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Abstracts: Oral Presentations

All oral presentations will take place in the Devon Room

Criminal Justice and Forensic Science

(1:30 p.m.)

The Current Landscape of Forensic Genetic Genealogy, Implementation, Understanding, and Opinions in the United States
Authors: Otto, Julia; Foley, Megan; Armstrong, Melanie; Peterson, Tynan
Advisor: Dr. Megan Foley (Hamline University)

Forensic Genetic Genealogy (FGG) combines forensic DNA analysis with genealogical research to assist in cold cases, unidentified remains, and investigations where traditional methods have stalled [Glynn CL (2022); Kling D, Phillips C, Kennett D, Tillmar A (2021)]. Unlike traditional STR profiling, FGG uses high-density SNP profiles compared with consumer genetic genealogy databases [United States Department of Justice (2019)]. This study surveyed American Academy of Forensic Sciences members in forensic biology and genetic genealogy to evaluate current FGG practices, policies, and professional perspectives. A total of 99 responses represented at least 34 U.S. states and territories. More than 50% of respondents primarily perform traditional DNA casework, while approximately 6% process DNA for FGG or perform FGG analysis. About 45% work in laboratories that do neither. Among organizations not performing FGG, 28% are considering implementation, while others cited limited resources, outsourcing, unclear standards, or limited value as barriers. Approximately half of respondents were aware of efforts to develop FGG standards. Nearly 90% believe laboratories generating FGG profiles should follow traditional DNA laboratory guidelines, compared with about 70% for organizations performing genealogical analysis. These findings demonstrate growing interest in FGG alongside continued variation in implementation and standardization. Clear standards, training, and collaboration will be important for its responsible integration into forensic practice.

History

(1:45 p.m.)

Resisting the Homopatriarchy: Black Lesbian Solidarities and Grassroots Mobilization in the U.S. Anti-AIDS Movement, 1970-2000
Author: Murphy, Natalie
Advisor: Dr. Gina Talley

Despite facing heightened intersectional oppression in both the women's and gay liberation movements, Black lesbians spearheaded the U.S. anti-AIDS efforts through their involvement in several organizations across New York City between 1970-2000. By emphasizing their collective

influence on expanding anti-AIDS healthcare initiatives, coalition-building, and support systems, "Resisting the Homopatriarchy: Black Lesbian Solidarities and Grassroots Mobilization in the U.S. Anti-AIDS Movement, 1970-2000" unearths the resistance, organizational setbacks, and experiences of systemic oppression of three organizations: the Lesbian Switchboard of New York City (1972), Salsa Soul Sisters Third World Women, Inc. (1976), and the National Coalition of Black Lesbians and Gays (1978). This project builds upon U.S. histories of gender and sexuality by analyzing intersectional Black lesbian identity in several organizational contexts, including their presence in white feminist and male-dominated, queer spaces, as well as an emphasis on their contributions independent of both the women's and gay liberation movements. By examining a variety of archival material, including meeting minutes, posters, photographs, call logs, statements, newspaper articles, and oral histories, this article highlights Black lesbians' contributions within anti-AIDS organizing, revealing the fundamental role Black lesbians played in challenging queer hierarchies within the U.S. anti-AIDS movement.

Mathematics and Statistics

(2:00 p.m.)

Comparing Mathematical Modeling Techniques to Describe Disease Transmission in Healthcare Settings
Authors: Cady, Noah; Sullivan, Will; Sulyok, Cara
Advisor: Dr. Cara Sulyok

Clostridioides difficile is the leading cause of healthcare-associated diarrhea in the United States, driven by environmentally-persistent spores and interactions between patients, healthcare workers (HCWs), and contaminated surfaces. Mathematical models are widely used to evaluate mitigation strategies; however, their conclusions may depend on assumptions, especially those related to the structure of the model. Our research examines how model structure changes the most influential parameters and resulting mitigation strategies for reducing *C. difficile* infection in hospitals. Compared with a previously-developed model that represents HCW and environmental contamination as average levels, our newly-developed compartmental model classifies these vectors as contaminated or uncontaminated. Using systems of ordinary differential equations, we compare colonization pathways across both models to assess whether influential parameters and mitigation recommendations are robust or sensitive to modeling structure.

Philosophy

(2:15 p.m.)

The Operative Concept of Reduction in Derrida's "Structure, Sign and Play in the Discourse of the Human Sciences"
Author: Monteith, Sean
Advisor: Dr. Farshid Baghai

This paper addresses the concept of reduction as it operates in a major text from Jacques Derrida, "Structure, Sign and Play in the Discourse of the Human Sciences." There, Derrida demonstrates the unintended consequences of neglecting what he terms the "structurality" of a structure. By positing a fixed understanding of a given structure, Derrida argues that structuralists fail to see how a structure is always undergoing change. I argue that the force of this response to the structuralist movement can be best understood with the concept of "reduction," as it appears both explicitly and implicitly in the text. Reduction can be understood there as the reduction of the differences between signs which make up a structure. That is a necessary conceptual act for making sense of a structure, and thus some differences between signs may justifiably be assigned an insignificant status. However, that insignificance must always be taken as a tentative insignificance rather than a permanent one. Asserting the permanence of a reduction closes off a conceptual project and fails to attend to what Derrida calls the "play" of signs in a structure, that which makes apparent the significance of what has been deemed insignificant. Central to this evaluation of reduction is thus the impossibility of an exhaustive map of significance within a structure. Beyond the epistemological concerns that an illegitimate reduction raises, Derrida's understanding of structure has important consequences for how we do and should behave toward differences or Otherness.

Sociology and Criminology

(2:30 p.m.)

