UNDERGRADUATE RESEARCH SYMPOSIUM

Temple University
College of Science and Technology

NOVEMER 13
2024

Science Education and Research Center (SERC)

11:30AM TO 4:30PM

Abstract Book

Welcome

This year's College of Science and Technology Undergraduate Research Symposium will showcase student research successes. Students have completed projects across many of Temple University's colleges and on many campuses. Faculty mentors from across the university, across the region, and the country opened their labs and shared their time. College of Science and Technology and Engineering labs, Ambler Field Station, Fox Chase Cancer Center, the Lewis Katz School of Medicine, and Shriners Children's Philadelphia were among the many sites that hosted students. Students found research opportunities in departmental coursework, through grant-funded opportunities, through the CST Research Scholars Program, as Frances Velay Scholars, Science Scholars, NIH-MARC fellows, and NSF-LSAMP Research Leaders. Some contributed much as lab volunteers.

Today, we celebrate their accomplishments with sincere gratitude to the mentors who gave their time and opened doors and minds. We recognize the critical role that research plays at all levels in the institution and throughout society. A special thank you is extended to Dean Miguel Mostafá for his endless support for undergraduate research in the College of Science and Technology.

After the poster session, our undergraduate students will have the opportunity to meet and learn from Dr. Chantelle Nobile Hart. Dr. Hart is a professor in the Department of Social and Behavioral Sciences and a research scientist at the Center for Obesity Research and Education in the College of Public Health at Temple University. She holds a graduate degree in clinical psychology from Case Western Reserve University and completed her internship and fellowship in pediatric obesity at the Alpert Medical School of Brown University. Prior to joining the faculty at Temple, Dr. Hart was an associate professor (research) at the Alpert Medical School of Brown University and staff psychologist at the Weight Control & Diabetes Research Center at the Miriam Hospital.

Dr. Hart's research focuses on the use of behavioral approaches for prevention and treatment of obesity in childhood. Specifically, her research focuses on understanding the role of enhancing children's sleep to decrease risk of obesity and cardiometabolic disturbance, and the effect of early life risk factors on children's obesity risk. A cross-cutting theme of this work is the identification of effective approaches to decrease health disparities in pediatric populations. Dr. Hart's work as PI has been continuously funded by the National Institutes of Health (NIH) and the American Diabetes Association since 2009. She has served as a member of the Psychosocial Risk and Disease Prevention study section and the Lifestyle Change and Behavioral Health (LCBH) study section for the National Institutes of Health and is on the editorial boards of the *International Journal of Behavioral Nutrition and Physical Activity*, *Eating Behaviors*, and *Frontiers for Young Minds*.

Agenda

11:00 AM – 11:30 AM	Presenter Registration	SERC Lobby
11:30 AM – 12:30 PM	Poster Session 1	SERC Lobby
12:30 PM – 1:00 PM	Refreshment Break	SERC Mezzanine
1:00 PM – 2:00 PM	Dean's Remarks & Keynote Address	SERC Room 116
2:00 PM – 2:15 PM	Refreshment Break	SERC Mezzanine
2:15 PM – 3:15 PM	Poster Session 2	SERC Lobby
3:15 PM – 3:30 PM	Refreshment Break	SERC Mezzanine
3:30 PM – 4:30 PM	Poster Session 3	SERC Lobby

The Symposium for Undergraduate Research and Creativity provides ambitious, intellectually motivated undergraduate students the opportunity to present and defend their original research or creative work among peers, faculty, family, and friends. Through its emphasis on original research and creative work, the Symposium seeks to inspire undergraduate students to analyze, critique, and engage with the world around them. We welcome research or creative work from every discipline. Symposium participation is on a competitive basis.

Direct link: https://app.suitable.co/#/getcredit/398305/nILajDXX4acfxzAJ

To the right is the QRCode for attending the Fall 2024 CST Undergraduate Research Symposium

Presenters

Session 1 Abstracts

Ahmad, Hafsah
Class Level: Senior
Major: Bioengineering with Minor in Biology
Mentor: Professor Nathaniel Snyder
Mentor Affiliation: Aging + Cardiovascular Discovery Center (LKSOM)

Assaying Transplacental Fetal Exposure to Chemotherapeutics by Meconium Sampling

Cancer occurs during approximately 1 in 1000 pregnancies with the rates of maternal cancer increasing worldwide. Chemotherapeutics, including antimetabolites, alkylating agents, anthracycline antibiotics, plant alkaloids, and taxanes are used for cancer therapy in the second trimester and onwards. Although there is an evidence base strongly supporting treatment, especially for aggressive cancers, fetal exposure to chemotherapeutics is an understudied field. Previously, we assayed meconium samples from a cohort study of the Cancer and Pregnancy Registry of newborns whose mothers had received chemotherapy. Our previous study agreed with non-human primate studies demonstrating the presence of paclitaxel in meconium, non-invasively measuring direct fetal exposure in humans using meconium samples. In this study, we expanded our previous findings to additional samples and other commonly used agents. Samples were tested for the presence of chemotherapeutics and their metabolites using liquid chromatography-high resolution mass spectrometry (LC-HRMS). The amount of Cyclophosphamide, Paclitaxel and its two metabolites 6-a-OH-paclitaxel and 3-p-OH-paclitaxel were quantified. Consistent with prior results, we detected paclitaxel and its metabolites in meconium from exposed newborns. Cyclophosphamide detection was technically challenging, with a high number of false positives at our originally estimated cut-offs for detection and quantification. Future analytical development is needed for reliable, sensitive, and specific assays of chemotherapeutics in meconium. Understanding how chemotherapeutics pass through the placenta blood barrier and being non-invasively measure fetal exposure will be useful in testing optimal treatment for maternal cancer.

Ahuja, Sanya
Class Level: Sophomore
Major: Biology
Mentor: Professor Bojeong Kim
Mentor Affiliation: Department of Earth and Environmental Science (CST)

High School Students' Perceptions of Sustainable Agriculture: An Entry Survey Study

This research project investigates sustainable urban agriculture by examining high school students' knowledge and perceptions of agricultural practices. The primary objective involves developing and administering a survey to identify gaps in students' understanding of sustainable agriculture and eco-friendly practices. By analyzing survey responses, the project aims to highlight areas for improvement in agricultural education and inform future outreach efforts. Through these efforts, the project seeks to build community engagement in urban agriculture and support broader sustainability goals.

Akbar, Razeen
Class Level: Senior
Major: Biology + German Language & Cultural Studies (Double Major)
Mentor: Professor Sara Ward
Mentor Affiliation: Center for Substance Abuse Research (LKSOM)

Combined Cannabinoid and Psilocybin Use on Pain Sensitivity in Mice

With the ongoing opioid crisis in the United States, many patients look towards safer, alternative treatment options for managing their chronic and acute inflammatory pain symptoms, including natural remedies. The use of psychoactive cannabinoids like Delta-9-Tetrahydrocannabinol (THC) has been proven to relieve pain. Psilocybin is a serotonin 5-HT2A agonist found naturally in 'magic mushrooms' and known to cause short-term psychedelic effects, which may suggest a decrease in pain sensation similar to THC. This study aims to demonstrate whether *Cannabis* constituents and psychedelics interact synergistically on pain sensitivity. We administered a series of cumulative intraperitoneal (IP) injections with a 30-minute pre-treatment interval between injections for the following test groups in male mice: psilocybin (0.1, 0.3, 1.0mg/kg), THC (3.0, 10, 30, 100mg/kg), and psilocybin+THC (0.3mg/kg psilocybin+THC dose curve vs. 1.0mg/kg+THC dose curve). Body temperature was recorded in each assay. We first performed a hotplate assay to observe the pain sensitivity of heat in each group. We then performed a catalepsy assay to observe the effects on locomotor activity. Body temperature remained constant across all treatment groups. Pain sensitivity decreased in the THC group and both combination groups, as well as an increase in catalepsy in a similar pattern. These studies indicated that although psilocybin alone suggested an adverse increase in pain sensitivity, the combined use of THC and psilocybin shows potential in the treatment of chronic and acute pain symptoms.

Ansari, Yusuf-Zain
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor Marc Moisi
Mentor Affiliation: Department of Neurosurgery (Hurley Medical Center)

The Role of XLIF in Removal of Foreign Bodies: Comprehensive Literature Review

The Extreme Lateral Interbody Fusion (XLIF) technique has become increasingly recognized for its versatility and efficacy in addressing complex spinal conditions, particularly in revision surgeries. This comprehensive review focuses on the novel application of XLIF in the removal of foreign bodies from the spine, such as subsided cages, failed hardware, and other implants. Through an analysis of documented cases, we examine the advantages of XLIF, including reduced operative time, blood loss, and shorter recovery periods, as well as its technical challenges and potential complications. Additionally, this review compares XLIF to conventional methods, highlighting its ability to safely navigate around scar tissue and avoid critical neurovascular structures. The findings suggest that XLIF is a valuable tool in spinal revision surgeries, offering a safer and more effective approach to foreign body removal. Future studies are needed to further validate these outcomes and optimize the technique for broader clinical application.

Anya, Frazier
Class Level: Junior
Major: Ecology, Evolution, and Biodiversity
Mentor: Professor Matthew Helmus
Mentor Affiliation: Department of Biology (CST)

Investigation of novel feeding relationships between the invasive spotted lanternfly (Lycorma delicatula) and ant genera (Family: Formicidae)

Ecological invasions globally impact native species and alter food web dynamics. The invasion of the spotted lanternfly (SLF; *Lycorma delicatula*) into Eastern U.S. forests has notably disrupted viticulture, though its broader ecological effects remain underexplored. A significant ecological consequence of the SLF invasion is the production of honeydew, a sticky, sugary excrement excreted by SLF after feeding on host plants such as the Tree of Heaven (ToH; *Ailanthus altissima*). This honeydew attracts ants, some of which feed on it and may even protect the SLF. While it is established that ants feed on honeydew, the specific ant genera associated with SLF honeydew have not been identified. This study aims to correlate ant genera with SLF presence by using light microscopy and dichotomous keys for ant identification, and then analyzing the data in Excel to explore relationships between ant genera and SLF locations. This preliminary investigation seeks to identify ant genera that feed on SLF honeydew, with the next phase focusing on observing ant behavior to determine if they are protecting and farming SLF.

Bakhit, Amro
Class Level: Sophomore
Major: Biology
Mentor: Professor Jean-David Grattepanche
Mentor Affiliation: Department of Biology (CST)

Spatial Distribution of Bacteria in Urban Environments

In many cities, microorganisms, especially bacteria, live on buildings and play important roles in the local environment. This study aims to explore how bacteria are spread across different areas of a rooftop and what environmental factors (e.g., sunlight, temperature, and pollution) affect their distribution. By collecting bacterial samples from different sites on the same rooftops, we hope to identify which specific conditions shape the bacteria communities. We employed a high throughput sequencing technique and bioinformatics to identify the various bacteria and understand what makes each one unique. These datasets will help us decipher how environmental factors influence the bacterial communities on rooftops. Learning more about the bacteria living in these urban spaces can give us insights into how city environments influence the communities. It could also guide decisions for city planning, building design, and public health measures, making cities healthier and more sustainable. This research highlights the importance of considering even the smallest organisms when thinking about how to create better urban environments.

Brownfield, Jack
Class Level: Sophomore
Major: Ecology, Evolution, and Biodiversity
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Exploring niche partitioning of aquatic invertebrates in ephemeral ecosystems of a tornado-disturbed forest

Unprecedented climate events are modifying landscapes and habitat structures around the globe, including the Temple Forest Observatory, which experienced large-scale disturbance due to an EF-2 tornado in Fall 2021. The habitat alteration created many ephemeral pools, which have acted as new transient ecosystems for freshwater invertebrates. This study aims to understand the asynchronous recruitment and niche partitioning of species colonizing these ephemeral pools. We compared the abundance through time and richness of aquatic macrofauna present in the water column and surface of samples collected once a month for 18 months from 10 randomly selected ephemeral pools. We hypothesize that invertebrates will display asynchronous recruitment and therefore will fluctuate through time, particularly in dominant groups to better allow for coexistence between potential competitors. We observe substantial evidence of niche partitioning across multiple groups, particularly temporally. Following these ecosystems from their point of creation provides novel insight into the formation of ecological communities, the development of niche dynamics, and the broader environmental impacts of unprecedented disturbances.

Di Pede, Rocco
Class Level: Junior
Major: Biochemistry
Mentor: Professor Nancy Pleshko
Mentor Affiliation: Department of Bioengineering (ENG)

Assessing the Efficacy of Near-Infrared Spectroscopy to Monitor the Maturation of Intraoral Bone Grafts

When a tooth is lost, the supporting bone begins to resorb, often creating a deficiency that requires a bone graft before placing a dental implant. A bone graft is positioned at the site of resorption and secured with a collagen membrane. Gradually, the graft is replaced by new, native bone. However, assessing graft maturation levels remains challenging due to variability in patient healing and the limitations of traditional radiographic imaging in quantifying bone quality. Recent studies have explored visible near-infrared (VNIR) spectroscopy as a non-invasive approach to assess graft maturation based on compositional changes. This study aimed to evaluate whether VNIR spectroscopy could effectively distinguish between models representing stages of bone graft maturation.

Four tissue models were created using different ratios of Straumann Xenograft material and porcine bone, soaked in porcine blood to simulate natural healing. Placed in a bone graft holder with a collagen membrane and porcine gingiva (cut to an average gingival thickness of 1.04 mm), these models represented graft maturation stages: early (75% Xenograft/25% bone), middle (50% Xenograft/50% bone), almost mature (25% Xenograft/75% bone), and fully mature (15% Xenograft/85% bone). An ASD Labspec 4 VNIR spectrometer with a fiber optic probe collected spectral data, processed through smoothing, normalization, and PCA. The analysis revealed distinct spectral differences across stages, primarily in water and protein content. PCA differentiated fully healed sites from earlier stages, suggesting VNIR's potential for assessing graft maturation and optimal implant timing. Further research could improve understanding of VNIR's efficacy in monitoring bone graft healing.

Dock, Savannah
Class Level: Senior
Major: Genomic Medicine
Mentor: Professor Glenn Gerhard
Mentor Affiliation: Department of Medical Genetics and Molecular Biochemistry (LKSOM)

Methylation of Mitochondrial DNA

The mitochondria, often referred to as the powerhouse of the cell, are organelles that generate energy by converting nutrients into adenosine triphosphate (ATP). Through cellular respiration, they regulate metabolic pathways, control apoptosis (programmed cell death), maintain calcium balance, and generate reactive oxygen as byproducts of energy production. Historically, mitochondrial DNA (mtDNA) were believed to be unmethylated. Recent findings reveal that CpG methylation does occur in mtDNA and can result in an abnormal increase in that methylation across the genome resulting in global hypermethylation. CpG regions are parts of DNA that consist of cytosine and guanine nucleotides, typically found near gene promoters, they are often associated with the regulation of gene expression from DNA methylation of nuclear encoded genes. Traditional mtDNA methylation studies used next-generation sequencing or methylation arrays involving chemical treatments and PCR amplification. Recent advances in nanopore sequencing now allow the analysis of native and unmodified mtDNA. In this study we aim to investigate CpG methylation variability across the mitochondrial genome and it's genes by isolating mtDNA from blood samples and subjecting it to nanopore sequencing to observe if mtDNA will generate differential methylation across its genome. Mutations in mtDNA is linked to various diseases. This method may potentially provide insight into diagnostic markers for patients with suspected mitochondrial related diseases. This method can be used as a foundation to develop a cost-effective assay for health testing, benefiting both clinicians and advancing the understanding of the mitochondrial function.

Eckert, Carlos
Class Level: Junior
Major: Computer Science
Mentor: Professor Benjamin Seibold & Gillian Quiesser
Mentor Affiliation: Department of Mathematics (CST)

NeuroVISOR - Neuron Voltage Simulator

Neuroscientists traditionally rely on experiments using living tissue or animal models to study neuronal function and dynamics, which are essential for understanding brain activity and disorders. However, such methods come with ethical challenges, logistical constraints, and limited control over experimental variables. In contrast, digital platforms like Neurovisor offer a novel, controlled environment to simulate neuronal activity at the cellular and network levels. Neurovisor allows for precise manipulation of voltage dynamics and ion channel behaviors, mirroring the conditions in which real neurons operate. In this study, we explore how experiments traditionally conducted with live neurons — such as assessing response to stimulation or investigating the propagation of action potentials — can be digitally replicated and modified in Neurovisor. By inputting varying voltage parameters and controlling the timing and spatial configurations of simulated signals, we observe the effects on virtual neurons, facilitating insights into neurophysiological responses without the need for live tissue. This method provides a unique bridge between computational neuroscience and experimental neurophysiology, potentially offering rapid and ethical insights into complex neural mechanisms.

Ejaz, Yumna
Class Level: Senior
Major: Biology
Mentor: Professor Parkson Chong
Mentor Affiliation: Department of Medical Genetics and Molecular Biochemistry (LKSOM)

Lipid-Based Nanoparticles: Design and Characterization of Liposomes for Enhanced Drug Delivery

This project investigates the design, fabrication, and characterization of novel lipid-based nanoparticles, specifically liposomes, for potential clinical applications in cancer therapy and thrombosis prevention. We synthesized liposomes with varying mole percentages to achieve sizes under 200 nm, ensuring their classification as nanoparticles. Stability assessments indicated that the majority of formulations exhibited minimal fluctuations in size and polydispersity index (PDI), with no aggregation detected.

Subsequently, we explored the binding interactions between these positively charged liposomes, ranging from 150 to 170 nm, and bovine serum albumin (BSA), a negatively charged globular protein critical for the transport of hydrophobic molecules in the bloodstream. The data revealed that the liposomes successfully bound to serum albumin without forming aggregates, demonstrating their potential for effective drug delivery. Additionally, albumin's role as a carrier for fatty acids, which are stored in adipose tissues and provide essential energy, highlights its importance in facilitating the transport of hydrophobic substances. These findings suggest that our lipid-based nanoparticles could serve as promising vehicles for therapeutic agents, enhancing treatment efficacy in clinical settings.

