project studied politicians' speech diachronically. We studied Jack Reed and Sheldon Whitehouse, the two US

senators from Rhode Island, between 1991 and 2024. We gathered publicly-available video clips of the two senators from C-SPAN, which were then transcribed in ELAN for phonetic analysis. Praat was used to sort individual phonetic tokens by speaker and year in order to draw conclusions about vowel movement and specific consonant usage. Our linguistic variables included vowels (such as the vowel in “GOOSE”), rhoticity (park the car vs pahk the cah), and ING (talking vs talkin’).

Results indicate broader trends in language use as well as more specific, socially motivated acoustic shifts. We see the broad trend of GOOSE and GOAT fronting, as well as TRAP, KIT, and DRESS backing and lowering, reflected in our results; politicians are linguistic beings just like anyone else, and their language may reflect common trends in language. However, these vowel shifts may also indicate individual persona construction, as the motivation for these sound changes may vary endlessly. Although they are both from areas in the Northeast where non-rhoticity is prevalent, Reed and Whitehouse employ very different varieties of English. In 1991 Reed employed a non rhotic variety, whereas in 2024 he was majoratively rhotic, indicating a socially motivated acoustic change. Whitehouse has been nearly uniformly rhotic since 2008, but his vowel shifts are still indicative of both broader social trends and individual persona construction. This project has implications for the political value and valence of language when employed by politicians. While these politicians are individuals with identities separate from their political agenda, the language they use on the Senate floor is bound to be judged on political grounds, and thus it is to their advantage to utilize the indexical field.

Claire Song: **Poster #F14**
Home Institution: Brown University

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

Faculty Mentor: Stefanie Friedhoff, School of Public Health; Rory Smith,

Visual representations of extreme heat in US media

Visual representations are often overlooked relative to text in research on climate change communication. Visual content can be processed significantly faster, interpreted more freely, and evoke a much higher emotional response compared to text. Analyzing the imagery surrounding climate change can provide insight to biases that impact public perceptions that are more nuanced than text. Further, heat waves and extreme heat are consequences of climate change where its effects directly impact the general public at the present. There has been a lack of research on visual portrayals of heat waves and extreme heat, phenomenons that are more closely relatable to the public than the general idea of climate change. In this study, we analyzed 350+ images from US media for a variety of codes, such as emotional valence and portrayal of heat. The images were selected from media that included key words such as “heat wave” or “extreme heat.”

Claire Wolfer-Jenkins: **Poster #F15**
Home Institution: Purdue University

Summer Research Program: National Institute on Drug Abuse (NIDA) Summer Research Internship Program

Faculty Mentor: Justin Berk, Bio Med Medical Education

When Are You Getting Out? A Machine Learning Model for Predicting Length of Jail Stay to Inform Medical Treatment

Background: Each year, American jails process over seven million admissions, presenting an opportunity to deliver essential public health services to individuals while incarcerated. One such service is Hepatitis C virus (HCV) treatment. HCV has a ten times higher prevalence in jail populations than the general population. Treatment for HCV is simple and can be completed in 8-12 weeks. However, a barrier to offering this treatment in jails is the uncertainty associated with an individual's length of stay.

Objective: We aimed to create a machine learning model that predicts if a given individual will be incarcerated in a jail for a short time or long time (based on a threshold of 90 days) to address this barrier to treatment.

Methods: Data included 93,977 jail incarceration observations from 2012-2019 that contain sociodemographic and crime data variables from the Rhode Island Department of Corrections (RIDOC). We generated various versions of the model that establish associations between the variables and length of stay reported namely, CatBoost, Random Forest, Gradient Boosted Machine (GBM) and logistic regression.

Results: The best performance evaluation metrics were found for the CatBoost version of the model with a mean balanced accuracy of 0.980, mean specificity of 0.968, mean sensitivity of 0.871, mean F1-score of 0.833, mean precision of 0.798, and mean precision-recall AUC of 0.921. The features reported to have the highest importance were median income, age, and number of children.

Conclusion: These results demonstrate a strong predictive model that, with further development, could be implemented into jails on a wide scale to help inform medical treatment decisions such as HCV treatment.

Autumn Wong: **Poster #F16**

Home Institution: Brown University

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

Faculty Mentor: Tosca Braun, Psychiatry and Human Behavior

Evaluating the Effectiveness of Mindfulness-based Practices on Reducing Burnout Among BIPOC Doulas

Doulas are support professionals who provide mothers with informational, emotional, and physical care from the periconceptional to the postpartum period. They play vital roles such as advocating for their client's preferences during labor, creating birth plans,and providing resources for support. Doulas additionally provide postpartum care for both the mother and baby as clients recover from birth and adjust to parenthood. While doulas are not responsible for making medical decisions, research shows that the presence of a doula can lead to shorter labor, reduced need for pain medication, and lower rates of cesarean deliveries (c-sections).