Crimmigration in Practice: Attorney Accounts of Padilla Implementation in New Jersey and Florida

Authors: Avila Jaimes, Lorena; Tosh, Sarah; Keough, Shaina
Advisor: Dr. Lorena Avila Jaimes

This project examines how criminal defense and immigration attorneys understand and implement the obligation established in Padilla v. Kentucky (2010), in which the Supreme Court held that the Sixth Amendment requires defense counsel to advise non-citizen clients about the immigration consequences of guilty pleas. Previously, such advisals were not required, despite the severe and often permanent consequences of deportable convictions. Padilla reshaped the intersection of criminal and immigration law, known as "crimmigration." Prior research in New York City immigration courts found that institutionalized crimmigration advisal within public defender offices protects due process and mitigates the racially stratified effects of conviction-based deportation, though attorneys worried about uneven implementation across jurisdictions. Because roughly 94-97% of U.S. criminal cases end in plea bargains, accurate immigration advice at the plea stage is central to protecting non-citizens. This research compares Padilla implementation in New Jersey, a Northern state that identifies as a sanctuary state, and Florida, a Southern state with few protective immigration policies. Through qualitative coding of 13 interviews with criminal defense and immigration attorneys (5 in New Jersey, 8 in Florida), the study identifies common themes: differences in immigration resources, implementation of immigration-related laws, how changing administrations and executive policies affect each state differently, and the types of crimes attorneys handle. These patterns show what is and is not working in advisal and how state context shapes protections for non-citizens.

Spanish

(2:45 p.m.)

Reimagining Machismo: Masculine Identity Formation in Bad Bunny's Music and Visual Media

Author: Polanco, Sofia
Advisor: Dr. Adriano Duque

Contemporary Latin music and visual art have become powerful spaces for challenging and redefining 'macho' norms. Throughout this research project, the following question guided my investigation: To what extent do contemporary Latinx media representations complicate masculinity and gender expression within Latinx culture? This investigation offers a concrete case study of the singer Bad Bunny that shows how contemporary Latin music can reshape public understandings of masculinity within Puerto Rican and other Latinx music cultures. The findings suggest that Bad Bunny's work simultaneously reproduces traditional machismo while expanding on fluid masculine identity. This allows for a deeper understanding of the social and cultural system of music and how it functions as a forum for affirming, challenging, and transmitting gender norms. Specifically, this study engages with ideological norms of machismo through lyrical coding, visual media analysis, word-frequency analysis, and GIS analysis. By examining primary materials, such as Bad Bunny's "Yo Perreo Sola" music video, this investigation delves into gender fluidity, cultural expression, and femininity within traditionally male-dominated genres. In fact, engaging with song lyrics, music videos, scholarly literature, and quantitative coding methods further corroborated the recurring themes of machismo and emotional repression that dominate these male spaces. Ultimately, this study contributes to interdisciplinary discussions of masculinity, gender expression, and diaspora in contemporary Latin music.

Abstracts: Posters

Accountancy

A-01: When Risk Disclosure Moves Markets: Evidence from AI and Cybersecurity Disclosures in 10-K Filings
Author: Nguyen, Hannah
Advisor: Dr. Brian Grant

Corporate risk disclosures are intended to inform investors about threats to firm value, but it remains unclear whether disclosures about emerging risks provide meaningful signals about market outcomes. This study examines whether artificial intelligence (AI) and cybersecurity risk disclosures are associated with investor reactions to 10-K filings and whether the length and tone of Risk Factors disclosures predict future stock return volatility. I analyze 71,528 U.S. 10-K filings from fiscal years 2016-2025 using textual analysis to measure AI and cybersecurity discussion, disclosure length, and the tone of language based on the Loughran-McDonald financial dictionary (Loughran and McDonald, 2011). Market outcomes include the absolute three-day market-adjusted return around the filing and stock return volatility over the following twelve months. Preliminary results show that more extensive AI disclosure is associated with larger stock-price reactions, while cybersecurity disclosure shows no comparable association. Longer Risk Factors disclosures also predict higher future volatility, while disclosure tone results are more mixed. Overall, the findings suggest that markets respond not only to how firms describe risk, but also to the type and extent of risks firms disclose.

Astrophysics and Planetary Science

A-02: Building a Pipeline to Systematically Search for Satellites of M33
Author: Ainey, Danielle
Advisor: Dr. Ekta Patel

Under the ΛCDM model, galaxies form within dark matter halos by accreting smaller galaxies. Theory predicts these halos host low-mass satellite galaxies, yet models predict an M33-mass halo should host 6–12 satellites while only three have been identified to date. This project searches for candidate satellites around M33 by identifying stellar overdensities using Dragonfly Telescope and Legacy Survey data. Data was divided into sub-tiles, filtered using Color–Magnitude Diagrams (CMDs) for old, metal-poor red giant branch stars, and mapped using Kernel Density Estimation (KDE). A False Discovery Rate (FDR) probability mapping pipeline was developed to detect statistically significant overdensities across Tiles 42, 18, and 88. Raw counts of 400–800 sources per sub-tile were reduced to 10–26 candidates using image-based FDR mapping, and condensed to 0–3 confirmed detections after integrating the source catalog. Most sub-tiles returned zero detections, with a small fraction containing 1–2 candidates. Most importantly, the pipeline successfully detected both Andromeda XXII (a larger satellite) and Pisces VII (a smaller satellite) as statistically significant overdensities, confirming that combining CMD filtering with catalog FDR probability mapping provides a methodology for uncovering satellite galaxies in M33's halo.