Elsabbagh, Tarek
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor Victor M. Luna
Mentor Affiliation: Department of Neural Sciences (LKSOM)

Sex and Genetic Background Determine Glutamate Receptor Composition in the Hippocampus

Introduction: Sex is a critical biological variable influencing memory and emotion, often modulated by glutamate receptor expression in the dentate gyrus (DG) of the hippocampus. This study examined ionotropic and metabotropic glutamate receptor subunits in the DG of male and female young adult C57BL/6 and HET3 mice to identify sex-based differences in receptor expression, providing a basis for future research on synaptic aging.
Methods: DG regions from C57BL/6 and HET3 mice (3–5 months old) were analyzed to determine glutamate receptor expression, utilizing “The Jess” automated western blotting system to measure 20 of the 23 known subunits.
Results: Sex differences in glutamate receptor expression emerged across both genetic backgrounds. In C57BL/6 mice, significant variations were observed in NR3A+B, mGluR2, and mGluR7 receptor subunits. Male mice showed increased NR3A+B but decreased mGluR2 and mGluR7 expression compared to females. In HET3 mice, a wider array of receptors displayed sex-based differences, including GluA2, GluN2A, GluN2B, NMDAR2C, KA1, and GluR6, with only NMDAR2C elevated in males. Female HET3 mice showed greater protein expression variability, possibly linked to the estrous cycle, which ongoing studies are further investigating.
Conclusion: Sex and genetic background significantly influence DG glutamate receptor expression, affecting receptors such as GluA2, GluN2A, GluN2B, NMDAR2C, NR3A+B, KA1, GluR6, mGluR2, and mGluR7. These findings suggest that heterogeneity in glutamate receptor expression might better mirror human synaptic and behavioral diversity, with implications for understanding memory, emotion, and aging.

Gibson, Katie
Class Level: Senior
Major: Ecology, Evolution, and Biodiversity
Mentor: Professor Jocelyn Behm
Mentor Affiliation: Department of Biology (CST)

Residency Time of Adult Spotted Lanternfly in an Urban Environment

The spotted lanternfly *Lycorma delicatula* (SLF) is an invasive pest that has expanded its range through states in the Northeast and Mid-Atlantic regions, which poses threats to local vineyards and the agriculture industry. There is currently limited information on local habitat use by SLF, particularly concerning the residency time of adults on trees during their egg-laying stage. This study investigates the residency time of adult SLF in an urban area of Philadelphia on Temple University's campus by grouping repeated sightings of individuals from field photographs. The photo-identification software I3S Classic is used to track individuals by plotting and comparing their unique wing spot patterns, allowing for residency times of individuals to be calculated. Overall, residency times varied from 1 – 24 days and 54 individuals were recaptured on a single tree. These values indicate that SLF are quite sedentary at this point in their lifecycle. This approach will improve understanding of SLF habitat use in urban settings, which could inform future management strategies by measuring how SLF establish themselves on specific trees.

Hampton, Mackenzie
Class Level: Sophomore
Major: Genomic Medicine
Mentor: Professor Stephanie Daws
Mentor Affiliation: Department of Neural Sciences (LKSOM)

Induced Inflammation Impacts on Dopamine Receptors from Opioid Use.

Studies have shown that opioid use causes an increased production of lipopolysaccharides (LPS). LPS are components of the outer membrane on gram-negative bacteria. These molecules result in higher levels of inflammation in the brain and can therefore impact how dopamine receptors are able to function. Research using complementary DNA is being conducted with the use of quantitative Polymerase Chain Reaction (qPCR). qPCR works by amplifying target DNA, which is shown through fluorescent light, and then reveals how much of the PCR products are actually in the cycles. There are many cycles completed during analysis, and when there is an increase in fluorescence, it creates a curve. There is an intensity that must be exceeded, which is the CT value, or number of cycles needed to detect a DNA target. Solid results for this project are still being found and tested, and hopefully they can bring science closer to understanding how opioids affect the brain, and then lead to non-harmful ways to combat addiction.

Izo, Veronika
Class Level: Junior
Major: Biology
Mentor: Professor Shohreh Amini
Mentor Affiliation: Department of Biology (CST)

Outcomes Of Intravesical Gemcitabine and Docetaxel for Bacillus Calmette-Guerin exposed High-Risk Non-Muscle Invasive Bladder Cancer: Results from a High-Volume Institution

Bladder cancer is one of the most common cancers worldwide, with non-muscle invasive bladder cancer (NMIBC) accounting for approximately 70% of newly diagnosed cases. NMIBC includes a spectrum of tumor stages, from superficial lesions (Ta) to high-grade (HG) T1 tumors, carcinoma in situ (CIS), and multifocal disease. High-risk NMIBC patients, characterized by CIS, HG T1, or multifocal disease, are at significant risk for recurrence and progression to muscle-invasive disease, which is associated with worse prognosis and the need for more aggressive treatments. The standard treatment for high-risk NMIBC is intravesical Bacillus Calmette-Guerin (BCG) immunotherapy, which has been shown to reduce recurrence and progression rates. However, 30-40% of patients experience BCG failure—either through resistance or intolerance—highlighting the need for alternative therapies.

BCG: BCG works by stimulating the immune system to induce a local inflammatory response that helps eradicate bladder cancer cells. Despite its widespread use and proven efficacy, BCG therapy is not without its limitations. A substantial proportion of high-risk NMIBC patients do not respond to BCG, or they suffer from significant side effects, leading to treatment discontinuation. For these patients, treatment options after BCG failure are limited, and the need for effective second-line therapies is urgent. As the incidence of BCG-unresponsive NMIBC continues to grow, identifying alternative intravesical therapies has become a critical area of research.

GEMDOCE: Intravesical gemcitabine and docetaxel (GEMDOCE) has emerged as a promising alternative to BCG, particularly in patients who are BCG-refractory or BCG-intolerant. Gemcitabine is a nucleoside analog that interferes with DNA synthesis, while docetaxel, a taxane, stabilizes microtubules, preventing cell division. Together, these agents have demonstrated potential in treating high-risk NMIBC, showing favorable response rates in various clinical trials. The Iowa protocol, which involves an induction phase followed by maintenance therapy, has become a widely used regimen for GEMDOCE. While there is substantial evidence supporting its short-term effectiveness, long-term data on the outcomes of GEMDOCE in BCG-exposed high-risk NMIBC patients remain limited. Understanding the role of GEMDOCE, especially in terms of failure-free survival (FFS) and cystectomy-free survival (CFS), is critical for optimizing treatment strategies.

This study aims to evaluate the real-world outcomes of sequential intravesical GEMDOCE therapy in BCG-exposed high-risk NMIBC patients treated at a high-volume institution. Specifically, we sought to assess failure-free survival (FFS) and cystectomy-free survival (CFS) following GEMDOCE treatment and to explore factors that may influence these outcomes, including the duration of maintenance therapy.

Kapp, Christine
Class Level: Junior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Evaluating the Use of Generative AI to Support Automated Just-in-Time Programming for Visual Scene Displays

Millions of people worldwide rely on alternative and augmentative communication devices to communicate. Visual scene displays (VSDs) can enhance communication for these individuals by embedding communication options within contextualized images. However, existing VSDs often present default images that may lack relevance or require manual configuration, placing a significant burden on communication partners. In this study, we assess the feasibility of leveraging large multimodal models (LMM), such as GPT-4V, to automatically create communication options for VSDs. Communication options were sourced from a LMM and speech-language pathologists (SLPs) and AAC researchers (N=13) for evaluation through an expert assessment conducted by the SLPs and AAC researchers. We present the study's findings, supplemented by insights from semi-structured interviews (N=5) about SLP's and AAC researchers' opinions on the use of generative AI in augmentative and alternative communication devices. Our results indicate that the communication options generated by the LMM were contextually relevant and often resembled those created by humans. However, vital questions remain that must be addressed before LMMs can be confidently implemented in AAC devices.

Kovalchick, Alyssa
Class Level: Junior
Major: Biochemistry
Mentor: Professor Michael Zdilla
Mentor Affiliation: Department of Chemistry (CST)

Mechanism of Oxygen Reduction by a Biologically Inspired Copper (I) Dimer

Copper coordination complexes have been of interest for decades due to their functionality in biological energy storage and transduction pathways. These metalloenzymes drive the oxidation of specific substrates by utilizing the energy saved by the thermodynamically favored reduction of oxygen into water. Despite their prevalence, questions remain regarding the mechanism of these proton-coupled redox reactions. Use of synthetic biomimetic model systems allows more accessible experimentation and means for mechanistic compounds. In recent years, our group has discovered a copper dimeric complex, $Cu^{I}_{2}(LH)_{2}I_{2}$(LH = R-(1-(pyridine-2-ylmethyl) pyrrolidine-2-yl) methanol), that reduces dioxygen in a manner possible related to copper redox enzymes via reduction of oxygen in solution. Over the course of this reaction, the copper (I) dimer is oxidized to $Cu^{II}_{2}(L)_{2}I_{2}$·H2O (L= R-(1-(pyridine-2-yl-methyl) pyrrolidine-2-yl) methoxide) presumably via reduction of diatomic oxygen. In preliminary research, the reaction was monitored using UV-Visible absorption spectroscopy and variable oxygen concentration. We have found first-order dependence on oxygen at lower concentrations in solution that saturates, becoming zero-order at higher oxygen concentrations. Further mechanistic proposals are currently being hypothesized and experiments planned. In the event our new proposed mechanisms are ruled out, further mechanistic proposals will proceed, and new experiments will be designed in attempts to rule out potential mechanisms of this copper-based redox enzyme model compound. Through the synthesis of biomimetic compounds such as this novel copper (I) dimeric complex, the fundamental aspects of stoichiometric and catalytic oxygen evolution and reduction reactions may allow for discovery of water-splitting catalysts that can augment knowledge of copper-mediated energy transduction catalysis.

Lam, Kenny
Class Level: Senior
Major: Biology
Mentor: Professor Matthew Helmus
Mentor Affiliation: Department of Biology (CST)

Behavioral Insights into Sexual Differences in Residence Time and Site Fidelity of Enchophora sanguinea, the Tropical Lanternfly

The tropical lanternfly (*Enchophora sanguinea*) is a species native to Central America and unlike their invasive relative spotted lanternfly (*Lycorma delicatula*), they are a neglected species in scientific research. Within behavioral ecology, there is little in-depth knowledge about *E. sanguinea*. This gap in information includes the sexual differences in coloring between males and females, their residency times on the trees they feed on, and their likelihood of returning to a certain site. This study utilizes images of the species taken at Camaquiri Conservation Initiative in northeastern Costa Rica to develop an analysis of the differences between male and female residency and movement patterns. Using an imaging software called I3S for its pattern recognition of the spots on the lower portion of the species' wings, individual lanternflies can be tracked to determine how long they remain on hosts and whether they are returning to a given site. In this study, we hypothesize that males will display a lower residence time on host trees and a lower site fidelity compared to their female counterparts. This proposes a difference in sexual priority, either for reproductive or survival motives, and contributes to a wide-ranging grasp around the understudied species. As there are few studies focusing on this species, these findings will play a significant role as the first steps in understanding *E. sanguinea* and its ecological behaviors.

Mai, Gavin
Class Level: Senior
Major: Computer Science
Mentor: Professor Longin Latecki & Jonathan Nyquist
Mentor Affiliation: Department of Computer and Information Sciences (CST) & Department of Earth and Environmental Science (CST)

Predicting long term missing values in time series data

The objective of this research is to identify improved methodologies for imputing long-term missing values in time series data. A variety of methods were explored, ranging from Python packages like sklearn and missForest to R packages such as imputeTS and mtsdi. Additionally, machine learning approaches, including multilayer perceptrons and trans- formers, were examined. Although most methods demonstrated strong performance for long-term missing values in a single feature, their effec- tiveness diminished when applied to datasets with multiple missing fea- tures. Ultimately, transformers exhibited the most robust performance among all evaluated methods.

Malladi, Sriharsha
Class Level: Senior
Major: Neuroscience
Mentor: Professor Shuxin Li
Mentor Affiliation: Department of Neural Sciences (LKSOM)

Developing selective peptides against non-muscle myosin II for regenerating injured optic nerve axons in adult mammals

It is essential to develop highly effective therapeutic strategies for regenerating lesioned CNS axons, including retinal ganglion cell axons. Recent transgenic studies demonstrate that non-muscle myosin IIA/B (NMIIA/B), the cytoskeletal proteins presented in axons, significantly suppress the elongation of injured optic nerve axons in adult mice. The major goal of this project is to develop post-injury deliverable therapeutic reagents for promoting robust axon regeneration following optic nerve crush. We designed six antagonist peptides for NMIIA/B by targeting the critical activity domains of these proteins. Pre- or post-injury intravitreal treatments with our selective peptides stimulated robust axon regeneration in wild-type mice with optic nerve crush. Notably, two of our peptides almost mimicked the effects of transgenic deletion of NMIIA/B or PTEN. PTEN suppression has been frequently used to promote CNS regeneration. Our peptide treatments also significantly increased the survival of retinal ganglion cells after optic nerve injury. Moreover, NMIIA/B suppression combined with the inhibition of Let7 signaling by AAV vectors showed synergistic actions in promoting the regeneration of axotomized optic axons in adult mice. Therefore, this project may facilitate the development of effective regenerative treatments for the lesions to neural visual pathways and other neurological disorders.

Mann, Cameron
Class Level: Senior
Major: Biology
Mentor: Professor Jocelyn Behm
Mentor Affiliation: Department of Biology (CST)

Patterns of Exotic Herpetofauna and Homogenization of the Caribbean Islands

The Anthropocene, marked by increased human globalization, has drastically impacted global ecosystems and climate stability. The biodiversity hotspot of the Caribbean is threatened by invasive herpetofauna via unintentional maritime transportation causing competition with native species, extinctions, and overall loss of biodiversity. The last century has seen a stark increase in the number of exotic species introduced by means of cargo ships and other forms of global transportation. Many invasive species arrive intentionally to islands through pet trade and unintentionally as stowaways on ships leading to limited knowledge and regulation of their spread. Invasive herpetofauna contribute significantly to the ecological homogenization of Caribbean islands, increasing species overlap across islands and thus reducing the uniqueness of local ecosystems. In our study we addressed this issue by compiling available records of invasive species. By focusing on introduced geckos as a representative subgroup of herpetofauna, we aim to identify variations in the homogenization of island ecosystems across the Caribbean. Understanding the distribution dynamics and ecological effects of non-native species will support future conservation efforts and mitigate ecological impacts of invasive species. While extirpation, complete removal of a species, is unrealistic, conservation efforts can be placed to tighten regulations regarding trade and transportation of goods. Future research needs to be carried out exploring long-term ecological impacts of non-native species.

Martin, Shannon
Class Level: Senior
Major: Genomic Medicine
Mentor: Professor Raymond Habas
Mentor Affiliation: Department of Biology (CST)

The role of Flightless in Wnt Signaling

The Wnt pathway is a highly conserved signaling pathway that is utilized heavily during embryonic development. The Wnt pathway functions specifically to regulate cell fate determination, motility, polarity, primary axis formation, organogenesis, and stem cell renewal (Komiya and Habas, 2008). Daam1 is one of the proteins involved in the Wnt pathway which regulates the nucleation and elongation of new actin filaments. The protein Flightless1 was identified as a binding partner of Daam1, but its precise role during early development is unknown in vertebrates. Flightless is known to help in the development of the flight muscle in Drosophila as mutations in this gene can cause an inability to fly, hence the name. The Habas lab has found that Flightless1 colocalizes with the actin cytoskeleton in mammalian HeLa culture cells, and its expression causes an increase in actin fiber formation which are important for development. In this study, temporal and spatial expression of Flightless1 was examined during the development of *Xenopus laevis* using RNA *in-situ* hybridization studies. We observed the temporal expression of Flightless1 throughout all stages of development. However, spatially a higher expression level was seen in the migratory dorsal mesodermal cells and later in the neural plate and neural folds, which then become refined to the brain and spinal cord. This expression pattern of Flightless1 also overlaps with Daam1 suggesting it may function as an effector for Daam1 during embryonic development. Therefore, understanding the expression pattern of Flightless1 during embryogenesis can help pinpoint its functional role and importance in development.

Mulbah, Tamai
Class Level: Senior
Major: Neuroscience: Cellular and Molecular
Mentor: Professor Xavier Graña
Mentor Affiliation: Department of Cancer and Cellular Biology (LKSOM)

Investigating the Role of PP2A/B55α inhibitor FAM122A in the Cell Cycle Progression of Glioblastoma Cells

Protein phosphorylation is critical in the regulation of the cell cycle, which is altered in cancer. PP2A/B55a is a serine/threonine phosphatase implicated in mitogenic signaling and various cell cycle transitions. FAM122A is a recently identified protein that binds and inhibits the Protein Phosphatase 2A (PP2A)/B55α holoenzyme by competitively inhibiting substrate binding, presumably regulating dephosphorylation events in various cell cycle transitions. However, its potential dysregulation leading to tumorigenesis is not fully understood. Using biochemical and functional genetic approaches, the Graña laboratory has reported that deletion of FAM122A via CRISPR knockout (KO) inhibits progression through interphase (G1/S/G2) and causes replication stress in a variety of cancer cells including the T98G glioblastoma cell line[4]. As B55$\boldsymbol{\alpha}$ is the regulatory subunit of PP2A and a tumor suppressor, investigation of the importance of FAM122A in the glioblastoma T98G cell line was conducted to determine the role of FAM122A in cell cycle progression. Using live imaging, cell cycle progression can be observed in a continuous and comprehensive manner, allowing for a more precise analysis of FAM122A's role in the cell cycle. We have performed cell cycle phase arrest and release experiments on wildtype and FAM122A KO cells expressing the FUCCI (Fluorescent Ubiquitination-based Cell Cycle Indicator) system and monitored live cell cycle progression using an Incucyte Imager. Delays in cell cycle progressions have been observed at multiple transitions. Identifying the mechanisms by which FAM122A modulates the cell cycle and suppresses replication stress in glioblastoma cells is important, as understanding the interplay between FAM122A and PP2A/B55$\boldsymbol{\alpha}$ may help in identifying new targets to develop strategies to suppress malignant brain tumors in individuals. These efforts may help develop personalized medication to treat said individuals.