Despite their crucial support, the demanding nature of extended on-call periods, the emotional strain from supporting challenging births, and the pressure of providing constant care often lead to burnout. BIPOC (Black, Indigenous, and People of Color) doulas encounter additional cultural and systemic barriers that can increase burnout such as racial biases within healthcare institutions.

This project investigates the effectiveness of mindfulness-based interventions for addressing doula burnout utilizing a mixed methods approach. These mindfulness-based sessions incorporate meditation,

journaling, breathwork, and group discussions with tailored instructions for stress management and dealing with healthcare burnout. By addressing the specific needs and challenges faced by BIPOC doulas, this research aims to contribute to support strategies that enhance their resilience, job satisfaction, and contribute to better maternal health outcomes for marginalized communities.

Thursday, August 1st, 2024

Name	Poster #
Alexia Burford	#A1
Myah Burt	#A2
Aidan Choi; Yuexiao Yang; Indigo Mudbhary	#A3
Harris Galvin	#A4
Jacob Gelman	#A5
Mal Go	#A6
Meg Henning; Eliana Lopez	#A7
Kyoungmin Lee	#A8
Ashley Abrego Gonzalez	#A9
Mercy Adewumi	#A10
Adira Altman; Elena Yeh	#A11
Jolymer Arocho Román	#A12
Amira Artykbayeva	#A13
Nirel Ayertey	#A14
Leanna Bai	#A15
Patience Beauchemin	#A16
Louis Boyang	#B1
Camille Brown	#B2
Megan Carlson	#B3
Amine Chajar	#B4
Anne Chang	#B5
Valen Chapel	#B6
Aman Bhutani	#B7
Daniel Cheong	#B8

Barron Clancy	#B9
Zita Cohen	#B10
Quinn Cowing	#B11
Clifton David	#B12
Nicole Dennis Talley	#B13
Marina Espinosa	#B14
Brittany Durham	#B15
Tony El Nemer	#B16
Saraphina Forman	#C1
Mmasiolu Gamero	#C2
Jesus Gonzalez	#C3
Marli Graves	#C4
Jada Hall	#C5
Maya Hawkins	#C6
Emilia Herdes	#C7
Alex Hernandez Manriquez; Amar Aqel; Melissa Robles Banuelos; Regan Cavin; Joseph Suh	#C8
Derek Hessinger	#C9
Lindsey Hofflander	#C10
Jiaying Hou; Pauline Cooper	#C11
Jane Hwang	#C12
Yumiko Imai	#C13
Sebastian Jauregui	#C14
Celia Johnson	#C15
Nyia Jones	#C16
Hawa Konate; Bailey Merlino	#D1
Chloe Kurka	#D2

Kevin Kwon	#D3
Lillian Langbein	#D4
Johanna Leang	#D5
Joanne Lee	#D6
Stefan Leonard	#D7
Liana Lewis	#D8
Jason Lin	#D9
Zhuoyang Lyu	#D10
Maya Magavi	#D11
Will Malloy	#D12
Chigozie Manu	#D13
Jaidan Marano	#D14
Mateen Markzar	#D15
Gabriel Martinez	#D16
Kayla Mash	#E1
Gabriela Meléndez Martínez	#E2
Davon Michael	#E3
AJ Murphy	#E4
Akiva Najman-Licht; Chris Chang; Sid Udata; Annie Wu; Alec Chen; Alan Mach	#E5
Levi Neuwirth; Kaley Newlin	#E6
Jerry O'Mara; Nathan Depiero	#E7
Yahir Oseguera	#E8
Leila Paltrowitz	#E9
Sophie Phipps	#E10
Adelaide Poulson	#E11
Derek Puin	#E12

Timothy Pyon	#E13
Valeria Quero	#E14
Tasawwar Rahman	#E15
Vivek Rajani	#E16
Lizeth Sanchez	#F1
Roselyn Santana; Samantha Zhang	#F2
Ashley Seong; Tasiemobi Ajie-Anozie	#F3
Jayleann Serrano	#F4
Mohammed Serri	#F5
Nina Shin	#F6
Zoe Siegel	#F7
Chris Stein	#F8
Lukas Strelecky	#F9
Yousuf Suleman	#F10
Clara Tandar	#F11
Michelle Tanujaya	#F12
Sevara Tashkhanova	#F13
Pran Teelucksingh	#F14
Demetria Tolbert	#F15
Claudia Toledo Molinary	#F16
Mae Torra	#G1
Cassandra Travis	#G2
Hope Trygstad	#G3
Sid Udata; Chris Chang; Ketan Pamurthy	#G4
Torsten Ullrich	#G5
W. Ryan Waite	#G6
Madeleine Wang	#G7