A-03: From Birth to Merger: A Unified Model of Low-Mass Close Binary Evolution
Author: Briggs, Chloe
Advisor: Dr. Matthias Fabry

Around 50% of low mass stars are in binary systems which evolve through detached, semi-detached and contact configurations. Thanks to observations of V1309 Scorpii, it is confirmed that contact binaries (short-period systems) are direct progenitors of stellar mergers. Despite their prevalence, the evolutionary path from birth to merger is poorly constrained, especially with respect to the thermal instability driven by energy transfer, and the angular momentum loss (AML) between the two stars. In order to represent these systems, we predict a slower rate of AML, which can drastically change the time spent in thermal instability. Here we constructed the first physically consistent evolutionary model of contact binaries until merger conditions. We used the MESA code to solve the stellar structure and evolution equations for two stars and their orbit simultaneously, and controlled any physics-related parameters, including mass transfer, energy transfer, and saturated MB. By tweaking initial parameters, we constructed multiple models of different mass ratios and periods. This project produced the first model to go from birth to onset of merger of a low-mass contact binary that undergoes thermal relaxation oscillations (TROs). By accounting for energy transfer, saturated magnetic braking, and mass transfer, our models successfully evolved down to mass ratios as low as q = 0.35. These results demonstrate how TROs naturally drive binary systems to these observed low mass ratios.

A-04: Hiding in Plain Light: Photometrically Distinguishing Stellar Multiplicity in Gaia DR3
Authors: Tyler, Jacob; Prsa, Andrej
Advisor: Dr. Andrej Prsa

Binary and multiple stars make up the majority of all Sun-like and higher-mass stars, yet color index measurements are often assume sources are singular. We present a framework designed to photometrically determine stellar multiplicity in Gaia Data Release 3 time-series observations in three light spectrum filters through anomalous differences compared to single-star PHOEBE models. Modeled fluxes derived from observed configurations of mass, radius, and effective temperature are compared against Gaia color indices for over 11.5 million general time-series photometric observations, as well as for independently identified non-single stars and high-confidence eclipsing binaries. Models cover a wide range of mid M-type to early B-type stars, with results demonstrating an increasing percentage of anomaly from general data to non-single stars to eclipsing binaries.

A-05: Large Scale Analysis of the Characteristics and Dust Polarization of the H[II] Regions of the Central Molecular Zone using Data from the 214 um SOFIA/HAWC+ FIREPLACE Survey
Authors: Molinari, Sophia; Butterfield, Natalie; Chuss, David
Advisor: Dr. Natalie Butterfield (National Radio Astronomy Observatory)

Recent results from the 214 micron FIREPLACE polarization survey of the Galactic Center have suggested that sightlines towards HII Regions may be associated with elevated levels of fractional polarization. The polarized emission is understood to be due to magnetic alignment of dust grains, which is dependent on anisotropic radiative torques (i.e. B-RAT theory). The massive stars associated with HII regions can inject energy and momentum into the surrounding material resulting in an

enhancement in efficiency of the grain alignment mechanism and a corresponding increase in polarization in these regions. In this poster, we investigate this hypothesis using a statistically unbiased approach where we isolate the pixels included in HII regions, surrounding areas, and the remaining pixels of the Galactic Center. These pixels were selected based on their MeerKAT Spectral Index emission and Paschen Alpha emission. We compared our HII Region samples with surrounding pixels as well as background pixels to act as the base level of the Galactic Center. Our preliminary findings consist of an increase of polarization towards the interior of the HII regions when compared with the surrounding and background pixels.

A-06: Milky Way Satellite Galaxy Orbits Most Affected by Distortion of the Milky Way's Dark Matter Halo

Authors: Patel, Ekta; Kowalski, Logan
Advisor: Dr. Ekta Patel

Galactic Dark Matter Haloes (DMHs) are traditionally modelled as rigid spherically symmetrical distributions. However, these haloes should change shape and distribution over time due to gravitational interactions between individual particles. The Milky Way's DMH and underlying gravitational potential has been distorted by its interaction with the Large Mallegenic Cloud (LMC). Different potential models can be compared by backwards integrating satellite galaxy orbits under them. We collected 50 MW satellite galaxies and their current 3-D positions and velocities and backwards integrated them under six potentials using the CRANES package. Following filtering out micro-oscillations, key orbital parameters were extracted: pericenters, apocenters, and infall times. The parameters were compared to a traditional rigid DMH model. A notable change was quantified as a 5% difference between a parameter in the offending potential and the baseline. Potential models lacking the LMC required the tolerance to be increased to a 10% difference, confirming the LMC plays a major role in satellite orbital dynamics. The satellites with the largest parameter deviations were Carina II, Carina III, Coma Berenices, and Tucana III, highlighting them as prime candidates for further analysis. Determining the origin of this potential sensitivity and comparing their predicted parameters to their accurate ones would increase the overall understanding of both the MW-LMC system and DMHs as a whole.

A-07: Principal Component Analysis for Direct Imaging of Nearby Stellar Systems in Search of Habitable Exoplanets with LBTI/NOMIC

Author: Yoon, Nakyung
Advisor: Dr. Kevin Wagner (University of Arizona)

High-contrast imaging techniques are capable of detecting and characterizing planets in the habitable zones of nearby stars, offering a pathway toward identifying potentially habitable worlds and characterizing their atmospheric properties (including signs of life) through spectroscopy. This work presents the development of data-reduction and analysis techniques for mid-infrared observations of nearby stellar systems broadly, with specific demonstrations of the new methodology on data obtained with the Large Binocular Telescope. Ground-based direct imaging is fundamentally limited by residual starlight and quasi-static speckle noise that can overwhelm the faint signal of an orbiting planet. To address this, typical approaches implement Principal Component Analysis (PCA)-based point spread function (PSF) subtraction, decomposing reference PSF libraries into orthogonal components to

model and remove starlight contamination while also preserving potential companion signals. We extended this framework for use in frame selection and data quality analysis to limit the frames that are fed into subsequent PSF subtraction and analysis to improve fidelity of any high-contrast imaging dataset with heterogeneous data quality. This PCA-based workflow uses observation metadata, allowing continued methodological testing and development independent of the full (often several hundred GB) datasets. We describe the pipeline architecture, the PCA quality and selection methodology, and its application to observations of the star Procyon. We also discuss implications for sensitivity to sub-stellar and planetary-mass companions while also outlining the next steps for extending this approach to a broader sample of nearby stars in ongoing habitable planet imaging surveys, as well as high-contrast imaging studies more broadly.