Palomino, David
Class Level: Junior
Major: Physics & Computer Science/Mathematics
Mentor: Professor Jie Wang
Mentor Affiliation: Department of Physics (CST)

Construction of Topological Chern Band Systems

Topological Chern bands are condensed matter systems exhibiting anomalous quantum transport and possibly host exotic interacting physics. Understanding the restriction of band topology from Hamiltonian is an important fundamental problem and useful for material design. This poster presents a mathematical general discussion of the topological property of a general multi-band system. It explicitly constructs their wave function for any required Chern number pattern. We also discuss one concrete construction of a topological two-band system with idealized quantum geometry that is proved to host fractionalized quantum phases as exact ground states. Our preliminary result paves the way for a further better understanding of the topological properties of multiple-band systems.

Ribikauskas, Jenna
Class Level: Senior
Major: Biology
Mentor: Professor Tonia Hsieh
Mentor Affiliation: Department of Biology (CST)

Effects of Body Shape on Arthropod Burrowing Performance in Granular Media

Many animals burrow for protection from predators or for food. Existing research primarily examines burrowing of soft-bodied rather than hard-bodied animals such as arthropods. We compared the burrowing behavior of the giant canyon isopod (*Porcellio dilatatus*) and two species of cockroach: the orange head (*Eublaberus posticus*) and dubia (*Blaptica dubia*) cockroach. Whereas isopods (Iso) have a domed body shape, the dubia (Dub) cockroach is relatively flat, and the orange head (OH) cockroach is intermediate. Our goal was to determine how body shape and behavior affect burrowing behavior among these three species. We filmed (1 fps, GoPro Hero 9) five similarly sized individuals of each species (14.57 ± 1.27 mm) as they burrowed into a narrow container filled with coconut coir. We then tracked their body movements to quantify burrowing speed, depth, entry angle, and tortuosity. We found that while the cockroaches burrowed faster than the isopods (Iso: 1.06 ± 0.64 mm/s; Dub: 4.26 ± 1.60 mm/s; OH: 4.14 ± 2.36 mm/s), they did not burrow as deep (Iso: -18.49 ± 13.4 mm; Dub: -5.80 ± 3.47 mm; OH: -3.97 ± 1.90 mm). This shallow depth was also accompanied by a lower entry angle and a less tortuous, straighter path. I hypothesize that the cockroaches' flatter body facilitates faster burrowing. However, because they tended to bury at a shallower depth, their faster burrowing could alternatively be a consequence of less material resistance that would be experienced with deeper burrowing.

Shajan, Alphin
Class Level: Junior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Fostering Belonging in Computing Research Labs through Spontaneous Online Social Networks

New members of academic labs and clubs often experience imposter syndrome and face challenges in integrating into an already existing community. This research aims to explore how spontaneous social networks, specifically a Slack channel along with an integrated photo bot can help reduce imposter syndrome and improve community integration. Using daily prompts designed to encourage self-disclosure and interaction such as sharing a picture of their current environment or personal items, we examine how variations in the timing of the prompt (morning, afternoon, evening), as well as the nature of the prompts (personal vs impersonal, choice-based vs default), along with whether the participants were tagged or not impacts participants engagement and self-disclosure. Experiments will be conducted in the context of the Temple University HCI Lab and through both qualitative and quantitative data collection, i.e. through pre- and post-surveys and zoom interviews, the research will analyze how spontaneous social interactions can make a community stronger and improve the overall sense of belonging for new members. The findings from this study will provide insights into how social platforms like Slack and a low-cost photo bot can be leveraged in research labs and clubs to create a more inclusive environment for new members.

Sharief, Sulaiman
Class Level: Sophomore
Major: Biochemistry
Mentor: Professor Rihab Bouchareb
Mentor Affiliation: Center for Metabolic Disease Research (LKSOM)

Characterization of Mitochondria in Proximal Tubular Cells during Acute Kidney Injury

Mitochondria plays a key role in cellular metabolism. Several disease results from mitochondrial dysfunction including Acute kidney Injury (AKI). AKI results from a generalized or localized impairment of oxygen and nutrient delivery to the kidney. As a result of this imbalance, the tubular epithelial cells undergo injury, which manifests as cell death by apoptosis and necrosis, with reduced kidney function, impaired water and electrolyte homeostasis, and reduced excretion of waste products of metabolism. Several research evidence suggests that damage to mitochondrial function in early AKI is a crucial factor leading to tubular injury and persistent renal insufficiency. Mitochondria provide the Na+–K+-ATPase energy to generate ion gradients across the cellular membrane. Therefore, their dysfunction is directly linked to organ failure. To study mitochondrial morphology, PTC with labeled mitochondria with ability to photoconvert from green to red when exposed to a 405 nm laser (4% laser power) for 5 minutes will be used for the study. The proximal tubular cells will be cultured on ibidi glass bottom dish. We will image mitochondria with a confocal microscope equipped with an environmental chamber to control the temperature at 37 °C, 5% CO2. The images would be used to analyze the mitochondrial morphology (area, Perimeter) and dynamics (fission and fusion) using Image J.

Spadaro, Emmy
Class Level: Senior
Major: Ecology, Evolution, and Biodiversity
Mentor: Professor S. Blair Hedges
Mentor Affiliation: Department of Biology (CST)

A hidden diversity of geckolets on the Caribbean island of Hispaniola

Sphaerodactylus is a genus of geckolets (<40 mm) with round adhesive toe pads found in the West Indies, with 34 known species in Hispaniola; the extreme mountainous geography of which results in a rich diversity of endemic species with especially small ranges.

Mitochondrial gene data suggests more Hispaniolian *Sphaerodactylus* yet to be discovered, having been either misattributed to a known species or labelled incorrectly as a subspecies, and upon morphological investigation, five new species have been discovered and will be proposed. Additionally, there is also good evidence for the promotion of the *S. copei* and *S. elegans* subspecies to species.

This poster will focus on the separation of a new geckolet species found in the Riviere de Baraderes valley from the two nearest subspecies of *S. copei*, *S. c. cataplexis* and *S. c. picturatus*.

Stonefield, Ian
Class Level: Senior
Major: Ecology, Evolution, and Biodiversity
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Functional Diversity and Reorganization in Windthrow-Disturbed Forest

As climate change drives an increase in novel disturbances, understanding how ecosystems recover from such events is increasingly important. Large windthrow events, in particular, can drastically alter the composition and structure of mature forests. This study investigates the functional diversity of sapling communities in a post-disturbance old-growth forest at the Temple Forest Observatory compared to a nearby undisturbed old-growth forest site. Using an established species trait diversity framework on each forest's sapling community, we aim to reveal the potential pathways of ecosystem recovery following a major windthrow event.

Sapling communities were sampled and measured over two years post-disturbance, and functional traits were retrieved from various plant trait databases. Functional diversity was quantified using Rao's Quadratic Entropy (RaoQ) and its components: functional richness, functional evenness, and functional divergence.

Results showed no significant differences in overall functional diversity or in the components of richness and evenness between the sites in both years. However, functional divergence differed significantly in 2024, suggesting increased niche partitioning post-disturbance. These findings suggest that old-growth sapling communities may possess inherent functional resilience, maintaining structural and compositional stability even as they adapt to disturbance pressures. This resilience framework can inform conservation strategies aimed at enhancing forest adaptability in a changing climate.

Tateishi, Haruto
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor Jody Hey
Mentor Affiliation: Department of Biology (CST)

Neutrality of synonymous mutation in human population.

In this summer, I researched the natural selection in human population. There are multiple types of mutation. For instance, intergenic, 3'/5' UTR, regulatory region, intron, and exons including synonymous variant and nonsynonymous variant. Depending on the effect of each type, some of the types are strongly under the selection, while others are weakly under the selection. Thus, the variants under the weak/neutral selection should appear more than the variants. By using the dataset called VCF files, we counted the number of each mutation type and generate Site Frequency Spectrum (SFS). Specifically, relative cumulative SFS visualize the degree of natural selection. With the relative cumulative SFS, we assessed the degree of natural selection on each type of mutation and the synonymous change in codon sequence (e.g. AAA->AAG), while we also focused on the reliability of the biobank such as 1000 genome project, and gnomad. Through the assessments, we analyzed the neutrality of natural selection on synonymous mutations. In conclusion, the natural selection on synonymous variants was less neutral than we expected, while we verified that the natural selection on synonymous variant is less strong than that on nonsynonymous selection. Even though there are some published papers stating that there is a difference in selection on synonymous codon pair, we could not verify that with our results. Also, the dataset from the 1000 genome project is more reliable than the dataset from gnomad and more suitable to the study than the dataset from UK biobank.

Venkat, Sunthriiwi
Class Level: Sophomore
Major: Biology
Mentor: Professor Nathaniel Snyder
Mentor Affiliation: Aging + Cardiovascular Discovery Center (LKSOM)

Acyl-CoEnzyme A Metabolism affected by Valproic Acid

Acyl-Coenzyme As or acyl-CoAs are evolutionarily conserved metabolites that carry an acyl-group for further reactions in catabolic and anabolic metabolism of both endogenous and exogenous compounds. Valproic acid (VPA), a common medication used to treat neurological and psychological disorders such as epilepsy, is known to undergo metabolism via multiple acyl-CoA intermediates. The interaction between VPA metabolism, VPA's unclear mechanisms of action, and the normal cellular acyl-CoA dependent metabolism is unknown. To test whether VPA affects the concentration of other endogenous acyl-CoAs used in major metabolic pathways, we performed a dose response experiment using serial dilutions of VPA on HepG2 cells to measure acyl-coA production. HepG2s are a hepatocellular carcinoma cell line commonly used for metabolic studies. Liquid chromatography-mass spectrometry was then used to quantify the amount of acyl-CoAs in HepG2 cells with increasing dosing of VPA.

Wise, Isaac
Class Level: Junior
Major: Environmental Science: Applied Ecology
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Earthworms and Forest Resilience: Effects of Windfall Disturbance and Environmental Hazards.

Climate change has increased the frequency of severe weather events, such as tornados. In 2021 a tornado devastated the Temple Forest Observatory (TFO), a crucial old-growth temperate deciduous forest research site, drastically impacting its disturbance regime. This study investigated how earthworms, key players in detritus processing and soil health, responded to such novel disturbance. We compared earthworm densities within the tornado-impacted TFO and the nearby undisturbed Robbins Park (RBP) forest. Despite cataloging 30 earthworms and analyzing carbon-nitrogen content alongside soil temperature and moisture data, our results revealed no significant correlation between soil conditions and earthworm abundance post-disturbance. This research offers valuable insights into the resilience of soil ecosystems facing extreme weather, inviting deeper exploration into the complex interplay between disturbance events and soil biodiversity.

Yao, Renxuan
Class Level: Senior
Major: Computer Science
Mentor: Professor Longin Latecki & Jonathan Nyquist
Mentor Affiliation: Department of Computer and Information Sciences (CST) & Department of Earth and Environmental Science (CST)

Time Series for Predicting Missing Data

The objective of this research is to identify improved methodologies for imputing long-term missing values in time series data. A variety of methods were explored, ranging from Python packages like sklearn and missForest to R packages such as imputeTS and mtsdi. Additionally, machine learning approaches, including multilayer perceptrons and trans- formers, were examined. Although most methods demonstrated strong performance for long-term missing values in a single feature, their effec- tiveness diminished when applied to datasets with multiple missing fea- tures. Ultimately, transformers exhibited the most robust performance among all evaluated methods.

Session 2 Abstracts

Amr, Maryam
Class Level: Junior
Major: Computer Science
Mentor: Professor Benjamin Seibold
Mentor Affiliation: Department of Mathematics (CST)

User-intuitive visualization of real-time synaptic current activity

This research investigates representing synaptic current activity for the purposes of user-intuitive visualization in the software Neuro-VISOR, a real-time virtual reality (VR) simulation for computational neuroscience. We approached the problem by categorizing synaptic activity into three different thresholds: low, medium, and high. Each level is associated with a specific color gradient, transitioning from green for low activity, through yellow for moderate activity, to red for high activity. To determine the thresholds of the synaptic current, its value over time as the simulation progressed was recorded and graphed to obtain the values. This color-coded gradient offers a visual indicator of the cycling of the synaptic current, with the aim of allowing users to observe the dynamic changes as the simulation progresses. This real-time visual feedback enables users to easily distinguish the varying levels of synaptic excitation and inhibition across the network. The gradient effect thus provides a more immersive and informative experience for studying neuron and synapse dynamics in a simulated environment.

Anglin, Madlyn
Class Level: Senior
Major: Environmental Science
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Frog Callings Across Novel Habitats in a Disturbed Temperate Forest

Amphibians, like frogs, play critical roles in ecosystems but face increasing threats from disease and climate change. In 2021, a tornado passed through Temple Forest Observatory (TFO), uprooting trees, and creating new ephemeral pools where the tree root balls once stood. These temporary water bodies offer a unique opportunity for anuran species to use them as breeding habitats, potentially supporting the aquatic stage of their biphasic life cycle. The benefits of breeding in these novel habitats include reduced predation and lower competition from offspring of sympatric species, which are more commonly found in permanent water. Additionally, these habitats create a natural corridor, allowing frogs to move further from the creek and disperse across a larger area. However, these benefits come with inherent risks. Species that occupy temporary aquatic environments face the possibility of early mortality if the pools do not retain water for sufficient periods. This study aimed to investigate how these habitats affect frog populations, specifically examining the "corridor effect" created by these pools. We focused on frog habitat use and behavior by analyzing frog calls. During the breeding season, frogs produce acoustic signals, or calls, to communicate with potential mates. In addition to mating calls, frogs also produce territorial, distress, warning, and release calls, all of which provide insight into their behavior. Frog calls were recorded using a microphone and recorder at four sites within TFO. Bioacoustics analysis allowed for the detection and identification of species calls, call types, and calling indices. Our findings indicate that while frogs exhibit higher calling and mating activity at streams, they also utilize ephemeral pools, suggesting these habitats offer resources or benefits not available at the stream. These insights into anuran species' use of fragmented habitats can inform more effective conservation strategies for these amphibians and their ecosystems.

Arora, Ekta
Class Level: Senior
Major: Biology
Mentor: Professor Michael Autieri
Mentor Affiliation: Department of Cardiovascular Sciences (LKSOM)

METTL14

Vascular diseases, including atherosclerosis, restenosis, and hypertension, are a leading cause of mortality worldwide. Vascular smooth muscle cells (VSMCs) comprise the wall of arteries and 90% of their cellular content. VSMCs play an important role in regulating proper vessel function and dysregulation in their gene expression and phenotype can contribute to disease pathogenesis. Recently epitranscriptomics, or RNA modifications, have shown to be crucial in controlling post-transcriptional gene expression within the cell. N6-methyladenosine modification, or m6A methylation, specifically has been shown to regulate RNA translation, stability, and degradation in VSMCs. Our overall hypothesis is that Methyltransferase-like 14 (METTL14), a major m6A methylase, may play a crucial role in modifying mRNA transcripts within VSMCs, altering gene expression and subsequent function and phenotype of the cell. The aim of this study is to develop and characterize a VSMC-specific, METTL14 conditional knockout mouse model to be able to study the effect of METTL14 knockout in VSMCs in vivo and how this affects proper vascular function. We will cross mice with the floxed METTL14 gene (METTL14 fl/fl) with mice that express a VSMC-specific Itga8-Cre recombinase, to produce mice that will have a knockout of METTL14 in VSMCs upon induction of the Cre recombinase. In this study I show DNA genotyping to characterize the genetic identify of this crossed mouse. We will ensure the mice have METTL14 floxed on both alleles and express the Cre via proper genotyping prior to performing further experiments.

Asif, Rikza
Class Level: Junior
Major: Biology
Mentor: Professor Stephanie Daws
Mentor Affiliation: Department of Neural Sciences (LKSOM)

Impact of heroin and inflammation on brain reward pathways

Opioid addiction is accompanied by physical dependency that may lead to drug overdose, and possibly death. It was responsible for nearly ¾ of overdose-related fatalities in 2020. The United States' ongoing opioid epidemic highlights the importance of studying the molecular neuroadaptations associated with opioid-seeking behavior. To model drug-taking behavior, rats underwent heroin self-administration (SA), followed by RNA sequencing to analyze transcriptional changes.

Opioids, including heroin, exploit the brain's reward system by inducing dopamine surges that will lead to addiction after repeated use. This rewires the brain by impairing the orbital frontal cortex (OFC) to weaken its decision-making abilities in favor of drug-seeking behavior (Volkow & Morales, 2015 *Cell*).

The immune system responds to opioid use with inflammation to reduce dopamine release within the brain's reward pathways. Examining protein expression in the OFC will indicate the role specific proteins contribute to promoting inflammation. Protein was extracted from OFC rat tissue, followed by a protein assay, before measuring concentration using imaging software to determine inflammation-related protein expression. Validation of regulated mRNA was performed in an independent cohort of rats through western blot analysis.