Megan Wang	#G8
Mary Claire Warren; Max Newman	#G9
Kiayla Washington	#G10
Dontrel Wilright	#G11
Ray Wu	#G12
Adam Xu	#G13
Kristine Yang	#G14
Isabella Yoo	#G15
Lucy Yu; Dennis Tai; Marina Zakhary Gad El-Sayed	#G16
Yingshen Zhang	#H1
Andrew Zhang	#H2
Ruiyang Zhu	#H3
Salena Zhu	#H4
Nikhil Sonthalia	#H5
Peter Ko	#H6
Lizbeth Martinez Contreras; Ansley Ryan	#H7
Julian Ramprashad	#H8
Alex Tomkinson; Michael Medeiros	#H9
Alexander Zeng	#H10
Mia Kamisato; Angelina Clark	#H11
Morton, Adrianna	#H12

Friday, August 2nd, 2024

Name	Poster #
Mia Adler; Ford McDill; Will Paz; Tiffanie Ng; Iris Horng; Sam Thomas	#A1
Anand Advani	#A2
Muhiim Ali; Ariana Azarbal	#A3
Jamiley Avila	#A4
Mina Bahadori	#A5
Charlotte Bain	#A6
Brandt Bechtel	#A7
Ailani Bonilla	#A8
Benjamin Bradley; Sofia Tazi	#A9
Alexandra Coia	#A11
Eleanor Buchanan	#A12
Thor Burkhardt	#A13
Lázaro Cabán	#A14
Alice Cannon	#A15
An Cao	#A16
Diego Delgado	#B1
Natalie DeVito	#B2
Siming Feng; Jonathan Zhou	#B3
Eads Fouché	#B4
Tommy Frank	#B5
Sofia Gilroy	#B6
Josh Ginzburg	#B7
Caitlin Gong; Clara Fee	#B8
Zhanxian Gong	#B9

Margaret Gonzalez	#B10
Alex Greve	#B11
Abnelis Guzmán Román	#B12
Jade Hardwick	#B13
Richard Cheng	#B14
Dalia Heikal	#B15
Adriana Hernández Vega	#B16
Journey Keen; Anh-Thai Le; Sam Thomas; Iris Horng	#C1
Katharina Kuehr	#C2
Damir Kulzhanov	#C3
Ruoning Lan; John Lockwood	#C4
Xavier Lee	#C5
Heon Lee	#C6
Yareli Macias-Sanchez; Campbell Thomas	#C7
Shivangi Manel; Kylie McCombs	#C8
Abrielle Mannino	#C9
WaTae Mickey	#C10
Olivia Miller	#C11
Katie Min	#C12
Matthew Moser	#C13
Kaleb Newman	#C14
Asmita Niyogi; Shirui Li	#C15
Naomi L. Núñez Altagracia	#C16
Madeline Oh	#D1
Julia Patterson	#D2
Gregorio Posada Pardo	#D3

Tarek Razzaz	#D4
William Roberts	#D5
Sergio Rodriguez	#D6
Santiago Romo	#D7
Tyler Rose	#D8
Christopher Sanchez Jr	#D9
Austin Sarker-Young	#D10
Emma Slaght; Julia Granato	#D11
Aino Smith	#D12
Jared Sonkin	#D13
Jasmine Sun	#D14
Isabella Szabo	#D15
Ashton Szarnicki	#D16
Nicolas Valencia	#E1
Oren Van Allen	#E2
Skylar Walters	#E3
Alex Wang; Anoop Kiran	#E4
Fan Ze Wang	#E5
Alan Wang	#E6
Claire Xu	#E7
Iris Yang	#E8
Lingwen Zhang	#E9
PengCheng Zhu	#E10
Adrián Duchesne	#E12
Amina Anekwe	#E13
Marlena Brown	#E14
Angelica Autman	#E15