A-08: Pulled into Alignment: Investigating Tidally Tilted Pulsations in EW Boo
Authors: Monteleone, Ava; Prsa, Kelly; D'Amaro, Maggie
Advisor: Dr. Kelly Hambleton Prsa

Binary star systems, in which two stars orbit around a common center of mass, provide valuable opportunities to investigate the physical properties, internal structures, and evolution of stars. In close binary systems, gravitational interactions can significantly influence stellar behavior. In rare cases, the gravitational pull of a companion star can alter the orientation of a star's pulsations, causing the pulsation axis to align with the tidal distortion produced by its companion rather than the star's rotation axis. This phenomenon, known as tidally tilted pulsation, produces distinct patterns in a star's brightness variations throughout its orbit. With only ten tidally tilted pulsators currently known, identifying additional systems is essential for understanding how gravitational interactions influence stellar oscillations. In this study, we investigate EW Boo, a short-period eclipsing binary system containing a pulsating star. Using brightness measurements from NASA's Transiting Exoplanet Survey Satellite (TESS), we refined the system's orbital period to $p = 0.9063$ d. We then modeled and removed the brightness variations caused by the stars' orbital motion and eclipses to isolate the smaller signals produced by stellar pulsations. By analyzing the frequencies, amplitudes, and phases of these pulsations, we identified patterns associated with the binary orbit that are characteristic of tidally tilted pulsation. Our findings indicate that EW Boo belongs to this rare class of stellar systems, providing further insight into how gravitational interactions influence stellar oscillations and the behavior of stars in close binary systems.

A-09: Surveying the stability of mass transfer, including the effects of rotation
Authors: Yang, Archer; Fabry, Matthias
Advisor: Dr. Matthias Fabry

About half of solar-type stars have a stellar companion. A substantial fraction of these binaries will interact through mass transfer during their lifetimes. The exchange of mass, energy, and angular momentum changes the subsequent evolution of the stars and gives rise to stellar populations that are not compatible with single-star evolution. Algols, cataclysmic variables, and low-mass X-ray binaries are all products of binary interaction phases. On the flip side, mergers are also of interest because they are linked to observable events known as luminous red novae. Whether a system goes on to form one of these populations or prematurely merges depends on whether mass transfer proceeds in a stable manner. This project aims to generalize the stability criteria for mass transfer across solar-type stars

of varying mass and orbital period, with a focus on the effects of rotation and tidal deformation. Rotating stars have larger equatorial radii than non-rotating stars of the same mass and thus fill their Roche lobes earlier and begin mass transfer at an earlier evolutionary stage, which changes the stability of the system. We use the binary-evolution code MESA (Modules for Experiments in Stellar Astrophysics) to run four sets of models: one including rotation, one including tidal deformation, and two sets of static models as a baseline, with and without magnetic braking, which removes angular momentum from the system and therefore can change the evolution of the orbit. We then compare the critical mass ratios beyond which mass transfer becomes unstable. These results help define stability boundaries across the parameter space and quantify how rotation, tides, and magnetic braking impact binary systems.

A-10: The Unusual Phase Curves of Active Centaur 174P/Echeclus
Authors: Thaxter, Kamilya; Kareta, Theodore
Advisor: Dr. Theodore Kareta

Centaurs are icy outer solar system bodies that are evolutionarily intermediate between the active inner solar system Jupiter Family Comets and their inactive progenitors in the trans-Neptunian region. 174P/Echeclus is one of the best-studied centaurs, primarily because it will undergo an "outburst" (sudden increase in cometary activity) and then go dormant for years. Echeclus is one of the few Centaurs bright enough for study by anything other than the largest telescopes, and is sometimes discussed as a spacecraft mission target, so any conclusions that can be drawn from it are important to the scientific community that studies these objects in general. This study was focused on measuring the change in brightness of 174P/Echeclus under four Sloan Digital Sky Survey (SDSS) filters over the course of multiple nights of data collected by the 4.3 m Lowell Discovery Telescope. To calculate the brightness of 174P/Echeclus we used a python software package called PhotometryPipeline. Using the information collected we were able to calculate the slope for each filter's "phase curve", or its reduced apparent magnitude as a function of phase angle (α). Phase curves measure how an object dims as it is viewed at different illumination angles, like the phases of the moon. Several previous studies had hinted that Echeclus might have an unusual phase curve, so our primary goal was to refine or refute those conclusions on the basis of our higher-SNR data over wider wavelengths. We unexpectedly observed a trend of the phase curve slopes decreasing at longer wavelengths. In other words, the phase curve of 174P/Echeclus is strongly and unexpectedly wavelength dependent. This dependence could be caused by undetected dust in long-term orbit around the object or the surface properties on 174P/Echeclus being considerably different from other comets in the same kinds of orbit.