Autieri, Stephen
Class Level: Junior
Major: Chemistry
Mentor: Professor Eric Borguet
Mentor Affiliation: Department of Chemistry (CST)

Metal Oxyhydroxides for Use in Glycosidic Bond Hydrolysis

Sugar hydrolysis, or glycosidic bond hydrolysis, is crucial to both biological and industrial systems, with sugars providing energy to cells and many hydrolysis products having applications in the food, pharmaceutical, and chemical industries. Studies suggest that the hydrolysis rate of the glycosidic bond is pH dependent, where an acidic solution works best.[1] This reaction is often catalyzed by enzymes, but due to the incompatible pH properties of enzymes, developing a catalyst that can withstand acidic conditions and are effective at any pH is important. Metal oxyhydroxides, with strong Lewis acidity of the metal ion and abundant hydroxyl groups, can be stable in acidic conditions, making them excellent catalysts for glycosidic hydrolysis. These oxyhydroxides can be used in metal-organic frameworks (MOFs), which were shown to efficiently hydrolyze glycosyl bonds when doped with hydroxyl groups.[2] We hypothesize cerium oxyhydroxide to be particularly effective due to the strong Lewis acidity of the Ce^{4+} ion it is made from.[3] In this study, we will use cerium oxyhydroxide and sucrose, composed of one glucose and fructose moiety bound via a glycosidic oxygen atom, as a benchmark system to study glycosidic bond hydrolysis. The reaction progress will be monitored using nuclear magnetic resonance (NMR) spectroscopy at varying pH levels.

1. **Efficient Hydrolytic Breakage of β-1,4-Glycosidic Bond Catalyzed by a Difunctional Magnetic Nanocatalyst**. Yang Ren-Qiang, Zhang Ni, Meng Xiang-Guang, Liao Xiao-Hong, Li Lu, Song Hong-Jin. *Australian Journal of Chemistry*. **2018** 71 559-565 DOI: https://doi.org/10.1071/CH18138
2. **Hydrolase–like Catalysis and Structural Resolution of Natural Products by a Metal–Organic Framework.** Mon M, Bruno R, Sanz-Navarro S, Negro C, Ferrando-Soria J, Bartella L, Di Donna L, Prejanò M, Marino T, Leyva-Pérez A, Armentano D, Pardo E. *Nat Commun*. **2020** 11 3080 DOI: https://doi.org/10.1038/s41467-020-16699-3
3. **Bimetallic Ce/Zr UiO-66 Metal-Organic Framework Nanostructures as Peptidase and Oxidase Nanozymes.** Alexandra Loosen, Charlotte Simms, Simon Smolders, Dirk E. De Vos, and Tatjana N. Parac-Vogt. *ACS Applied Nanomaterials*. **2021** 4 6 5748-5757. DOI: 10.1021/acsanm.1c00546

Bedell, Madison
Class Level: Senior
Major: Environmental Science
Mentor: Professor Ilya Buynevich
Mentor Affiliation: Department of Earth and Environmental Science (CST)

Hydrogeologic Implications of Bioturbation from Owls

Burrowing owls (Athene cunicularia) produce burrows for nesting and shelter, sometimes relying on underground structures created by other animals or even anthropogenic excavations. The species inhabits arid, semi-arid, and some coastal and insular regions of the Americas, and have protected status in some countries. In addition to typical siliciclastic substrate, they inhabit evaporite (e.g., White Sands desert, New Mexico) and carbonate (Florida, the Bahamas) settings. As they prefer well-drained areas, but rely on subterranean structures for thermoregulation and to avoid water loss, with typical burrow depth of ~1 m, the burrows serve as bioindicators of surface erosion and minimum water table depth. This study examined the relationship between the owl burrows and fluctuations of the vadose zone. Using examples of georadar images from the White Sands desert and published data about co-located burrow and hydrological databases, it is possible to establish these zoogenic structures as constraints on regional aquifer patterns. Preliminary research suggests that A. cunicularia nests may be located <2-3 m above the long-term water table, with implications for reconstructing paleo-landscape and paleoecological conditions using fossil structures.

Bicalho, Daniel
Class Level: Sophomore
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Simulating Social Bots in Computing Education

Online discussion forums have played a helpful role in education by providing support outside of class time, but they bring significant challenges such as delayed response times, miscommunication, and off-topic discussions. We address these issues by engaging in a research-through-design process, which involves using design fiction methods where we create and explore imagined scenarios of how future technologies can influence education. Our design workshop suggests that students desire a bot that not only guides them through course material but also actively supports their planning and time management, suggesting that these kinds of chatbot systems could potentially be transformative tools in educational forums. Building on these insights, we envision a collection of design ideas that imagine a tool powered by large language models (LLMs) to support student planning and scheduling. For example, a social bot in a classroom could help students stay on track by reminding them of upcoming assignments, providing motivation, and keeping them organized. This approach provides a solution that could improve student engagement and learning outcomes by addressing the limitations of current online discussion forums. We have completed two workshops with four participants, gathered some initial results, and are still expecting additional findings.

Borukhovich, Sofia
Class Level: Junior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Prompt Precision: Evaluating Student Methods for LLM Engagement

With the rapid sophistication and development of large language models (LLMs) in recent years, AI tools are expected to become integral to learning environments. This integration brings forward concerns regarding the potential impacts on students' education, especially for those with limited programming experience. This research examines how novice programmers in various introductory-level computer science courses approach the creation of text-to-code prompts for an LLM, identifying characteristics that lead to “successful” prompts capable of completing coding tasks. We analyze existing metrics for evaluating prompt effectiveness and propose new criteria to support non-experts in generating productive prompts. This evaluation aims to offer insights into the role of code-oriented LLMs in foundational computer science education.

Bucher, Sarah
Class Level: Senior
Major: Biology
Mentor: Professor Brent Sewall
Mentor Affiliation: Department of Biology (CST)

Differences in Severity of Infection Based on Sex of Hibernating Bats in Response to White-Nose Syndrome

White nose syndrome (WNS), an emerging infectious disease caused by the fungal pathogen *Pseudogymnoascus destructans* (Pd), originates from Europe but was first detected in 2006 in New York and has since spread to caves and mines across the United States and Canada. It has since led to mass mortality of many hibernating bat species due to disruption in homeostasis during hibernation. This project aimed to study the differences in severity of infection based on the sex of hibernating bats in Northern American populations in response to WNS. This was done by analyzing ultraviolet (UV) imagery of skin lesions and genetic analysis of Pd from swab samples of each bat wing. Preliminary results may suggest that intersexual differences play a role in severity of infection. Studying the intersexual differences in WNS infection is important for the conservation and management of decreasing bat populations.

Chacko, Noel
Class Level: Senior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Lightweight Social Computing Tools for Undergraduate Research Community Building

Many barriers exist when new members join a research community, including imposter syndrome. These barriers can be especially challenging for undergraduate students who are new to research. In our study, we will explore how the use of social computing tools in the form of spontaneous online social networks can be used in small research communities to improve sense of belonging, peripheral awareness, and feelings of togetherness within an existing CS research community. Inspired by spontaneous online social networks (SOSNs) such as BeReal, we plan to integrate a Wizard-of-Oz photo-sharing bot into a computing research lab to foster community building among members. Over a five-week period, we aim to observe any increase in participants' sense of togetherness based on pre- and post-study surveys. Our planned surveys and semi-structured interviews are designed to reveal how this approach may increase awareness of peers' personal lives, enhance feelings of community, and reduce feelings of disconnectedness.

Cosminski, Beth
Class Level: Senior
Major: Environmental Science
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Tree Sapling Mortality in an Eastern Deciduous Forest: Early-Stage Recovery Post Novel Windthrow Disturbance

In the fall of 2021, a novel tornado event struck Ambler Temple Campus, inflicting significant damage to a section of old-growth forest on campus. Three years later, this forest is in the early stages of recovery, resulting in a reshuffling of resources and competition among the surviving vegetation and establishing post-disturbance. Understanding the early stages of forest recovery is critical as the frequency and intensity of extreme weather events is expected to rise due to Earth's changing climate. Monitoring sapling mortality can provide valuable insights into forest resilience and the factors that influence regrowth. Specifically, tracking how environmental factors such as light availability and vegetation density influence sapling survival may support predicting the future structure of forests and their capacity to recover from disturbance. This study hypothesizes that tree sapling survival will be significantly influenced by environmental factors, specifically light availability and the density of vegetation on the forest floor. These factors will contribute to sapling mortality rates, offering insights into how forest recovery may unfold in the context of increasing disturbance events. To test this, we utilized data collected during the 2023 and 2024 sapling and vegetation surveys, as well as ground-level light exposure data collected during 2023 and 2024. Our results suggest that neither light availability nor vegetation coverage alone leads to tree sapling mortality. This may indicate that other environmental factors—such as herbivory, soil moisture, or temperature—or an interplay of multiple factors may drive sapling mortality.

Gawde, Sakshi
Class Level: Senior
Major: Biology
Mentor: Professor Mary Barbe
Mentor Affiliation: Aging + Cardiovascular Discovery Center (LKSOM)

Neuroplasticity and Reinnervation in Lower Motor Neuron-Lesioned Bladder, Urethra, and Anal Sphincter

Our laboratory has spent over two decades developing surgical techniques to reinnervate lower motor neuron-lesioned organs, especially the urinary bladder, using canine models. This research has shown promise, with clinical trials restoring partial bladder control in humans with sacral nerve damage. Leveraging anatomical similarities between canine and human urinary systems, our study aims to enhance understanding of neuroplasticity in functional recovery post-reinnervation surgery, focusing on sensory-motor integration for improved bladder and bowel function in spinal cord injury patients.

Our project investigates whether an adenovirus vector with brain-derived neurotrophic factor (BDNF) injected into the reinnervated bladder wall can improve recovery. We will examine axonal growth, synaptic reorganization, and tissue regrowth in bladder and related structures. Neuroplastic changes in both central and peripheral nervous systems will be assessed to correlate with functional recovery, predicting sensory-motor integration in reinnervated bladder pathways.

Comparative analysis with a control group receiving an empty adenoviral vector will evaluate recovery through bladder emptying tests and 24-hour behavioral monitoring. For neuroplasticity assessment, we will perform histological and molecular analyses, focusing on axonal growth and synaptic density markers. My role includes tissue processing, cryosectioning, video analysis, and assisting in awake urodynamics filling studies.

We expect BDNF to enhance neuroplasticity, potentially supporting a predictive model for motor and sensory recovery, which may inform therapeutic strategies for patients with lower motor neuron injuries.

Harper, Emily
Class Level: Senior
Major: Biochemistry
Mentor: Professor Lin Zhu
Mentor Affiliation: Department of Urban Health and Population Science (LKSOM)

The Social, Biological, and Physiological Factors of Asian Glow

Asian glow is a common reaction that affects about 50% of East Asians, typically characterized by facial flushing after consuming alcohol. This response to drinking alcohol is because of an inherited genetic mutation in the enzyme aldehyde dehydrogenase 2 (ALDH2) that is responsible for metabolizing alcohol. Individuals with this mutation are unable to metabolize alcohol efficiently, which would lead to an accumulation of acetaldehyde, a toxic byproduct from metabolizing alcohol. This accumulation leads to the symptoms of Asian glow (facial flushing, tachycardia, nausea, headaches, etc.)

Although this reaction affects half of East Asian populations, it is misunderstood and often misconstrued within the community. High levels of acetaldehyde is carcinogenic; even though symptoms seem superficial and cosmetic, Asian glow has major health implications for higher risk of esophageal cancer and alcohol-related cancers. Despite the health risks, awareness on the severity of the reaction and education on health behaviors is limited between health professionals and Asian populations.

Historically, Asian populations are the least represented group in healthcare due to barriers such as language, immigration status, health literacy, and accessibility to health insurance. For those with no access to healthcare, there are products in the market to address the cosmetic symptoms of Asian glow, however it is imperative to note that these temporary dermal and oral remedies do not address the genetic causes. Measures to mitigate the effects of Asian glow as well as prevention for head, mouth, throat, and alcohol related cancers should be taken within the community and health professionals.

Healey, Caroline
Class Level: Senior
Major: Biology
Mentor: Professor Benjamin Blass
Mentor Affiliation: Department of Pharmaceutical Sciences (PHARM)

Investigation of 5-1H-indole bioisosteres: 5-HT_7 antagonists and cocaine use disorder

Substance use disorder (SUD) is a major, unmet medical condition with a global impact. According to the 2018 National Survey on Drug Use and Health, ~32 million people over the age of 12 in the U.S. had reported using an illicit drug in the past 30 days, and >8.1 million people were addicted to illicit drugs. Cocaine is one of the most commonly abused illicit drugs. Despite the clear and compelling need, there are no FDA approved medications for the treatment of cocaine use disorder (CUD). We have identified a preliminary series of novel, drug-like 5-HT_7 antagonists that include the lead compound MC-170073, which produce a positive impact in the cocaine reinstatement rate model of addiction in our preliminary studies. While this compound is useful as a proof of concept, the presence of a phenol on this compound is a liability. In this program, we will prepare indole biosisostere that can be incorporated novel 5-HT_7 antagonists.

Hurm, Katherine
Class Level: Senior
Major: Genomic Medicine
Mentor: Professor David Liberles
Mentor Affiliation: Department of Biology (CST)

A New Mechanistic Probabilistic Model to Characterize the Frequency of Gene Duplicates in a Population

Duplicate genes are an important driver of phenotypic changes in organisms. Understanding the selective pressures on gene duplicates themselves uncovers the underlying evolutionary dynamics of these genes. Previously, there has been a lack of appropriate methods that enable us to understand these events at a population genetic level. Most analyses of gene duplicates have been demographic. Here a straightforward probabilistic model for harnessing the relationship between allele age and expected frequency in a population is introduced.

Implemented as a Wright-Fisher-style Model in python, genotype fitness is calculated based on hypothetical relationships of the link between expression level and fitness. Simulations of these relationships under several diploid effective population sizes with parameters for various attributes. The nature of neo-functionalization is a variable, as are the possibilities of linked vs unlinked duplicates, and distinct sexes vs. hermaphroditic individuals in the population. These simulations describe the expected allelic and genotypic frequencies over generations in a population once a new identical duplicate is introduced to a population. This method of analysis will provide a helpful tool for researchers aiming to efficiently and quickly understand selection on segregating gene duplicates in their own population data in any species.

Johnson, Saniyah
Class Level: Senior
Major: Biology
Mentor: Professor Alison Gould
Mentor Affiliation: Department of Biology (CST)

Variations in Luminescence of Bioluminescent Cardinalfish Symbionts

Siphamia forms unique symbiotic relationships with the *bacterium Photobacterium mandapamensis* that reside within its specialized light organ. This light organ, connected to the GI tract, allows them to counterillumate, which obscures their silhouette by matching the amount of downwelling light on a given night. An individual light organ contains approxiamtley six symbiont genotypes, which show variation in gene content A particular gene of interest is luxF, which is a part of the lux-rib operon that is responsible for light production in the symbiont.

Kalsi, Jasleen
Class Level: Junior
Major: Biology
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Examining the Variability of Soil Fungal Diversity In a Disturbed vs. Undisturbed Forest Ecosystem

Soil fungi are critical to nutrient cycling and storage of carbon and nitrogen in forests because they can decompose organic matter and prevent pathogens from infecting trees (Eagar et al. 2022). One type of soil fungi called mycorrhizae, which aids plant growth, may be a good predictor of overall soil fungal diversity of certain woody plants. To test this, the techniques of field sampling, serial dilution, and plating were used in a wind disturbed forest and a non-wind disturbed forest. The data collected was analyzed using methods of graph-making and running statistical analyses to determine statistical significance. It is important to understand how soil fungal diversity differs in a disturbed vs. undisturbed ecosystem because soil fungus is critical to plant resilience, establishment, and disease following a wind-driven disturbance.

Khandave, Dhruv
Class Level: Senior
Major: Information Science and Technology
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Fostering Belonging in Computing Research Labs through Spontaneous Online Social Networks

Many barriers exist when new members join a research community, including imposter syndrome. These barriers can be especially challenging for undergraduate students who are new to research. In our study, we will explore how the use of social computing tools in the form of spontaneous online social networks can be used in small research communities to improve sense of belonging, peripheral awareness, and feelings of togetherness within an existing CS research community. Inspired by spontaneous online social networks (SOSNs) such as BeReal, we plan to integrate a Wizard-of-Oz photo-sharing bot into a computing research lab to foster community building among members. Over a five-week period, we aim to observe any increase in participants' sense of togetherness based on pre- and post-study surveys. Our planned surveys and semi-structured interviews are designed to reveal how this approach may increase awareness of peers' personal lives, enhance feelings of community, and reduce feelings of disconnectedness.

Lupold, Jayden
Class Level: Junior
Major: Computer Science
Mentor: Professor Martha Constantinou
Mentor Affiliation: Department of Physics (CST)

Exploring Pion Structure Through Quantum Chromodynamics

Our project evaluates the rich and complex internal structure of the pion, a meson particle made up of one quark and one anti-quark that give the characteristics to the pion. We utilized computing to analyze data from numerical simulations of the Quantum Chromodynamics (QCD) theory. QCD is the foundational theory governing the strong interaction responsible for binding quarks and gluons into composite particles known as hadrons, which are the core of visible matter. This research analyzes the relationship between particle mass, energy, and momentum using Python. We aim to calculate the correlation function between two pions on a 4-dimensional discretized space. This correlation function is calculated for multiple time-separations between the two pion states. Two-point function data collected from these simulations is used to calculate particles' energies as a function of time and initial momentum.

Marshall, Danny
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor John Elrod
Mentor Affiliation: Aging + Cardiovascular Discovery Center (LKSOM)

Loss of the mitochondrial calcium sensor MICU3 contributes to mitochondrial dysfunction and cognitive decline

Mitochondrial calcium homeostasis is essential for cellular energy production and synaptic activity, both critical for cognitive function. In Alzheimer's Disease (AD), dysregulated mitochondrial calcium signaling may drive neurodegeneration. While prior studies suggest that excessive mitochondrial calcium is linked to AD pathology, the role of mitochondrial calcium uptake regulators, particularly MICU3, remains unclear. MICU3, predominantly expressed in neurons and downregulated in AD, was hypothesized to maintain mitochondrial calcium balance, thereby influencing cognitive health. To test this, we examined MICU3 knockout mice, assessing mitochondrial function and cognitive behavior relative to AD models. Western blotting confirmed MICU3 deletion, and behavioral assessments, including Y-maze, novel object recognition, and contextual recognition tests, revealed intensified cognitive deficits in MICU3 knockouts compared to amyloid precursor protein (APP) knock-in mice. Interestingly, calcium assays demonstrated heightened vulnerability to calcium-induced cell death in MICU3-deficient neurons, despite reduced calcium uptake. Overall, these findings suggest that MICU3 loss exacerbates AD-related cognitive decline by impairing calcium regulation and mitochondrial function, positioning MICU3 as a potential therapeutic target. Future research will explore a neuron-specific MICU3 rescue model to further validate this therapeutic potential.