Madison Byrd; Shokria Sakhi	#E16
Asiah Donahue	#F1
Coda Dunn	#F2
Petros Engelhardt; Anny Nelzy	#F3
Masoumah Haidari; Amanda Lee Molina	#F4
Mary Rose Khamfong	#F5
Ishita Khurana; Ebubechukwu Anaevune	#F6
Thiên Nguyễn	#F7
Rocío Quintana	#F8
Yanuel E. Ramos López	#F9
Cyntia Roig; Lily Randell; Jacqueline Zhang	#F10
Anayah Sanders	#F11
Raven Shaw	#F12
Talia Sherman; Luca Iallonardi	#F13
Claire Song	#F14
Claire Wolfer-Jenkins	#F15
Autumn Wong	#F16
Josh Brown; Audrey Bu; Zachary Cheesman; Benjamin Orman; Sam Thomas; Iris Horng	#G1
Andrea Jimenez Moreno	#G2
Jay O'Neill	#G3
Alejandra Torres	#G4
Natsuka Hayashida; Priscilla Doran; Kristen Joyner; Grace Moberg; Matthew Senese	#G5
Shayaan Chaudhary	#G6
Lauren Hogan; Lucie Johnson	#G7
Keyan O’Donnell	#G8
Jessica Tingley; Deepa Mahesh	#G9

Andrew Cabrera	#G10
Max Cook	#G11
Alli Brophy; Andrés Castellanos Hernandez; Bryce Iversen; Danielle Murphy; Austin Kind; Matthew Senese	#G12

SUMMER RESEARCH PROGRAMS REPRESENTED

- BP-ENDURE
- Churchill College Cambridge Exchange Program
- The Emerging Infectious Disease and HIV Scholars Program (H-EIDS)
- IBES Internship
- Institute for Computational and Experimental Research in Mathematics (ICERM)
- John Hay Library Undergraduate Fellowship
- Leadership Alliance-Summer Research Early Identification Program (SR-EIP)
- NIDA Summer Internship Program, and SPRINT|Undergraduate Teaching and Research Awards (UTRA)
- National Institute on Drug Abuse (NIDA) Summer Research Internship Program
- National Institute on Drug Abuse Summer Research Internship Program
- Presidential Scholars Program (PSP)
- Royce Fellowship
- SPRINT|Undergraduate Teaching and Research Awards (UTRA)
- SPRINT|Undergraduate Teaching and Research Awards (UTRA), LaidLaw
- SPRINT|Undergraduate Teaching and Research Awards (UTRA), Summer Research Assistantship in Biomedical Sciences
- SPRINT|Undergraduate Teaching and Research Awards (UTRA),
- Space Grant/NASA, SPRINT|Undergraduate Teaching and Research Awards (UTRA)
- Summer Research Assistantship in Biomedical Sciences
- Techfoundation Data Science and Medical Research program
- Voss Environmental Fellows, The Reade Y. Tompson Summer Award

REPRESENTED INSTITUTIONS

- Barnard College (Columbia University)
- Belmont University
- Bowdoin College
- Brooklyn College
- Brown University
- Bryan College
- Bryn Mawr College
- CUNY Hunter College
- CUNY-BROOKLYN COLLEGE
- California State University Dominguez Hills
- California State University, Northridge
- Claflin University
- Colby College
- Dillard University
- Emory University
- Grinnell College
- Howard University
- Hunter College
- Inter American University of Puerto Rico Aguadilla Campus
- John Jay College of Criminal Justice
- Kenyon College
- Lafayette College
- Lewis University
- Loyola University Chicago
- Macalester
- Miami University
- Minerva University
- Morehouse College
- Morgan State University
- Mount Holyoke College
- New York University
- North Carolina A&T State University
- North Carolina Agricultural & Technical State University
- Northeastern University
- Pomona College
- Purdue University
- Rollins College
- Smith College
- Sonoma State University
- Southern Methodist University

- State University of New York at Plattsburgh
- Swarthmore College
- Temple University
- The University of Texas Rio Grande Valley
- The University of Texas at Austin
- Tougaloo College
- Tufts University
- UC Berkeley
- UC RIVERSIDE
- University of California Santa Cruz
- University of California, Berkeley
- University of Cambridge
- University of Central Florida
- University of Colorado Boulder
- University of Houston
- University of Maryland, Baltimore County
- University of Nevada Reno
- University of North Carolina at Chapel Hill
- University of Pennsylvania
- University of Puerto Rico at Mayagüez
- University of Puerto Rico, Humacao campus
- University of Puerto Rico, Río Piedras Campus
- University of Rhode Island
- University of Southern California
- University of Tennessee, Knoxville
- Ursinus College
- Vassar College
- Washington University in St. Louis
- Wesleyan University
- Winthrop University
- Xavier University of Louisiana
- Yale University