B-11: Vibrations in a Binary Star System
Authors: D'Amaro, Maggie; Hambleton Prsa, Kelly
Advisor: Dr. Kelly Hambleton Prsa

Some stars vibrate. They rhythmically expand and contract, like a bell ringing after being struck. When a star exists in a close binary system (two stars orbiting each other), the gravitational pull of the companion can change the axis of these vibrations, tilting them toward the companion star rather than being in alignment with star's own spin axis. Stars that behave this way are called tidally tilted pulsators (TTPs), and they were only discovered in 2020. Since then, fewer than ten have been confirmed,

making every new one an important find. We studied one such system, KIC 6669809, a pair of stars, observed by NASA's Kepler space telescope, that orbit each other every 17.6 hours. Both stars are teardrop shape, but the material of one star is falling onto the companion due to the strong gravitational force of the companion (a function of mass of companion, distance between stars and the surface gravity of the star loosing mass) This makes it a particularly interesting case for understanding how gravity between stars affects the way they vibrate. To analyze the vibrations, we first subtracted the transit features in the light curve, caused by the stars passing in front of each other and blocking the light. We then searched the remaining data for key signatures, specifically vibration frequencies that have separations related to the orbital period of the double star system, the signature of a tidally tilted pulsation. We identified several such groups and used them to determine the shape and orientation of each vibration mode. Our results add to the small but growing list of known tidally tilted pulsators and provide new insight into how gravity between stars in close binary systems can fundamentally alter the way those stars oscillate.

Biology

B-12: Age and Feeding and Its Effects on Wound Healing in Adult Medusa: Clytia hemispherica:
Author: Mbah, Sidney
Advisor: Dr. Elizabeth Lee

Wound healing is a fundamental biological process that restores tissue structure and function after injury. Clytia hemisphaerica, a hydrozoan jellyfish, provides a useful model for studying wound healing because cnidarians are closely related to bilaterians and have organized muscle and nervous systems. Clytia also has advantages for laboratory research, including transparency for live imaging and genetic consistency through asexual reproduction. However, how nutrition and age affect muscle wound healing in Clytia remains poorly understood. My project investigates how feeding state and age influence muscle wound healing in Clytia medusae. I hypothesized that fed medusae would heal faster than starved medusae and that younger medusae would show greater regenerative capacity than older individuals. Using standardized subumbrella wounding assays and live differential interference contrast (DIC) microscopy, I measured wound closure over time. Medusae aged 28 to 40 days were compared under fed and 1-to-3-day starved conditions. To assess age effects, younger medusae (20 to 28 days) were compared with older medusae (40 to 48 days) under both nutritional conditions, with 7 to 10 individuals per group. Preliminary results show that muscle wounds heal in both fed and unfed young and old medusae, with fed medusae healing faster. Future studies will continue observing wound closure under different feeding and age conditions to collect more consistent data and better determine which factors affect wound healing. Ultimately, this work will improve our understanding of how nutrition and aging influence muscle repair and regeneration.

B-13: Defining Vhr1-Dependent Transcriptional Regulation of Biotin Uptake Genes in *N. glabratus*
Author: Barbay, Elise
Advisor: Dr. Dennis Wykoff

Candida yeast infections are increasingly prevalent in immunocompromised individuals due to anti-fungal resistance. Virulence of some pathogenic fungi has been correlated to the loss of the biotin (vitamin B7) biosynthetic pathway. To grow and survive, pathogenic yeasts take up biotin from their human hosts using biotin transporters controlled by regulatory pathways. This research characterizes biotin-regulated transcription and establishes how the transcription factor, Vhr1, regulates biotin transporter expression in yeast. We studied *VHT1* and *BPL1* promoters, which are highly induced during biotin starvation as seen in RNA-seq data, in *N. glabratus* (formerly *Candida glabratus*). Through truncation analysis we found putative Vhr1 binding sites in the *VHT1* promoter at -470bp and -790bp and in the *BPL1* promoter at -220bp and -390bp. We tested the putative sites further by mutating them individually and in combination in the same promoter. We found that in *VHT1* and *BPL1* both sites are needed for maximum expression of the promoters, as both sites must be removed from the promoters to lower expression significantly. We inserted these sites individually and together in a non-biotin-regulated promoter, *VHT2*, and found that one site was not enough to generate expression while both sites were enough to generate biotin regulation. This research strengthens our understanding of where Vhr1 binds to biotin-regulated promoters, a key step in analyzing fungal biotin biosynthetic pathways, and may provide targets for interrupting biotin metabolism in pathogenic fungi.

B-14: Dynamics of Yeast Persistence & Mosquito Association on Persistence and Survivability

Author: Krisanda, Chase
Advisor: Dr. Dana Opulente

Yeasts are frequently detected in association with mosquitoes, but the nature of these associations remains unclear. Mosquitoes may acquire yeasts while feeding on nectar, blood, or other substrates, raising the question of whether these yeasts persist within their hosts or simply pass through following ingestion. Supporting the possibility that these interactions are not entirely transient, environmental sequencing data have identified associations between particular yeast species and mosquitoes. To examine how yeast ecology may contribute to these associations, we exposed mosquitoes to yeast species associated with nectar and with humans, representing potential sources of yeast encountered through feeding. We then investigated how long ingested yeasts persist within mosquitoes and whether yeast exposure affects mosquito survival. To investigate these interactions, we experimentally exposed adult Aedes aegypti mosquitoes to different yeast species and monitored persistence and mosquito survival. Viable yeasts could be recovered from mosquitoes for at least seven days following exposure, demonstrating that ingested yeasts can persist within mosquitoes well beyond the initial feeding period. Yeast exposure did not substantially reduce mosquito survival under the conditions tested. However, preliminary experiments suggest that mosquito age may influence survival outcomes, highlighting host age as an important variable for future experiments. Ongoing work will examine yeasts in wild mosquitoes and environmental samples from southeastern Pennsylvania. Future experiments will test mosquito feeding preferences for different yeasts and determine where persistent yeasts are retained within the mosquito.