McLaughlin, MaryKate
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor Jean-David Grattepanche
Mentor Affiliation: Department of Biology (CST)

Distribution of Antarctic Dinoflagellates in Contrasted Seasons

Dinoflagellates are microbial eukaryotes that can be heterotrophs, phototrophs or mixotrophs. Phototrophic dinoflagellates play a critical role as primary producers in marine ecosystems. Phototropic phytoplankton are especially important, as they are responsible for approximately half of the Earth's oxygen production. To better understand the parameters shaping the phototrophic dinoflagellate community, we examined the seasonal distribution of dinoflagellate samples that were collected in Antarctica during two contrasted seasons. We hypothesized that there would be more phototropic dinoflagellates present in the Spring than in the Winter. Using high-throughput sequencing and bioinformatic tools such as Biopython and BLAST, sequences were analyzed to differentiate the different dinoflagellate species and their trophic groups. Preliminary conclusions suggest that dinoflagellates are resilient, as no significant changes were observed among trophic groups between seasons.This stability may be due to the influence of other taxa distributions in the area and low light availability in early Spring. The identification of dinoflagellate species was limited to the contents of existing databases, with approximately one-third of samples remaining unidentified. This gap highlights the need for further documentation to bridge the knowledge gap between recorded dinoflagellate species and the broader population.

Miller, Isabella
Class Level: Junior
Major: Environmental Science
Mentor: Professor Mariana Bonfim
Mentor Affiliation: Department of Biology (CST)

Examining Ground Arthropod Diversity and Varying Vegetation Cover Across a Disturbance Gradient

Arthropods including insects, arachnids, and crustaceans, are important for ecosystem recovery as they contribute to nutrient cycling and ecosystem development. According to the Intermediate Disturbance Hypothesis, areas with higher plant cover are expected to occur in areas of medium disturbance because moderate disturbances establish a balance between new species colonizing the environment and preexisting species survival following the disturbance, further promoting greater diversity. In this experiment, pitfall traps across three disturbance levels were deployed to capture forest arthropods and plant percent cover was measured. The Shannon Diversity Index was calculated across disturbance gradient considering species richness and evenness. Medium disturbed forest ecosystems showed greatest species. Across all disturbance levels, a total of 57 unique species were identified, varying in abundance, including arachnids, flying insects, and other ground arthropods with 279 samples collected and identified.

Millwood, Stephanie
Class Level: Senior
Major: Computer Science
Mentor: Professor Longin Jan Latecki
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Remote Photoplethysmography Signals Improve Engagement Detection

Student engagement in class is one of the most important predictors of academic success. While online classes have numerous benefits, a drawback is the increased difficulty of gauging and maintaining students' attention compared to traditional, in-person learning environments. As both online learning and artificial intelligence have become more widespread in recent years, researchers have explored the ability of AI models to ascertain a person's level of focus in virtual settings. Separately, it has been found that heart rate variability is correlated with engagement and attention.

This project developed a novel method of combining heart rate signal data with video data in a way that improves the ability of vision-language models (VLMs) to detect engagement. A transformer-based model was used to obtain heart rate signals from videos of study participants using an online learning platform. Those signals were then converted into images that represented the heart rate in a format that could be understood by a VLM, while preserving the periodic nature of the data. Combining videos of study subjects with their heart rate information significantly improved the accuracy of the vision-language model's judgements of the participants' engagement levels.

Moreno, Soul
Class Level: Sophomore
Major: Biology
Mentor: Professor Alison Gould
Mentor Affiliation: Department of Biology (CST)

Luminosity Differs Between Symbiotic Bacterial Strains of a Coral Reef Fish

The purpose of this research is to investigate the impact of luminosity on the coral reef fish *Siphamia versicolor (tubifer)* illumination behavior. It hypothesizes that optimal luminosity is crucial for effective counter-illumination, with overly dim or bright communities increasing predation risk. Controlled experiments showed significant variation in luminosity among strains, suggesting S.tubifer may assemble its symbiotic community by promoting strains that meet functional brightness thresholds. Understanding these dynamics could inform ecological theories and conservation strategies for symbiosis-dependent species.

Muthusekaran, Srishty
Class Level: Sophomore
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

The Evolving Usage of GenAI by Computing Students

Help-seeking is a critical aspect of learning and problem-solving for computing students. Recent research has shown that many students are aware of generative AI (GenAI) tools; however, there are gaps in the extent and effectiveness of how students use them. With over two years of widespread GenAI usage, it is crucial to understand whether students' help-seeking behaviors with these tools have evolved and how. This paper presents findings from a repeated cross-sectional survey conducted among computing students across North American universities (n=95). Our results indicate shifts in GenAI usage patterns. In 2023, 34.1% of students (n=47) reported never using ChatGPT for help, ranking it fourth after online searches, peer support, and class forums. By 2024, this figure dropped sharply to 6.3% (n=48), with ChatGPT nearly matching online search as the most commonly used help resource. Despite this growing prevalence, there has been a decline in students' hourly and daily usage of GenAI tools, which may be attributed to a common tendency to underestimate usage frequency. These findings offer new insights into the evolving role of GenAI in computing education, highlighting its increasing acceptance and solidifying its position as a key help resource.

Naeem, Anniyah
Class Level: Junior
Major: Neuroscience: Cellular and Molecular
Mentor: Professor Derek Isenberg
Mentor Affiliation: Department of Emergency Medicine (LKSOM)

Surveillance of Emerging Infectious Diseases in Emergency Departments: An Observational Study of Mpox and MRSA Through EIDNET

The rise in cases of Mpox and Methicillin-resistant *Staphylococcus aureus* (MRSA) underscores the need for vigilant surveillance within emergency departments (ERs), where these infections often present first. This study is part of the Emerging Infectious Disease Network (EIDNET) which includes two observational studies: CRASHED (targeting Mpox) and ESCAPES (targeting MRSA). CRASHED's primary objective is to capture the epidemiology and clinical presentation of Mpox in emergency departments and provide valuable data on how to improve responses to emerging outbreaks. ESCAPED focuses on capturing the MRSA prevalence and resistant patterns to understand the transmission dynamics and challenges presented by the antibiotic resistance. The studies involve data collection through participant screening, surveys, patient interviews, lesion photography, and sample collection. The result of this study will be used to further enlighten public health strategies on the pattern of spread, the challenges of resistance in these infections, and the process of affording the care in clinical epidemiology. The development of specific intervention strategies could help to reduce Mpox and MRSA transmission along with making an impact within a healthcare setting.

Patel, Kush
Class Level: Sophomore
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Hacking Student Leadership: Student Leadership In Hackathons

Hackathons provide a dynamic environment for students to cultivate leadership skills that are challenging to develop in traditional classroom settings. These events demand student leaders adjust to new obstacles and collaborate with diverse teams while effectively managing their time – all essential qualities of effective leaders. By spearheading and coordinating hackathons, students acquire insights into project management techniques and the art of resolving conflicts efficiently while making decisions under pressure. Our team, composed of experienced undergraduate organizers and participants, has successfully led OwlHacks from its birth in 2019, growing from 150 to over 300 attendees beyond the Philadelphia region. These experiences have not only improved Owl Hacks organizer's leadership abilities but also nurtured a profound insight into leadership dynamics in challenging environments. Students can gain hands-on leadership skills when being challenged under both the pressure of working on a team and a time limit to create a specific project. This allows students to hone their leadership abilities while working collaboratively on a large project. In contrast, to classrooms, where leadership roles are often confined to small group tasks, hackathons present participants with high-pressure situations that demand quick decision-making, effective communication, and flexible problem-solving skills. The teamwork aspect of hackathons encourages a shared sense of responsibility and ownership prompting individuals to take on leadership roles that directly translate to real-world scenarios. We explore the lasting effects of these encounters on advancement and personal maturation, showcasing how hackathons can act as a driving force for cultivating upcoming technology leaders.

Pelletier, Nina
Class Level: Junior
Major: General Science with Teaching
Mentor: Professor Ilya Buynevich
Mentor Affiliation: Department of Earth and Environmental Science (CST)

Biogeomorphological Impact of Riverbank Bark Damage by Beavers

This research focuses on zoogeomorphological impact of an anomalous activity by the North American beaver (*Castor canadensis*) in eastern Pennsylvania. In addition to traditional tree felling as part of foraging and bio-construction, there has been an increase in partial or full bark stripping (girdling) of large live trees, without any indication of deep incision. At a number of sites in Tioga and Bucks Counties, as well as along the islands on the lower Delaware River, recently live tress with diameters >30 cm (some > 1 m) have been partially or completely stripped along their lower trunk section by the resurgent beaver population. Girdling has been particularly detrimental to white oak *(Quercus alba)*. Some partially stripped trees show evidence of healing, while many (some >100 years old) along stream banks have succumbed to extensive bark loss. This activity, including similar behavior by the Eurasian beaver *(C. fiber),* has the potential long-term impact on bank stability due to the reduction in canopy cover (increased rain-splash impact) and soil-stabilizing capacity. Image color-intensity analysis was used for rapid assessment and quantification of the damaged area. This study has potential paleoichnological implications, with sub-fossil tree stumps bearing castorid incisor marks ~0.2-0.8 m above the paleo-surface.

Perez, Rosamia
Class Level: Senior
Major: Biology
Mentor: Professor Erik Cordes
Mentor Affiliation: Department of Biology (CST)

Ontogenetic dietary shifts in deep-sea yeti crabs, *Kiwa puravida*, revealed by stable isotope analysis

Cold seeps are chemosynthetic habitats found in the deep ocean, where producers like bacteria generate energy from inorganic carbon sources. *Kiwa puravida*, an Anomuran yeti crab endemic to Mound 12, a cold seep on the Pacific Costa Rican margin, cultivates and feeds on these chemosynthetic bacteria. These bacteria employ different carbon fixation pathways, with the most common being Gammaproteobacteria, which use the Calvin-Benson-Bassham (CBB) cycle, and Epsilonproteobacteria, which use the reverse-tricarboxylic acid (rTCA) cycle. Previous research has shown many chemosymbiotic crustaceans experience a shift in the relative abundance of these bacterial groups throughout their development, which potentially leads to dietary changes. We hypothesized that as *K. puravida* matures from juveniles to adults, it undergoes dietary shifts driven by changes in the dominant bacterial communities. To explore this, we collected individuals across all life stages, from young juveniles to fully grown adults, and performed stable isotope analyses. Initial results revealed that juveniles exhibited lower $\delta^{13}C$ values, consistent with a diet dominated by Gammaproteobacteria, which use the CBB cycle. In contrast, adults showed more enriched $\delta^{13}C$ values, indicating a greater reliance on Epsilonproteobacteria, which use the rTCA cycle. These findings support the theory that *K. puravida* undergoes an ontogenetic shift in diet as it matures, reflecting changes in the bacterial communities associated with different life stages.

Pobandith, Katelyn
Class Level: Senior
Major: Genomic Medicine
Mentor: Professor Ellen M. Unterwald
Mentor Affiliation: Center for Substance Abuse Research (LKSOM)

Identification of the Molecular Mechanisms Underlying Susceptibility to Heroin Self-administration Following Traumatic Stress Exposure to Rats

Post traumatic stress disorder (PTSD) can increase vulnerability to drug use and can affect the everyday behaviors of an individual. In the growing years, PTSD rates have been high among the opioid-using population, with previous research discovering that among persons with opioid use disorder, 41% have a history of PTSD and 33.2% meet the criteria for having PTSD. The specific aim of this study was to identify the molecular mechanisms to the susceptibility of heroin self-administration following traumatic stress. The primary aim of this study is to investigate the link between PTSD and substance use by identifying molecular mechanisms that underlie susceptibility to heroin self-administration following traumatic stress exposure in the rat model. Our study focused on two brain regions: the bed nucleus of the stria terminalis (BNST) and the basolateral amygdala (BLA). Both structures are responsible for regulating stress and anxiety-like behaviors and reward circuitry within the hypothalamic-pituitary-adrenal (HPA) system. A single prolonged stress (SPS) model was utilized to induce anxiety-like behaviors in the rat subjects, then, next generation RNA sequencing was performed on the BLA to observe and identify the differentially expressed genes that may influence drug seeking behavior in rats. Based on gene ontology, it was found that the ensheathment of neurons were found to be the most significant biological process. We had selected two genes related to myelination, lysophosphatidic acid receptor 1 (LPAR1) and proteolipid protein 1 (PLP1), to be analyzed and quantified in the BNST and the BLA through RT-qPCR to determine its activity in resiliency or susceptibility of heroin addiction following traumatic stress.

Sitaram, Shrey
Class Level: Junior
Major: Neuroscience: Cellular and Molecular
Mentor: Professor Pedro Torres-Ayuso
Mentor Affiliation: Department of Cancer and Cellular Biology (LKSOM)

Discovering the TNIK proximatome and interactome using an inducible biotin ligase system

TNIK (Traf2- and Nck-interacting kinase) is a pivotal kinase in the Wnt/β-catenin signaling pathway and a promising therapeutic target in squamous cell carcinomas of the lung and head and neck (LSCC and HNSCC, respectively). However, the mechanisms by which TNIK contributes to LSCC and HNSCC remain to be elucidated. This study aims to characterize the TNIK proximatome and interactome to identify molecular mechanisms associated with TNIK's function in cancer progression. By leveraging an inducible biotin ligase system (miniTurbo, a derivative of BioID), we aim to capture TNIK's proximal protein environment in a controlled, temporal manner. We have used the Gateway cloning system to generate doxycycline-inducible vectors with FLAG-tagged TNIK constructs fused to the miniTurbo biotin ligase. Next, we will generate LSCC and HNSCC stable cell lines, will verify the expression, localization, and biotinylating activity of these constructs. In future studies, we will combine proximity labeling with affinity purification followed by mass spectrometry to map TNIK-associated proteins in LSCC and HNSCC cells. Our studies will elucidate TNIK's interaction network and contribute to a deeper understanding of TNIK's role in oncogenic signaling in lung and head and neck cancers, and may reveal new therapeutic targets within the TNIK signaling network.

Souza de Cerqueira, Beatriz
Class Level: Sophomore
Major: Computer Science
Mentor: Professor Benjamin Seibold
Mentor Affiliation: Department of Mathematics (CST)

Real-Time Behavior Tracking and Automated Reporting in Neuro-VISOR

The Neuro-VISOR project, developed by Temple University's Center for Computational Mathematics and Modeling (C2M2), focuses on advancing virtual reality (VR) interactions through real-time behavior tracking. This research proposes the development of an automated system to capture user behaviors in VR simulations, analyzing the data to generate reports that reveal usage patterns and trends. These insights will help optimize user experiences by providing tailored assistance and predictive tools. In the project's initial stages, essential metrics and key performance indicators (KPIs) are defined, and algorithms are designed to track user movements, interactions, and system states. By integrating this data into the VISOR system, the project aims to enhance both data integrity and user experience.

Sullivan, Olivia
Class Level: Junior
Major: Biology
Mentor: Professor Mohsin Khan
Mentor Affiliation: Department of Cardiovascular Sciences (LKSOM)

Uncoupling protein 2 (UCP2) as a novel target for cardiac repair

Cardiovascular disease is the leading cause of death worldwide and includes diseases that affect the heart and blood vessels, such as myocardial infarction (MI), commonly known as heart attack. During fetal development, the heart grows due to an increase in cardiomyocytes (CMs). However, as individuals age, cellular regeneration decreases, making it difficult for injuries to be fully repaired. Current treatments involving stem cells have not shown promising long-term results, highlighting the urgent need for more effective treatment options. The purpose of this experiment is to investigate whether introducing uncoupling protein 2 (UCP2) into cardiomyocytes can stimulate them to enter a proliferative state. To test this, we will utilize a mouse model with UCP2 knocked out specifically in the CMs. These mice will subsequently underwent myocardial infarction surgery to induce MI. Mice in the study were divided into five groups: Tamoxifen (TAM)-SHAM (placebo), TAM-MI, Corn Oil (control vehicle)-SHAM, and Corn Oil-MI. Echocardiograms were performed at 1 week, 4 weeks, and 6 weeks post-MI then motion mode (M-Mode) tracing of the left ventricle was conducted to analyze cardiac function. Our findings indicate that a loss of UCP2 in CMs leads to a decrease in cardiac function following MI. Future research will involve staining AAV9 CMs that carry UCP2 to determine whether an increase in UCP2 can enhance cardiac function.

Keywords: Cardiovascular disease, Myocardial infarction, Cardiomyocytes, Uncoupling protein 2, Tamoxifen

Tobin, K.
Class Level: Junior
Major: Biochemistry
Mentor: Professor Darius Balciunas
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ALFA-tag Integration into the RXRGA Gene

Tissue regeneration is a complex process involving the coordinated activation of various signaling pathways, among which the retinoic acid (RA) signaling pathway has emerged as a crucial regulator. Retinoic acid receptors (RXRs), including RXRGA, play key roles in mediating the effects of RA signaling during regeneration in vertebrates, including zebrafish. The zebrafish is a well-established and effective model organism that can be utilized to study tissue regeneration, but existing knowledge of genes that impact the retinoic acid (RA) signaling pathways functionality are insufficient for determining what genetic programs govern regeneration. We propose to develop a novel approach using ALFA-tag integration into the RXRGA gene in zebrafish to investigate the role of the RA signaling pathway in tissue regeneration. The ALFA tag offers the advantage of precise and non-invasive visualization of RXRGA protein dynamics in live animals, allowing for the mapping of RXRGA localization, interaction partners, and activity during regeneration processes.