B-15: Effects of Δ383–389 and N386A Mutations on UPF1 Helicase Activity

Authors: Sabani, Jon; Fritz, Sarah
Advisor: Dr. Sarah Fritz

Nonsense-mediated mRNA decay (NMD) is a eukaryotic quality control pathway that degrades mRNAs containing premature stop codons. NMD depends on UPF1, an RNA helicase regulated in part by an 11 amino acid loop in its helicase core that affects how quickly UPF1 releases from mRNA. Molecular dynamics simulations suggest UPF1 has a second regulatory loop (residues 383–389), in which N386 is predicted to interact with F809 upon ATP hydrolysis to promote RNA release. How this loop affects UPF1 activity and NMD target selection remains unknown. I cloned two UPF1 mutants, a loop deletion (Δ383–389) and a substitution (N386A), hypothesizing that both would disrupt the N386–F809 interaction and prolong RNA binding, with a stronger effect from the deletion. I purified both from E. coli and measured dissociation from nucleic acid and unwinding activity. N386A dissociated at a rate similar to wild-type UPF1, while Δ383–389 trended toward slower dissociation. Δ383–389 unwound duplexed nucleic acid faster and more extensively than wild-type UPF1, while N386A was comparable to wild type. These results indicate the second loop affects UPF1 unwinding without significantly impacting dissociation. Future knockdown-rescue experiments will test how these properties influence NMD target selection. Because thirty percent of genetic diseases are linked to NMD, understanding how UPF1 selects its targets could guide new therapies.

B-16: Evaluating the Effect of Neuronal Activity Blockade on Wound Healing in Jellyfish

Author: Oliveras, Adriana
Advisor: Dr. Elizabeth Lee

Even though many organisms require coordinated neural signaling for movement and behavior, it remains unclear if and how neuronal activity directly contributes to wound healing. *C. hemisphaerica* provides an ideal model to investigate this question due to its simple nerve net, transparent body, and strong regenerative capacity. Therefore, this study examines whether blocking neuronal activity affects the rate of epithelial wound repair in *Clytia* medusae. Neuronal activity is inhibited using the pharmacological agent tetraethylammonium (TEA), a potassium channel blocker that disrupts action potential repolarization and reduces contractile activity. First, I tested different TEA concentrations to identify an optimal concentration that reduces pulsing while maintaining organism viability. Second, I created standardized wounds in the subumbrella tissue of control and TEA-treated medusae and monitored wound closure using live differential interference contrast (DIC) microscopy. Then, I assessed the healing rate through image analysis (FIJI). Preliminary results indicate that 50 mM TEA reduces contractions without altering viability compared with untreated controls. Initial wound-healing observations also suggest that repair may be slower in TEA-treated medusae, although wound closure still occurs. This pattern appears to vary with wound size, with smaller wounds showing more apparent closure than larger wounds. These preliminary findings suggest that tissue repair can continue despite reduced contractile activity, while neuronal activity or other TEA-sensitive physiological processes may contribute to efficient wound healing. Further experiments are needed to quantify healing rates and determine the extent to which neuronal activity influences tissue repair.

B-17: Home Sweet Home: Exploring Yeast Diversity and Sugar Tolerance in Flowers and Soil

Authors: Mirarchi, Isabella; Opulente, Dana
Advisor: Dr. Dana Opulente

Yeasts are members of plant–pollinator systems and can influence pollinator behavior and plant reproductive success. Although yeasts are frequently associated with floral nectar, many yeasts occur in soil and other plant-associated substrates. Their occurrence across these habitats raises questions about whether flowers harbor a functionally specialized subset of the broader environmental yeast community. This project investigated differences between yeasts isolated from flowers and surrounding soil and examined their ability to grow at the elevated sugar concentrations characteristic of nectar. Samples were collected from the flowers of common milkweed (*Asclepias syriaca*) and Japanese honeysuckle (*Lonicera japonica*) and surrounding soil on Villanova University's campus. Approximately 240 yeast isolates were recovered, and molecular identification was initiated using PCR amplification in preparation for sequencing. Growth assays evaluated isolates across varying concentrations of glucose, sucrose, and fructose. Yeasts were successfully isolated from both floral and soil habitats, with preliminary observations suggesting differences in the yeasts recovered from the two habitats. Isolates grew across a range of sugar concentrations, with some exhibiting growth at concentrations as high as 40%. Further identification and comparative analyses are needed to determine whether yeast community composition and sugar tolerance differ consistently between habitats. These preliminary findings provide a foundation for examining how habitat conditions, including sugar availability, may shape yeast communities associated with flowers and surrounding soil.