Tohamy, Yusef
Class Level: Senior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Enhancing Active Learning for Neurodivergent Students in Computing Education

Prior research in computing education often centers neurotypical students. Leaving neurodiverse people out of computing education research means only neurotypical people will be designing and developing curricula and educational technologies. This lack of representation may harm neurodiverse students. This begs the question: what are the opportunities and challenges for neurodiverse computing students? To better understand what research has been conducted in this field, we are conducting a systematic literature review regarding neurodivergent students and computing education. A systematic review of the literature, following by PRISMA reporting guidelines, synthesizes current studies on neurodivergence in computing education, highlighting gaps and where further research is required. The current study will try to devise strategies which will address the sensory needs, communication needs, and social interaction difficulties of neurodivergent students while also promoting a safe and welcoming classroom environment. In doing so, it also seeks to empower students by fostering autonomy and confidence in their learning journey. Ultimately, it examines key factors such as engagement, satisfaction, and learning outcomes, contributing valuable insights into how computing education can be made more accessible and effective for neurodivergent learners. This research lays the ground for developing computing education practices that meet the increasing demands of the diverse student population by focusing on the needs of neurodivergent students.

Tully, Evan
Class Level: Sophomore
Major: Biochemistry
Mentor: Professor Mary Barbe
Mentor Affiliation: Aging + Cardiovascular Discovery Center (LKSOM)

Nerve Transfer For Restoration of lower motor neuron-lesion bladder, urethral and anal sphincter function: effectiveness of administration of growth factors(BDNF) via Adeno associated virus vectors into the bladder

In previous analyses, we have found that nerve transfer of obturator nerve to distal pelvic nerve branches of the bladder can restore motor function in decentralized dogs. We continue to explore the effectiveness of bladder reinnervation using 3 groups(groups 1-3) of 5 female mongrel hound dogs (15 total). Group 1 was used as a comparison group. The first two groups were critical to figuring out whether BDNF will enhance the regrowth of the transferred nerves (a portion of the obturator nerve) into the bladder. Group 1 underwent nerve transfer under anesthesia and was injected with AAV- GFP (adenovirus associated green fluorescent protein). This was our control, and in previous studies we have seen that the transfer is an effective procedure. Group 2 underwent the same nerve transfer (a portion of obturator to distal pelvis nerve), but were injected with AAV- BDNF (adenovirus associated brain derived neurotrophic factor). Group 3 has not yet been studied. The results from groups 1 and 2 have shown, so far, that the AAV- BDNF injected dogs had a three times increase in contractility of the muscles surrounding the bladder. This proves that the injection of AAV-BDNF is an effective treatment alongside the nerve transfer for patients with decentralized bladder. However, this study is inconclusive at the moment and more work and data needs to be produced to further prove our hypothesis.

Vaughn, Jennifer
Class Level: Senior
Major: Computer Science
Mentor: Professor Martha Constantinou
Mentor Affiliation: Department of Physics (CST)

Analyzing Pion Structure through Numerical Simulations of Quantum Chromodynamics

"Our project evaluates the rich and complex internal structure of the pion, a meson particle made up of one quark and one anti-quark that give the characteristics to the pion. We utilized computing to analyze data from numerical simulations of the Quantum Chromodynamics (QCD) theory. QCD is the foundational theory governing the strong interaction responsible for binding quarks and gluons into composite particles known as hadrons, which are the core of visible matter. This research analyzes the relationship between particle mass, energy, and momentum using Python. We aim to calculate the correlation function between two pions on a 4-dimensional discretized space. This correlation function is calculated for multiple time-separations between the two pion states. Two-point function data collected from these simulations is used to calculate particles' energies as a function of time and initial momentum."

Vijay, Kamaljeeth
Class Level: Senior
Major: Computer Science
Mentor: Professor Hayan Lee
Mentor Affiliation: Nuclear Dynamics and Cancer Research Program (FCCC)

Extensive eQTL Analysis Reveals Methylation-Gene Expression Non-Canonical Correlation is Prevalent in Ovary

DNA methylation is a chemical reaction that occurs when methyl groups are added to the DNA molecule, mostly cytosine in CpG dinucleotides. DNA methylation regulates gene expression, and its pattern varies from organ to organ. Nonmutational epigenetic reprogramming is one of the hallmarks of cancer. The relationship between DNA methylation and genetic expression can be analyzed using an expression quantitative trait methylation (eQTM) map. The goal of this research is to develop a reliable and fast eQTM algorithm and analyze the correlation between methylation at CpG sites in flanking regions and gene expression of various organs to determine the presence of a non-canonical positive correlation. This eQTM algorithm utilizes a mixed linear model to analyze methylation alongside age and, if applicable, sex covariate data. Our study discovered the ovary among nine organs have the most non-canonical positive correlations between methylation level and gene expression. Our study will elucidate the biological mechanisms underlying non-canonical correlations between methylation and gene expression across nine organs.

Vo, Megan
Class Level: Junior
Major: Chemistry
Mentor: Professor Stephanie Wunder
Mentor Affiliation: Department of Chemistry (CST)

Perfluorooctane Sulfonic Acid's (PFOS) Effect on Large Unilamellar Vesicle (LUV) Size and Zeta Potential

Perfluorinated alkyl substances (PFAS) are persistent chemicals in the environment that enter microorganisms and higher plant and animal species via their cellular membranes. Entry into cells can be through alteration of cell membrane properties or through binding to membrane proteins. The resultant adverse effects on flora and fauna, in particular humans, have been extensively studied. Here the interactions of one PFAS, perfluorooctane sulfonic acid (PFOS), with a model membrane composed of dipalmitoyl phosphatidylcholine (DPPC) were investigated, using dynamic light scattering (DLS) and zeta potential measurements. PFOS has a low pK_a and is thus negatively charged at pH 7. DPPC is a zwitterionic lipid and so is neutral. DPPC was prepared as large unilamellar vesicles (LUVs). Neat LUVs were incubated with the PFOS as a function of the mole ratio of DPPC/PFOS (75/1 to 1/1) and ionic strength (varying the molarity of NaCl). The size of the LUVs before and after incubation with PFOS solutions indicates whether the addition of PFOS maintains the integrity of the LUVs. The diameter of the neat LUVs were ~ 100 nm, and ~ 110 nm after incubation with PFOS for DPPC/PFOS ratios between 75/1 to 1/1. Zeta potentials (ζ), which reflect the surface charge of the LUVs, were $\zeta \approx -1$ mV for the neat LUVs in water or NaCl. However, incubation with PFOS decreased the zeta potential to $\zeta \approx -40$ mV, consistent with the negatively charged PFOS.

Wu, Henry
Class Level: Sophomore
Major: Computer Science
Mentor: Professor Matthew Helmus
Mentor Affiliation: Department of Biology (CST)

SLF Research - A Closer Look From Foreign Articles

The Spotted Lanternfly (SLF) originated from foreign countries like China, India, and Vietnam. Since most of these small insects came from China, several articles, research, and experiments based on the behavior of the SLF are written in Chinese characters. These pieces of Chinese literature are important because they hold vital information regarding the habits and nature of the SLF. While many of the researchers at IEcoLabs are not sufficient Chinese readers, an accurate translation of these articles would be needed to decipher them. With the use of public translation API's, several accurately translated articles were produced. These articles contain critical, legitimate research that should allow the current research of SLF to be enhanced. This project aims to create more resources from sources that would otherwise be inaccessible. By having Chinese articles translated into English, it will allow references to them to help build what the world knows about the invasive species today.

Session 3 Abstracts

Abt-Fraioli, Elizabeth
Class Level: Senior
Major: Mathematics with Teaching
Mentor: Professor Jeromy Sivek
Mentor Affiliation: Department of Mathematics (CST)

Contractive Maps, Fixed Points, and Minimal Invariant Sets

This poster describes recent work on the properties of fixed-point-free (f.p.f.), non-expansive functions in both real and complex function spaces. We have built on foundational and recent results in metric fixed point theory to establish new results about the existence of contractive maps and the size of their minimal invariant sets. In particular, we share a new result about the minimal invariant set for a contractive series being smaller than the minimal invariant set for the well-known function whose iterates form the series. This answers a natural question and challenges the boundaries for how small such sets can be. We will also share new details of related examples and new work about the potential for generalizing these results and techniques. Our ongoing research is focused on the potential for these generalizations.

Alvarez, Kathryn
Class Level: Senior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Antagonistic AI - Github Copilot Clone

Generative AI systems, such as GitHub Copilot, have rapidly become integral tools in software development, offering real-time code suggestions that streamline the coding processes. However, despite their clear benefits for productivity, these systems present significant pedagogical challenges, particularly in undermining critical thinking skills. For example, our prior work has shown that higher performing students tend to know when to accept suggestions from intelligent coding assistants; however, students who performed poorly appeared to struggle with knowing when to accept or ignore suggestions. High-performing students tend to accept fewer suggestions and this may relate to the concept of "negative expertise", wherein experts develop a nuanced understanding not only of effective strategies but also of common pitfalls and errors. This project addresses these pedagogical challenges by developing open-source tools designed to scaffold students' interactions with AI copilots. Specifically, we will develop two prototypes: 1) an Antagonistic AI system that promotes critical thinking and active learning by introducing deliberately incorrect code suggestions as "attention checks" to challenge students and recalibrate their trust, and 2) a system that leverages the concept of negative expertise to help students practice distinguishing between good and bad code suggestions. As AI copilots continue to proliferate beyond software development, these scaffolding mechanisms could play a critical role in ensuring users remain actively engaged and avoid becoming overly dependent on AI systems. In the long term, this work seeks to inform the design of future AI assistants that promote critical thinking, enabling users to actively participate in decision-making processes rather than passively following suggestions.

The project aims to develop and evaluate a configurable clone of GitHub Copilot that incorporates features designed to enhance learning by encouraging critical engagement. The system will introduce penalties to slow down students when they fail attention checks, thereby promoting more thoughtful interactions with AI-generated code suggestions.

Auker, Emma
Class Level: Senior
Major: Biochemistry
Mentor: Professor Daniel Kim
Mentor Affiliation: Department of Chemistry (CST)

Development and Synthetic Applications of Designer Masked Acyl Reagents

Due to its impressive ability promoting biological activity as a carboxylic acid bioisostere, the introduction of trifluoromethylacyl (F3CCO-) functionality into organic compounds has become an important and growing research area. Although various protocols have been developed to access the trifluoromethylacyl moiety, the direct installation of F3CCO• acyl radicals remains a challenge, due to the thermodynamically favored decarbonylation and subsequent decomposition. To tackle these challenges, novel masked umpolung reagents were developed that both stabilize the radical and allow for the transformation of the traditionally electrophilic radical, into a nucleophilic radical. Utilizing this reagent allows for coupling with electron deficient and biologically reactive heterocycles in an oxidative decarboxylation Minisci type reaction, followed by deprotection into the desired trifluoromethyl ketone.

Baraneedaran, Vidyut
Class Level: Sophomore
Major: Biochemistry
Mentor: Professor Sunil Karhadkar
Mentor Affiliation: Department of Surgey (LKSOM)

Liver Transplantation for Primary Sclerosing Cholangitis

Primary sclerosing cholangitis (PSC) is a chronic, immune-mediated cholestatic disease that increases hepatobiliary malignancy risk. While liver transplantation (LT) is the only definitive treatment, little is known about outcomes in patients who develop such malignancies post-transplant. As LT indications expand to include hepatic malignancies, understanding outcomes for patients with PSC who develop malignancies is increasingly important. This study examines how malignancy affects LT outcomes for PSC.

The UNOS/OPTN database was used to identify patients listed for LT from April 18, 1988, to June 30, 2022 with a primary indication of PSC (n=13,638). Transplanted patients (n=8,573) were refined to those with tumor findings on explant pathology (n=57) and propensity score matched by MELD, recipient age, donor age, and ethnicity to patients from other indications with tumors (n=57). PSC patients without tumors (n=127) were similarly matched to non-PSC patients without tumors. Patient and graft survival were analyzed via Kaplan-Meier and log-rank testing.

Patients listed for PSC had significantly longer waitlist times than other indications (214.5 vs. 138.0 days, $p < 0.001$). When tumors are present on explant, patient ($P = 0.590$) and graft survival ($P = 0.826$) between PSC and non-PSC patients did not differ. For those without malignancy, non-PSC patients had a higher BMI (27.3 vs. 23.5; $P < 0.001$), with no difference in patient ($P = 0.219$) or graft survival ($P = 0.912$) between groupings.

PSC patients receiving LT, regardless of whether tumors develop, show comparable survival to other indications, suggesting that LT is an effective option for PSC patients.

Binu, Jennifer
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor Bettina Buttaro
Mentor Affiliation: Department of Biomedical Education and Data Science (LKSOM)

Genetic Determinants of *Streptococcus pyogenes* and *Enterococcus faecalis* Virulence

The overall purpose of our studies is to determine the genetic determinants of virulence in genetically variable Gram-positive streptococcal pathogens.

Group A Streptococcus (GAS) infection is a significant global health concern, presenting from mild infections to severe invasive diseases. GAS strains show considerable genetic diversity, influencing their pathogenicity and response to host defenses, particularly among highly virulent clonal *Emm* types. We are studying an increase in invasive GAS (iGAS) infections in the Kensington area of Philadelphia that started in 2019 in the PWID and housing insecurity. While beginning the process of collecting strains we are performing a scoping review to investigate the association of emm type injection drug use. By synthesizing current research, we aim to highlight knowledge gaps and inform future experiments including emm typing and superantigen production strains collected from Philadelphia iGAS infections.

Enterococcus faecalis is a resilient pathogen implicated in various infections, from urinary tract infections to endocarditis. Its impact on human health is significant, worsened by strain variations and genetic adaptability. We recently discovered the association of a subset of plasmids with the ability to remodel biofilms and increase antibiotic resistance. We hypothesize that these genes will be present in clinical isolates with more severe disease outcomes. The goal of this project is to develop a robust genetic screen for the genes associated with rigid structure formation using a current collection of dental isolates. This screen will be used on *Enterococcus faecalis* isolates to be collected from patients at TUHS to determine there association with severe disease outcomes.

Bonamy, Michaela
Class Level: Senior
Major: Biochemistry
Mentor: Professor Ross Wang
Mentor Affiliation: Department of Chemistry (CST)

Investigation of Cytotoxic Effect of Common Tetrazine Derivative Drugs on Various Cancer Cell Lines via Tumor Growth Inhibiting Mechanisms.

Cancer is known to have intensely negative effects on mental health and treatment is often coupled with antidepressants, commonly from the selective serotonin reuptake inhibitor (SSRI) group, in order to improve quality of life. Along with the positive mental effects of these drugs, there has been evidence of anti-carcinogenic function when these drugs are coupled with traditional chemotherapy. Not only have antidepressants shown influence in promoting tumor growth suppression, but so have certain antihistamines. Common prescription antihistamines have been studied for their anti-tumorigenic properties and their potential value within cancer treatment research. Previous research has shown that these two drug groups can be used to target the metabolic pathways of certain cancer types and induce lysosomal cell death via autophagy in breast, prostate, melanoma, and non-small cell lung cancers in order to increase the efficiency of cancer therapy. In this experiment, we investigated the cytotoxicities of a common SSRI antidepressant, paroxetine, and a prescription antihistamine, desloratadine, in order to determine the most effective concentration of each drug to use for tumor-suppressive purposes.

Butler, Morgan
Class Level: Junior
Major: Computer Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Streamlining Peripheral Awareness and Accountability: Strategic Organizational Methods for HCI Lab Efficiency

Running a large, undergraduate-focused research lab presents unique challenges in coordination, progress tracking, and sustaining engagement among members. As lab membership grows, so do the demands for effective organization and tools to foster peripheral awareness, enabling students to stay informed on lab-wide activities and deadlines. This project explores the development and implementation of a Notion-based digital workspace to centralize resources, streamline communication, and support lab members in tracking both individual and collective research progress. The platform aims to facilitate better awareness, accountability, and cohesion across a diverse lab team. Through a series of evaluations, we will investigate the platform's impact on student engagement, collaboration, and self-management skills.

Dachepalli, Meghana
Class Level: Junior
Major: Genomic Medicine
Mentor: Professor Glenn Gerhard
Mentor Affiliation: Department of Medical Genetics and Molecular Biochemistry (LKSOM)

Grade Decrease of Diastolic Dysfunction after Bariatric Surgery

Obesity's impact on hemodynamics can lead to cardiac remodeling and diastolic dysfunction, which in turn increases the risk of heart failure with preserved ejection fraction (HFpEF). Bariatric surgery, an effective long-term approach for obesity, may influence cardiac structure and function, but this relationship is yet to be understood. We analyzed pre- and post-operative echocardiograms from a multitude of patients who underwent bariatric surgery between 2013 and 2024. Variables assessed included ejection fraction (EF), diastolic dysfunction grade, BMI, and weight. The overall results indicated that bariatric surgery decreased the diastolic dysfunction grade in patients with obesity, despite no significant change in ejection fraction. Further investigation is needed to better understand the mechanisms of cardiac remodeling related to weight loss and its long-term effects on heart function.

Dougherty, Kay
Class Level: Sophomore
Major: Biochemistry
Mentor: Professor Robert Stanley
Mentor Affiliation: Department of Chemistry (CST)

Using Photolyase Mutants to Reverse Ultraviolet Damage to DNA

Cyclobutane pyrimidine dimers are created from ultraviolet radiation damaging deoxyribonucleic acid (DNA). These dimers disrupt the formation of base-pairs during DNA replication. Photolyase is an enzyme that repairs this UV damage by breaking these cyclobutane dimers. This enzyme is a flavoprotein, a protein that has a nucleotide derivative of riboflavin. This family of proteins is involved in light-driven DNA repair as they contain the photo activated electron donor, flavin adenine dinucleotide (FAD) and can participate in oxidation-reduction reactions.

Photolyase has an internal electric field produced by the salt bridge present in the center of the molecule. Salt bridges are interactions between two amino acids of opposite charge that stabilize the protein's structure and facilitate the electron transfers that are present in DNA repair. This field may be responsible for the main reduction potential of the enzyme. When the two amino acids present in the salt bridge are changed, the photolyase's energy, electric field, and reaction potential should change as well. Many forms of salt bridge mutants will be made and tested to understand which works most efficiently in repairing DNA that has been damaged from ultraviolet radiation.

Espinal, Randy
Class Level: Senior
Major: Biochemistry
Mentor: Professor Eric Borguet
Mentor Affiliation: Department of Chemistry (CST)

Zirconium Catalyzed ATP Hydrolysis

Hydrolytic cleavage of adenosine triphosphate (ATP) is a crucial biochemical reaction that releases energy, which cells use to power many biological processes.[1] Polyoxometalates (POMs) are nanosized metal-oxygen clusters that have been shown to catalyze the hydrolysis of phosphodiester bonds.[2] POMs have limitations, specifically the potential oxidation of the metal species which changes the rate at which POMs can catalyze a reaction.[3] Since the catalytic activity of POMs arises from the metal nodes of the cluster, we hypothesize that the precursor salt species of POMs are powerful enough to catalyze phosphodiester bond hydrolysis. This hypothesis will be tested by using $ZrCl_4$, ZrOOH, ZrOOH@COF and $ZrOCl_2 \bullet 8H_2O$, precursors of zirconium based POMs, in a solution of ATP and D_2O. The reaction progress of phosphodiester bond hydrolysis in ATP molecules to form adenosine monophosphate (AMP), can be monitored via ^{1}H NMR and ^{31}P NMR, as ATP and AMP have different chemical shift values.[4] Investigation of ATP hydrolytic efficiency by these catalysts can provide insights into the mechanism of phosphodiester bond hydrolysis by POMs.

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Gonipati, Sneha
Class Level: Senior
Major: Biology
Mentor: Professor M. Abul Kashem
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Potential Effects of Preoperative Blood Transfusions on Cardiac Transplantation Patient's Postoperative Condition

Introduction: Perioperative anemia and preoperative transfusions both have their own set of potential complications.Learning if, and how much an effect transfusion has in cardiac surgery can lead to better decision-making to reduce postoperative complications.

Methods: The UNOS database was used to find adult heart transplant patients from 2000-2023 (n = 51,325). They were split into groups that received preoperative blood products (n=10,873) or did not (n=40,452). Endpoints analyzed include mortality, length of stay, graft status, and acute rejection. Mortality was analyzed using a Kaplan-Meier curve, and Cox proportional hazards were used to find risk factors.

Results: It was found that there was a significant difference in length of stay ($p<0.0001$), graft status ($p<0.0001$), and acute rejection ($p=0.0430$), with transfusion patients having a longer LOS, and more graft failure and acute rejection. The Kaplan-Meier curve shows a significant difference in mortality between the two groups ($p<0.0001$). Life support at registration also showed significant differences, with ECMO ($p<0.0001$), ventilator ($p<0.0001$), and IABP ($p<0.0001$) use having higher percentages in patients with preoperative transfusions. Cox regression showed that there is an increased risk of mortality in patients who did not receive transfusions before transplant ($p<0.0001$).

Conclusion: While there was an increase in postoperative complications with preoperative transfusions, there also appears to be a correlation between the need for life support and the use of blood products preoperatively. This shows the possibility that differences in outcomes relating to transfusions may be due to patient conditions before the surgery rather than transfusions alone.

Hart, Korrey
Class Level: Senior
Major: Biochemistry
Mentor: Professor Pedro Torres-Ayuso
Mentor Affiliation: Department of Cancer and Cellular Biology (LKSOM)

Developing an Analog Sensitive TNIK Mutant to Identify Direct Substrates in Lung Squamous Cell Carcinoma

Lung cancer is the second most common form of cancer and the leading cause of cancer-related deaths in the United States. Approximately 25% of lung cancer cases are lung squamous cell carcinoma (LSCC). Low efficacy of current treatments and a lack of targeted therapies present a need for new LSCC treatments.
Approximately 40% of LSCC cases exhibit amplified expression of TRAF2 and NCK-interacting protein Kinase (TNIK). Our team has shown inhibiting TNIK as a possible therapeutic strategy; reducing cell viability in LSCC cell lines with amplified *TNIK* and sensitizing them to carboplatin treatment.

Identifying downstream signaling modulated by TNIK is critical to understand how it contributes to LSCC tumorigenesis and therapy resistance. Our goal is to elucidate direct substrates of TNIK by utilizing an Analog Sensitive (AS) kinase mutant. The AS-TNIK can utilize "bulky" ATP analogs, which endogenous kinases cannot use. Additionally, this approach utilizes γ-S-ATP derivates, which the AS-TNIK uses to thio-phosphorylate direct substrates. Potential substrates can then be isolated using immunoprecipitation and identified by mass spectrometry. In this project, we have generated two AS-TNIK: M105G and M105A. Currently, we have verified that mutants retain enzymatic activity in presence of standard and bulky ATP analogs. Our next goal is to generate stable LSCC cell lines expressing AS-TNIK and proceed to substrate identification.

Elucidation of downstream signaling factors modulated by TNIK provides insight into mechanisms of tumorigenesis and therapy resistance, and biomarkers predictive of response to TNIK inhibitors, while possibly identifying additional therapeutic targets to improve treatment efficacy in LSCC.

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Jasim, Zain
Class Level: Sophomore
Major: Genomic Medicine
Mentor: Professor Aley E. Tohamy
Mentor Affiliation: Department of Surgery (Drexel University School of Medicine)

Comparative Incidence of Post-Operative Nutrient Deficiencies Following Roux-en-Y Versus SADI-S Gastric Bypass: A Systematic Review

Background: Nutrient deficiencies are common complications following bariatric surgeries. Roux-en-Y gastric bypass (RYGB) and Single Anastomosis Duodeno–Ileal bypass with Sleeve gastrectomy (SADI-S) are prevalent surgical procedures for weight loss. Comparing the incidence of post-operative nutrient deficiencies between these surgeries is crucial for optimizing patient outcomes.

Methods: A systematic search of PubMed/MEDLINE, Cochrane Library, and Google Scholar was conducted to collect studies of Level 3 design or higher (randomized controlled trials or prospective studies) that reported nutrient deficiencies after SADI-S or RYGB surgeries.

Results: A total of 2,590 patients were included across 12 studies, comprising 805 RYGB patients (72% female, average age 46.03 ± 10.23 years) and 1,785 SADI-S patients (73% female, average age 47.04 ± 10.95 years). In the RYGB group, pre-operative deficiencies were: Vitamin B12 deficiency 6%, iron deficiency 58%, ferritin deficiency 24%, and hemoglobin deficiency 20%. Post-operatively, these rates changed to Vitamin B12 deficiency 20%, iron deficiency 52%, ferritin deficiency 49%, and hemoglobin deficiency 31%. In the SADI-S group, pre-operative deficiencies were: Vitamin B12 deficiency 10%, iron deficiency 42%, ferritin deficiency 47%, and hemoglobin deficiency 38%. Post-operatively, the rates were Vitamin B12 deficiency 19%, iron deficiency 29%, ferritin deficiency 43%, and hemoglobin deficiency 26%. Statistical analysis showed no significant differences between the two surgeries regarding their individual effects on vitamin deficiencies. However, a statistically significant effect on ferritin levels was observed in patients undergoing either surgery ($p = 0.01285$).

Conclusion: Both RYGB and SADI-S surgeries significantly affect post-operative ferritin levels, underscoring the importance of monitoring iron stores in patients undergoing these procedures. While no significant differences were found in other nutrient deficiencies, these findings highlight the need for tailored nutritional support to prevent post-operative complications and improve patient outcomes.

Joseph, Gober
Class Level: Senior
Major: Biology
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Specificity of Acyl-CoA Synthetases in Eukaryotic Metabolism of Medium-Chain Fatty Acids

Acyl-Coenzyme As (acyl-CoAs) are conserved metabolites crucial for cell metabolism. Acyl-CoAs function as acyl-carriers in metabolic pathways and acyl-donors for protein acylation. Understanding effects of acyl groups of acyl-CoAs on cells is challenging due to structural and physiochemical diversity. Similarly, enzymes that catalyze ATP-dependent thioesterification of fatty acids (FAs), called acyl-CoA synthetases, have unclear specificities. Thus, the enzymatic sources of many acyl-CoAs are unknown. Medium-chain FAs (6- to 12-carbon chain) have diverse effects on eukaryotic cells, but the enzyme(s) that metabolize them are not defined. This project will investigate acyl-CoA metabolism in yeast (*Saccharomyces cerevisiae* strain BY4743), which shares important similarities with human cell metabolism. Using BY4743 yeast and strains with individual genetic knockouts of 9 known or putative acyl-CoA synthetases, we will supplement yeast cultures with medium-chain FAs in the presence or absence of various carbon sources and obtain growth profiles to evaluate biological effects. We will use liquid chromatography-mass spectrometry-based assays to measure corresponding acyl-CoAs. We anticipate that knockout strains will display altered metabolism of FAs, which may have biological effects dependent on carbon sources in the medium. Identifying pathways for the generation of medium-chain acyl-CoAs will provide insights into FA metabolism in normal physiology and metabolic diseases.

Kennedy, Liam
Class Level: Senior
Major: Neuroscience: Cellular and Molecular
Mentor: Professor Elena Berezhnaya
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MCU loss protects neurons against amyloid accumulation by enhancing autophagy

Alzheimer's Disease (AD) is an infamous neurodegenerative disease characterized by an accumulation of amyloid-beta plaque (Aβ). AD has been recently linked to mitochondrial calcium (mCa2+) dysregulation. The mitochondrial uniporter (MCU) mediates mCa2+ influx, and its ablation in neurons halts the disease progression and reduces amyloid accumulation in the 3xTg-AD mouse model of AD. To study how MCU loss protects neurons in AD we used neuroblastoma Neuro-2a (N2a) cells overexpressing the Swedish APP mutant and generated MCU knockout (MCUkd) using shRNA. Using fluorescently tagged Aβ, we confirmed that MCU loss significantly lowers amyloid accumulation in N2a cells. This can be either due to increased production or reduced clearance of Aβ. Using western blot analysis, we did not detect increased expression of gamma secretase subunits (Nicastrin, Presenelin-1, and APH) indicating that MCU loss does not affect Aβ production in N2a cells. However, using Proteostat assay and tandem fluorescent-tagged LC3 (mRFP-EGFP-LC3) we showed that MCU ablation reduces protein aggregation and elevates percentage of autophagolysosomes in N2a APPsw cells in the resting condition. Altogether this indicates that MCU loss protects neurons against AD pathology by enhancing autophagy.

Lamperelli, Julia
Class Level: Senior
Major: Biology
Mentor: Professor Erica Golemis
Mentor Affiliation: Cancer Signaling and Microenvironment Research Program (FCCC)

Inhibition of Aurora Kinase A (AURKA) and Heat Shock Protein 90 (HSP90) Through the Chimeric Compound NN-01-195

Chemotherapy has been a long standing form of treatment for cancer patients, however while it can work to fight the growth of tumors and cancerous cells, it also can cause issues with healthy tissue. The drug NN-01-195 is designed to initiate apoptosis in cancer cells and decrease tumor development with reduced toxicity through inhibition of Aurora Kinase A (AURKA) and Heat Shock Protein 90 (HSP90). AURKA is a protein that controls mitotic development and aids in chromosome separation. Inhibition of AURKA alone has not yielded great results as far as treatment forms, but when paired with another cancer cell specific protein it is the hope that it will work for a more targeted form of cancer drug. HSP90 is a protein that allows for the stabilization of cells in fraught or harsh environments, so it is very prevalent in cancer cells. Previous tests have shown that HSP90 when paired with another chemotherapy reagent, allows for longer retention of the drug in tumor cells. When paired with AURKA, it will allow for the inhibition of AURKA in cancerous cells for a longer period of time, allowing for increased apoptosis levels. Our results have shown that the chimeric compound works in cell lines to inhibit these two specific proteins to allow for a more targeted form of therapy since it is designed to stop the function of these two proteins. This will allow patients to have a form of treatment that is much less toxic to their healthy cells, but can also increase death in cancer cells and combat tumor development.

LaPierre, Grayson
Class Level: Sophomore
Major: Environmental Science: Applied Ecology
Mentor: Professor Brent Sewall
Mentor Affiliation: Department of Biology (CST)

Host Switching: Exploring Host Preference and Competition in adult Lycorma Delicatula

The Spotted Lanternfly (SLF) , *Lycorma Delicatula*, is an invasive pest first discovered in the United States in 2014, specifically Berks County, Pennsylvania. Since then, its population has spread to eight states and significantly affects a large portion of Pennsylvania. The invasive species thrives in various habitats, including natural and managed forest environments, agricultural, and urban/suburban areas where they live in exceptionally dense populations (Urban, 2023). Known for their insatiable feeding habits, SLF are highly polyphagous insects that target a wide variety of both native and non-native host plants. (Urban, 2023).
This experiment investigates the host preference and intraspecific competition among individual male and female Spotted Lanternflies within microcosms. By using rearing cages with varying population densities and introducing native and non-native species of plant, this study aims to assess the dietary range of the Spotted Lanternfly. Additionally, tracking host switch behavior among individual SLF will illustrate the dietary preference and interactions of this invasive species within its varying ecosystems. Furthermore, analyzing mortality rates, survivorship, individual sex, and types of host plants present, will allow for a more comprehensive understanding of the Spotted Lanternfly's life and impacts.

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Lengle, Makenna
Class Level: Senior
Major: Biology
Mentor: Professor Beata Kosmider
Mentor Affiliation: Department of Microbiology, Immunology, and Inflammation (LKSOM)

The Restoration of ATII Cell Function in Emphysema

Pulmonary emphysema is a form of chronic obstructive pulmonary disease (COPD). Currently there are no known cures for emphysema as the pathophysiology is not well understood. Emphysema is characterized by irreversible alveolar wall destruction induced primarily by cigarette smoking. Alveolar type II (ATII) cells found in lung alveoli have stem cell potential, as they can proliferate and differentiate to alveolar type I cells to restore epithelium after damage. Furthermore, these cells are abundant in mitochondria for such high energy-demanding functions. Mitochondrial dysfunction induced by airborne irritants contributes to ATII cell death and emphysema progression. Therefore, strategies to restore the function of mitochondria in ATII cells of emphysema patients can delay the progression of this disease. We hypothesized that transplantation of control mitochondria would result in the restoration of ATII cell function in emphysema. Our results showed that isolated microvesicles from control human lungs are abundant in mitochondria. We treated precision cut lung slices (PCLS) from patients with emphysema with the isolated control microvesicles. Furthermore, we analyzed the expression of surfactant protein C, a specific marker of ATII cells, using immunofluorescence. This approach may lead to novel therapeutic strategies to slow the progression of emphysema.

Linhart, Rachel
Class Level: Junior
Major: Ecology, Evolution, and Biodiversity
Mentor: Professor Brent Sewall
Mentor Affiliation: Department of Biology (CST)

Bat activity across levels of ecological disturbance

As novel disturbances increase in frequency due to our changing global climate, it becomes even more vital to study their consequences as ecological communities recover from these novel events. Bats play vital roles in ecosystems, making them one of many important species to monitor in a recovering community. Studies show that bats frequently use temperate forests as roosting sites in addition to contributing a great deal to insect control in these environments. Some studies even suggest bats may be indicator species in forest systems. Our study looks at bat presence in a forest recovering from a severe windthrow disturbance. We used passive acoustic monitoring to detect which species of bats were present in 24 focal plots within our disturbed site as well as a nearby, undisturbed site. We hypothesize that bats with more maneuverability will be more active at sites with higher structural complexity, or sites with less disturbance, while bats with less maneuverability, or straight-flying bats, will have higher activity at sites with less structural complexity, or sites with higher disturbance.

Maray, Raquel
Class Level: Junior
Major: Chemistry
Mentor: Professor Daniel Kim
Mentor Affiliation: Department of Chemistry (CST)

Synthesis of Functionalized Heterocycles Using Intramolecular Ketyl Radicals and Pendent Nucleophile

Trifluoromethyl ketones (TFMKs) are a class of carboxylic acid bioisosteres that have gained attention for their ability to enhance drug properties like lipophilicity and cell permeability. However, methods for synthesizing TFMKs via C–C bond-forming reactions are still limited, particularly with electrophilic coupling partners. The Kim research group is exploring a novel strategy to address this by transforming trifluoropyruvic acids into ketyl radicals. These radicals can then be coupled with styrenes to form lactones, which can be further transformed into TFMKs through a net difunctionalization reaction. This fundamental study to trap a pendent carboxylic acid to make lactones opens an interesting opportunity to make new saturated heterocycles from simple building blocks. Starting materials have been synthesized, and progress has been made in optimizing light-mediated photoredox catalysis to generate TFMK-containing heterocycles. The project has shown promising results in creating new saturated heterocycles from simple building blocks. Ongoing efforts are focused on exploring the scope of these reactions and expanding the range of substrates being tested.

Martinez, Emily
Class Level: Sophomore
Major: Data Science
Mentor: Professor Stephen MacNeil
Mentor Affiliation: Department of Computer and Information Sciences (CST)

Navigating Computing Careers: An Analysis of TikTok Videos

Video content on platforms like YouTube has become an invaluable source of support for computing students progressing through their tech careers. With the emergence of short-form videos on TikTok as a new potential resource, we investigate their role in supporting students through navigating their careers. Our analysis of 100 TikTok videos reveals that career pathway content provides valuable insights into practical job and internship tips, strategies for succeeding in academic and professional environments, and advice on navigating the complexities of the tech industry. Videos in this category often emphasize high-paying roles and remote work opportunities, offering students a clearer understanding of industry expectations. These findings offer a comprehensive understanding of the various career pathways conveyed through TikTok, providing a foundation for further research into the impact of social media on career readiness in computing majors.