B-18: Influence of increased temperature and predators on the intraspecific interactions of Atlantic mud fiddler crabs

Authors: Gibbs, Peyton; Ziegler, Shelby
Advisor: Dr. Shelby Ziegler

Atlantic mud fiddler crabs, *Minuca pugnax,* are key ecosystem engineers in saltmarsh ecosystems that facilitate the growth of marsh vegetation through their burrowing behaviors. Through burrowing, fiddler crabs can regulate their internal body temperature to cool themselves. Increased sediment surface temperatures caused by climate change are hypothesized to increase burrowing behaviors and alter predator-prey interactions due to the range expansion of novel predators. Blue crabs, *Callinectes sapidus,* are native predators of fiddler crabs, while stone crabs, *Menippe mercenaria,* are migrating northward with warming conditions, becoming novel predators to fiddler crabs in the Delaware Bay. In this study, we aimed to evaluate the singular and interactive effects of increased sediment temperatures and predator type (native vs novel) on fiddler crab burrowing behavior and intraspecific interactions in a fully crossed design. To assess how burrowing behaviors and intraspecific interactions among fiddler crabs varied across temperature and predator treatments, we used video analysis and recorded individual fiddler crab behaviors. Preliminary data suggest that temperature had the greatest influence on the proportion of time fiddler crabs spent active or standing still. Interestingly, we found that predator presence did not influence fiddler crab behavior in any treatment. Overall, this study allows us to understand how fiddler crab behavior may be impacted by drivers of global change and subsequently how marsh ecosystems will be influenced by changes in ecosystem engineering behaviors.

B-19: Investigating Sex Differences in α-Synuclein Neurotoxicity in a *Drosophila* model of Parkinson's Disease

Author: Gyane, Nustifafa

Advisor: Dr. Troy Shirangi

Parkinson's disease (PD) is a progressive neurodegenerative disorder caused in part by the loss of dopaminergic neurons. This loss is associated with the abnormal aggregation of α-synuclein protein. Studies have shown that PD is more common in men than women, but the cellular basis for this sex difference is not fully understood. This project aims to investigate sex differences in α-synuclein neurotoxicity using *Drosophila melanogaster* as a model system. Using the GAL4/UAS system, wild-type or A53T mutant α-synuclein will be expressed specifically in dopaminergic neurons using the *TH-GAL4* driver. Male and female flies will be examined at 15, 30, and 45 days after eclosion to investigate age-related neuronal loss. The central nervous system will be dissected, immunostained using an anti-tyrosine hydroxylase (TH) antibody, and imaged using confocal microscopy. Dopaminergic neurons will be systematically counted across identified neuronal groups, with samples coded to ensure analysis is performed blind to sex and genotype. I hypothesize that A53T α-synuclein will cause greater dopaminergic neuron loss than wild-type α-synuclein. I also predict that this loss will selectively affect certain neuronal groups and that aged males will show greater degeneration than females. By comparing neuronal survival across sex, genotype, age, and neuronal group, this study will determine whether α-synuclein toxicity is selective, progressive, and influenced by biological sex. These findings may identify vulnerable neuronal populations and provide a foundation for future experiments investigating whether sex-determination genes, such as *doublesex* (*dsx*) and *fruitless* (*fru*), contribute to sex differences in neurodegeneration.

B-20: Investigating the role of ecdysone signaling in the maturation of sexually dimorphic neurons in *Drosophila melanogaster*

Author: McGovern, Sean
Advisor: Dr. Troy Shirangi

During the juvenile-to-adult transition, the circuitry of the nervous system will undergo remodeling, which will allow for the gain of adult-specific behaviors. In *Drosophila melanogaster*, this developmental transition is primarily driven by a steroid hormone called ecdysone. Our lab previously identified a set of neurons in the abdominal ganglion that coexpressed doublesex (dsx) and dissatisfaction (dsf). We wanted to investigate how ecdysone signaling might be involved in the maturation of a Retn-expressing subgroup of these neurons by knocking out ecdysone receptor (EcR) expression. RNAi-mediated knockdown is commonly employed for cell-type specific loss of mRNA transcripts, but this technique can be prone to incomplete knockdown. In order to circumvent these limitations, I created a recombinant line containing a deletion of one allele of the EcR gene and a Retn-GAL4. This recombinant could then be crossed to a Drosophila line with a modified allele of the EcR gene called EcR-Flp-Stop. This allele allows for the expression of functional EcR to be disrupted in a cell-type specific manner. In the resulting progeny, we observed a loss of EcR expression that was specific to Retn-expressing neurons in larvae. In the future, we plan to create new recombinants to perform similar experiments with different neuronal subgroups. This will allow us to investigate how the loss of ecdysone signaling will alter their development and the gain of adult-specific behaviors.

C-21: Neural Activity and Mechanical Contraction in Wound Healing of Jellyfish *Clytia Hemisphaerica*

Author: Zavalaga, Sebastian
Advisor: Dr. Elizabeth Lee

Muscle repair is important for restoring tissue function after injury, but the mechanisms that regulate muscle healing in animals with decentralized nervous systems remain poorly understood. The jellyfish *Clytia hemisphaerica* is a useful model for studying this process because its transparent anatomy allows in vivo imaging of wound healing. Previous work has shown that *Clytia* can repair epithelial wounds scar-free and remodel tissues through mechanically driven reorganization. Here, I investigate whether muscle repair is more influenced by active neuronal signaling or contractile mechanics. Using live differential interference contrast (DIC) microscopy, I compared wound healing in animals with suppressed neuronal activity (Tricaine-treated) or muscle contractions (blebbistatin-treated) to untreated wounded jellyfish. To determine the optimal effective drug concentrations for these experiments, I performed a medusae pulsing behavior experiment, comparing untreated medusae to Tricaine or blebbistatin-exposed jellyfish. Initial results show that Tricaine treatment prevents the healing of larger muscle wounds, but lamellipodia still forms, and smaller wounds are still able to close. This suggests that neural activity may contribute to efficient repair of larger muscle injuries, although smaller wounds may be able to heal through neural-independent mechanisms. Ongoing experiments with blebbistatin will determine whether muscle contraction is similarly required for efficient wound closure and if size influences the ability for it to heal. Future work will examine how neural signaling and contractile forces interact during muscle repair and whether their contributions vary depending on wound size and location.