Miano, Michael
Class Level: Senior
Major: Genomic Medicine
Mentor: Professor Edna Cukierman
Mentor Affiliation: Cancer Signaling and Microenvironment Research Program (FCCC)

Proteomic Profiling of Cancer-Associated Fibroblasts in Pancreatic Ductal Adenocarcinoma to Identify Exploitable Protein-Protein Interactions for Potential Therapeutics

Pancreatic ductal adenocarcinoma (PDAC) currently has a 13% 5-year survival rate post-diagnosis, largely due to late-stage diagnoses and a lack of effective therapeutics. A significant driver of poor outcomes is desmoplasia; the fibrous PDAC tumor microenvironment (TME) functionally modulated by cancer-associated fibroblasts (CAFs) and self-generated extracellular matrix (ECM). CAFs can be classified as either tumor-suppressing (TS) or tumor-promoting (TP) and differ from naïve fibroblasts through their activated phenotype that is driven by signaling pathways such as canonical TGF-β, leading to altered cell-ECM interaction via integrin relocation. For example, TS- and TP-CAFs can be distinguished by their desmoplastic-ECM (D-ECM) alignment and by the subcellular localization of the activated $\alpha_5\beta_1$-integrin. All CAFs have both active (open) and inactive (closed) $\alpha_5\beta_1$ conformations. TS-CAFs have more active $\alpha_5\beta_1$-integrin on the cell surface, while TP-CAFs have more active $\alpha_5\beta_1$ in intracellular vesicles. This suggests that the amount and location of active $\alpha_5\beta_1$ are crucial in determining CAF function, and consequently, in predicting CAF-dependent tumor progression. Elucidating the active $\alpha_5\beta_1$-dependent protein-protein interactions involved in TS-CAFs vs. TP-CAFs is hence critical in identifying novel potential therapeutic targets for PDAC. Shotgun proteomics analyses allow for mapping of these protein-protein interactions, which may lead to uncovering new targeted treatments capable of modifying the PDAC TME and controlling disease progression. By profiling proteomic differences between TS- and TP-CAFs, we aim to reveal protein complexes that could be exploited in the future clinic, ultimately leading to the discovery of novel drug targets and biomarkers that could improve PDAC patient outcomes.

Ohm, Sun
Class Level: Junior
Major: Biology
Mentor: Professor Bon Seok Koo
Mentor Affiliation: Department of Otolaryngology (Chungnam National University)

The Role of miR-92b-3p in Notch Signaling and Monitoring of Oral Squamous Cell Carcinoma

Dysregulation of microRNAs (miRNAs) influences diverse hallmarks of cancer, including proliferative signaling, metastasis, and resistance to cell death. We explored the contribution of miR-92b-3p in oral squamous cell carcinoma (OSCC) and its potential as a monitoring biomarker. Analysis of TCGA, GEO, and our own cohort revealed dysregulation of miR-92b-3p in OSCC, which correlated with aggressive tumor characteristics. miR-92b-3p overexpression augmented proliferation and the epithelialmesenchymal transition in both YD8 and SCC25 cell lines and xenograft models. Mechanically, augmented miR-92b-3p expression suppressed ATXN1 and CPEB3, activating the Notch signaling pathway and thereby promoting metastasis and cisplatin resistance. In our cohort, serum miR-92b-3p expression reflected the disease status, including relapse. Our results suggest that miR-92b-3p might be an onco-miR involved in OSCC through regulating the ATXN1/CPEB3/Notch pathway. These findings provide novel insights for treating and monitoring OSCC.

Opila, Katherine
Class Level: Junior
Major: Biophysics
Mentor: Professor Josh Caplan
Mentor Affiliation: Department of Horticulture (TYLER)

Physiological Performance of Salt Tolerant Stormwater Vegetation Adjacent to I-95

PennDOT has been renovating I-95 through North Philadelphia for most of the past decade and, in accordance with the Green City Clean Waters Program, they are using green infrastructure to capture stormwater runoff rather than sending it into the combined sewer system. While this has worked well for capturing water, many of the plants PennDOT installed have died from high salt conditions caused by road salt in the runoff water. The goal of my project is evaluating how high salt concentrations from storm water runoff affect plant physiology and determine what plants can tolerate the high salinity the best to make green infrastructure more sustainable. For this project, I will study stormwater basins along I-95 that contain 13 types of salt tolerating and non-tolerating test plants. I will measure gas exchange rates and chlorophyll fluorescence directly from the plants, and also measure salinity in the plants and the soil, as well as map the distribution of salinity across the plot. I will present the results at Temple and regional symposia as well as share the results in a summary paper and salinity map. My experience with this project will prepare me for my educational and professional career in research in environmental sustainability and plant physiology.

Parrucci, Miriam Amelia
Class Level: Junior
Major: Ecology, Evolution, and Biodiversity
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Mentor Affiliation: Department of Biology (CST)

Is there a Difference in White-Nose Syndrome Infection Rates Across North-American Bat Species?

North-American bats, or New world bats, are a keystone species in our ecosystem. They play an important role in pest control and nutrient recycling. For almost a decade, North-American bat populations have been threatened by an invasive fungal pathogen, causing populations to rapidly decline. Pseudogymnoascus destructans (Pd) is a cold-adapted fungus that infects the dermis and epidermis of cave-dwelling bats, causing the disease known as White-Nose Syndrome (WNS). Lesions grow on the wings and the muzzle area of bats, disturbing them from hibernation and depleting them of fat storage. Pd was first spotted in upstate New York, 2006, and has since then rapidly spread across the east coast of the United States. White-Nose Syndrome has caused a rapid decline of North-American bat populations. However, different phenological and behavioral traits amongst North-American bat species may suggest certain species may be more or less susceptible to Pd infection. This study focuses on three main bat species, *Myotis lucifigus* (little brown bat), *Perimyotis subflavous* (tri-colored bat) *and Eptesicus fuscus* (big brown bat), from capture sites in Ohio and Pennsylvania and uses UV images of the left and right wing to quantify Pd growth on each bat.

Puig Cruz, Alexandra
Class Level: Junior
Major: Biology
Mentor: Professor Evangelia Bellas
Mentor Affiliation: Department of Bioengineering (ENG)

The Effect of β-Estradiol on Lipedema in Engineered Adipose Tissue

Lipedema is a chronic condition characterized by abnormal, excess adipose tissue in the extremities. It is often underdiagnosed or misdiagnosed as lymphedema or obesity, and primarily affects women. It coincides with a change in estrogen levels, which can lead to changes in adipose tissue distribution. We seek to determine how estrogen (β-Estradiol) will affect adipocyte function and tissue organization.

To create the tissue model, stem cell derived adipocytes will be encapsulated in a collagen hydrogel. Encapsulated adipocytes will then be exposed to 0 μM (control), 1 μM, 10 μM, and 100 μM of β-Estradiol for 1 week. Adipocyte function will be quantified by insulin stimulated glucose uptake, lipolysis, and an adipocyte gene expression panel. Cell and tissue organization will be assessed by adipocyte size with confocal microscopy.

We expect increased exposure to estrogen to result in less matrix deposition and thus less fibrosis seen by confocal microscopy. Fibrosis is accompanied by more total collagen and decreased adipocyte size. This will be identified by an increase in lipolysis and glucose uptake. These models will further lipedema research and help to establish a correlation between periods of hormonal changes and adipocyte function.

Rahman, Zeshawn
Class Level: Senior
Major: Natural Sciences: Chemistry
Mentor: Professor Michael Zdilla
Mentor Affiliation: Department of Chemistry (CST)

Synthesis of High Performance LDH's for HER and OER Catalysis

A demand for clean energy sources has spurred research into the production of alternative fuels, such as hydrogen gas. One method of producing hydrogen gas is through electrolytic water splitting, which involves a pair of half-reactions that generate oxygen and hydrogen gas. These are known as the Oxygen Evolution Reaction (OER) and the Hydrogen Evolution Reaction (HER). The oxygen generating step is rate-limiting. Thus, improving OER kinetics similarly improves the HER performance. Layered Double Hydroxides (LDH's) are a subgroup of layered materials which can be used as catalysts for the water splitting reaction. Some benefits of using LDH's for this purpose are their low cost, and tunable structure. Many techniques are currently in use for the synthesis of these Layered Double Hydroxides, such as co-precipitation, the hydrothermal processes, microwave-assisted synthesis, urea-assisted hydrolysis, and sol-gel methods. The co-precipitation method offers the convenience of not requiring specialized equipment. In this research, two high-performing trimetallic LDH's were synthesized using the co-precipitation method, CuCoFe (CCF) and CoFeCr (CFC) which give overpotentials of -349 mV and -338 mV for HER and OER respectively. The above synthesized LDH's were characterized using p-XRD, SEM, EDX, and FT-IR. It is noteworthy that the overpotentials listed above are for the bulk (as synthesized) material with no further treatment. Heat-treating the CCF LDH improved performance to -328 mV for HER. To explore the effects of heat treatment, both LDH materials were further analyzed using DSC/TGA.

Schoemer, Henry
Class Level: Junior
Major: Computer Science
Mentor: Professor Cihangir Duy
Mentor Affiliation: Nuclear Dynamics and Cancer Research Program (FCCC)

RNA Sequencing Analysis of Genes Involved in the Acute Myeloid Leukemia Relapse Mechanism

Acute myeloid leukemia (AML) cases have an abnormally high relapse rate after chemotherapy, which is believed to be partly attributable to chemotherapy's activation of genes that contribute to cell resilience, including the AXL gene. Targeting and suppressing these genes therefore presents as an important concern for future treatment of AML patients. By RNA sequencing sample cells from patients with AML, we can evaluate different methods of achieving suppression with the long-term goal of limiting relapse. Particularly, this involves the analysis of differences in gene expression after using short hairpin RNA (shRNA) to biologically knock down the gene. Cells are also treated with chemotherapy to observe the effect of simultaneously knocking down and activating the targeted genes.

Shtino, Lilah
Class Level: Senior
Major: Environmental Science
Mentor: Professor Matthew Helmus
Mentor Affiliation: Department of Biology (CST)

Arthropod Biodiversity in Green and Traditional Burial Grounds

This study investigates arthropod biodiversity in cemetery environments, comparing green burial sites with traditional burial sites. Our findings show significantly higher biodiversity and arthropod abundance in green burial areas, likely due to their ecological practices and enhanced vegetation. These results suggest that green burial sites promote biodiversity, positioning cemeteries as important refuges for arthropod populations. This research underscores the ecological benefits of sustainable burial practices in urban landscapes.

Simiyu, Belinta
Class Level: Senior
Major: Chemistry
Mentor: Professor Eric Borguet
Mentor Affiliation: Department of Chemistry (CST)

Retro-Michael and exchange reaction in quantifying maleimide Linkers in a Mixed Self Assembled Monolayer

Mixed self-assembled monolayers (SAMs) consist of linkers and blockers, mainly used to modify the surfaces of biosensors to enhance their sensitivity. This enhancement is achieved by minimizing nonspecific adsorption due to the presence of blockers and regulating the orientation of immobilized antibodies and guiding positioning of anchored antibodies via linkers. Quantifying the number of linker molecules in mixed SAMs is important for understanding the role of concentration, orientation, and distribution of blockers and linkers on the sensor performance. Researchers have attempted to characterize mixed SAMs by FTIR, X-ray Photoelectron Spectroscopy, Time of Flight-Secondary Ion Mass Spectroscopy, and 1H-NMR. However, these techniques only show the order and rigidity of the SAM on the surface, they do not provide information on the exact number of molecules deposited. In this study, we employ fluorescence spectroscopy to assess the absolute quantity of molecules deposited in a mixed-SAMs. We specifically investigate the number of maleimide terminated linker molecules on a mixed-SAMs. Using the Michael addition and the retro-Michael reaction, a thiol dye can be attached to and then cleaved from the maleimide SAM. The released dye is then analyzed by fluorescence to evaluate the number of SAM molecules per the surface density of SAM molecule. Preliminary findings suggest a direct correlation between the concentration of the deposited linker molecules and their ratio in the depositing solution, underscoring the significance of molecular proportionality in enhancing sensor functionality.

Stevens, Angelina
Class Level: Senior
Major: Biology
Mentor: Professor Derek Isenberg
Mentor Affiliation: Temple University Hospital

Factors Associated with Prehospital Delay in Patients with Acute Ischemic Stroke

Strokes are a widely recognized medical emergency, yet symptom recognition continues to pose a significant challenge for the general population. Prompt action in response to a stroke is critical, as prehospital delays can significantly impede timely treatment. Through qualitative interviews, this study aims to identify and understand the factors contributing to prehospital delays in patients experiencing acute ischemic strokes (AIS). By exploring the reasons behind the delays, we hope to uncover valuable insights. Enhancing public education on stroke symptom recognition could profoundly improve treatment outcomes for individuals who experience a stroke.

Keywords: Tenecteplase, Ischemic, PAI-1, Plasminogen, Pre-Hospital Delays

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Class Level: Senior
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Epitope tag integration into the smad5 gene of zebrafish

An epitope is the region of an antigen to which an individual antibody binds. Epitope tagging, first introduced in 1984 by Munro and Pelham, is a commonly used method in which a known epitope is fused to a target protein through recombinant DNA techniques. This epitope-tagged protein is then expressed by the organism and can be recognized by specific antibodies allowing it to be analyzed through various applications such as immunohistochemistry. Researchers using this technique must consider the ideal position to insert the tag as the epitope must be at a position on the protein that is readily accessible to the antibody, while also not interfering with the protein's function. EpicTope is a newly developed method that considers a protein's sequence and structure to determine epitope insertion locations least disruptive to the protein's function. In this project, EpicTope technology was used to identify two internal amino acid positions ideal for tag insertion in the zebrafish *smad5* gene: S181 and S247. Described here is the approach used for integrating the ALFA tag coding sequences into positions S181 and S247 of the *smad5* gene via CRISPR/Cas9 and homology-directed repair techniques.

Tobin, Ryan
Class Level: Senior
Major: Genomic Medicine
Mentor: Professor Sudhir Kumar & Sayaka Miura
Mentor Affiliation: Department of Biology (CST)

GenoPath: Pipeline to perform tumor evolution analysis from bulk DNA sequencing data

Motivation: Bulk DNA sequencing data is commonly used to analyze tumor evolution. It begins with inferring clone genotypes and their evolutionary relationship (clone phylogeny).
Inferred clone phylogeny is then used to analyze timing of driver mutation occurrences, dynamics of mutational processes, and migration history of cells between tumor sites.
This evolutionary analysis requires the use of various computational methods, and there is no pipeline that can easily produce these evolutionary inferences.

Results: We developed a pipeline (GenoPath) that allows users to perform various tumor evolution analysis. We implemented CloneFinder for clone phylogeny inference from bulk DNA sequencing data, PathFinder for clone migration analysis, PhyloSignare for mutational signature analysis, and Meltos for structural variant analysis. GenoPath is written in Python, and desired analyses workflow can be designed through command line. We illustrate an example tumor evolution analysis workflow and demonstrate that GenoPath can produce similar results to when other methods are used, revealing complex evolutionary trajectories and mutational patterns within tumors. Furthermore, the GenoPath pipeline's utility produces visuals, e.g., mapping cell migration paths and clarifying the mutational landscape, which offers a nuanced view of tumor biology. The integration of GenoPath signi□cantly reduces computational overhead, thereby enhancing access to genomic analysis for a broad range of researchers. GenoPath will facilitate tumor evolution analysis using bulk DNA sequencing data.

Varghese, Noel
Class Level: Senior
Major: Biology
Mentor: Professor Ang Sun
Mentor Affiliation: Department of Biology (CST)

Evaluate the Environmental Impact of Cigarette Butts Using Cultured Cells

Cigarette butts, as the most prevalent form of tobacco waste, pose significant environmental and health challenges due to their widespread disposal and the toxic substances they contain. With more than 31.11 million tobacco users in the United States, understanding the ecological implications of this waste is critical. This study investigates the environmental impact of cigarette butts through the analysis of their leachates and their effects on cultured human primary liver epithelial cells (H-6044) and Zebrafish primary liver epithelial cells (CRL-2643). We collected combustible cigarette butts from various urban locations in Philadelphia and compared the biological impacts of these samples with research-grade cigarette products.

Our investigation reveals significant cytotoxic and inflammatory responses induced by cigarette butt leachates. Using the MTS and NRU assay, we observed a marked reduction in cell viability, particularly at higher concentrations from leachates obtained from old and new research labs and park conditions. These findings align with the known presence of toxic substances in cigarette butts, such as heavy metals, and polycyclic aromatic hydrocarbons, which can disrupt cellular processes and lead to decreased cell survival.

The variability in cytotoxicity observed among different sources of leachates suggests that local environmental conditions and the specific composition of cigarette butts significantly influence their overall toxicity. Notably, leachates from the old city and new city exhibited less pronounced effects, indicating potential differences in their chemical makeup. RT-PCR analysis further elucidated the inflammatory mechanisms activated by these leachates, revealing significant upregulation of inflammatory cytokines particularly in higher dilution. Leachates from the new park and old city conditions elicited robust inflammatory responses, as indicated by substantial increases in expression of inflammatory cytokines. These cytokines are critical mediators in inflammatory pathways and are implicated in various inflammatory diseases.

Our results underscore the health risks associated with cigarette butt pollution. The observed cytotoxic and inflammatory effects suggest that these ubiquitous pollutants can have profound implications for cellular health and function. Moreover, the concentration-dependent effects indicate that higher concentrations of leachate pose a greater risk of inducing inflammatory reactions, emphasizing the need for comprehensive monitoring of environmental pollutants. The variability in inflammatory responses across different environmental sources further highlights the potential influence of specific local contaminants or the unique chemical compositions of leachates. This study illustrates the urgent need for public health initiatives aimed at mitigating the impact of cigarette butt pollution. Identifying and regulating the specific toxic components in cigarette butt leachates is crucial for protecting public health. Furthermore, public awareness campaigns and stricter disposal regulations could play pivotal roles in reducing the environmental footprint of tobacco products. Our findings provide a crucial basis for policy formulation and underscore the necessity for effective strategies to address the health and ecological risks posed by cigarette butt waste.