C-22: Novel Compounds Inhibit Growth of *T. brucei* Parasites

Authors: Mongiovi, Marissa; Povelones, Megan; Silverberg, Lee
Advisor: Dr. Megan Povelones

Trypanosoma brucei is a parasitic kinetoplastid responsible for Human African Trypanosomiasis (HAT). This disease is transmitted through the bite of the tsetse fly and poses a significant threat to individuals residing in affected regions. Identifying compounds that reduce the viability of *T. brucei* is crucial to the future of drug development for HAT. In addition, inhibitor studies can reveal new aspects of parasite biology. Previous studies have shown that novel 2,3-diphenyl-2,3-dihydro-4H-1,3-thiaza-4-one compounds can block division of bloodstream form (BSF) *T. brucei* (Malfara et al., 2021). To further explore this structure-activity relationship, we used a cell viability assay based on Alamar Blue to screen additional substituted 2,3-diphenyl-2,3-dihydro-4H-1,3-thiaza-4-one compounds for activity against BSF *T. brucei*. Alamar Blue is a resazurin-based dye that can be metabolized by living cells and acts as an indicator of parasite viability. Each of the series 2 compounds were initially screened at a concentration of 50 μM and the effect on *T.brucei* was compared to a DMSO media control. The two most potent compounds, identified as MMJP 1-1 and LJS 6-63, were then tested at concentrations of 50, 25, and 12.5 μM, respectively. The effectiveness of these compounds was compared with that of Fexinidazole at the same three concentrations. Fexinidazole is currently used to treat HAT. Using a two-fold dilution series, we have expanded the dose-response analysis to estimate the half-maximal inhibitory concentration (IC50) for MMJP 1-1 and LJS 6-63. This value represents the concentration required to reduce *T.brucei* viability by 50%. Our findings provide a foundation for future studies in genetic screening, to identify the compounds' molecular targets, and in comparing cellular phenotypes of those treated with Compound 1 in Malfara et al.

C-23: Repelling the invaders: probing the transcriptional responses of the mosquito crop diverticulum that limit infection by Crithidia fasciculata

Authors: Beban, Lucia; Povelones, Michael
Advisor: Dr. Michael Povelones

Vector-borne pathogens must successfully establish an initial infection within their mosquito hosts before transmission can occur. In mosquitoes, pathogens encounter both systemic and tissue-specific defenses designed to restrict their survival. Understanding the molecular mechanisms mosquitoes use to detect and eliminate these invaders provides critical insight into vector competence and reveals novel targets to block transmission. Using the yellow fever mosquito, Aedes aegypti, infected with the model kinetoplastid parasite Crithidia fasciculata, I investigated early infection dynamics across the digestive tract. Intriguingly, parasites entering the mosquito initially colonize the crop diverticulum, a foregut organ primarily dedicated to sugar storage. Within the crop, single attached cells divide and form typical 4-16 cell rosettes. Surprisingly, parasite morphology becomes severely disorganized quickly, showing cellular compaction and eventual clearance from the crop lumen. This localized elimination is striking, whereas parasites concurrently establish persistent, high-density infections in the distal hindgut. I hypothesize that parasite outgrowth triggers an active, localized host defense within the crop tissue environment that disrupts attachment and prevents long-term colonization. To test this, I am performing comparative mRNA sequencing on isolated crop tissue and whole mosquitoes during the early stages of infection to identify candidate defensive and stress-response transcripts. Candidate genes will subsequently be functionally tested using RNA interference to determine whether knockdown rescues parasite survival and stability in the crop. Dissecting this barrier will identify antiparasitic host factors and shed light on kinetoplastid-vector tissue tropisms, providing broader relevance for foregut and hindgut barriers in related human parasites such as Leishmania and Trypanosoma cruzi.

C-24: Role for a Conserved Arginine Residue in the UPF1 RNA Helicase in RNA Decay Target Selection

Authors: Qinami, Edvin; Sabani, Jon; Fritz, Sarah
Advisor: Dr. Sarah Fritz

Nonsense-mediated mRNA decay (NMD) is a eukaryotic quality-control pathway that degrades mRNAs containing premature termination codons, preventing truncated protein formation. The RNA helicase UPF1 facilitates NMD, with its activity regulated by a conserved 11-amino-acid loop that influences UPF1 dissociation from RNA and NMD target selection. During ATP hydrolysis, this loop sterically clashes with the helicase core, promoting dissociation. Mammals also express an alternatively spliced isoform, $UPF1_{LL}$, containing a 22-amino-acid loop that exhibits longer RNA residence times and expanded NMD target selection compared to the shorter isoform, $UPF1_{SL}$. However, how the regulatory loop architecture governs these processes remains unclear. This project investigated the role of the R355 residue in UPF1 regulation. I hypothesized that replacing a positively charged arginine with a neutral alanine (R355A) would reduce steric clashing, slow dissociation, and expand NMD target selection. $UPF1_{R355A}$ was expressed in E. coli, purified, and analyzed using biochemical assays measuring nucleic acid dissociation rates and unwinding activity. $UPF1_{R355A}$ exhibited rapid dissociation similar to $UPF1_{SL}$ but showed a trend toward enhanced translocation activity resembling $UPF1_{LL}$. Preliminary cellular knockdown-rescue experiments demonstrated that $UPF1_{R355A}$ retained NMD activity, promoting downregulation of a canonical substrate. These findings suggest that R355

may regulate UPF1 helicase activity by influencing unwinding independently of dissociation. Future studies will investigate whether R355A expands the range of RNAs selected for NMD.

C-25: Exploring the Effect of Temperature, Predators and Disease on the Health and Survival of Eastern Oysters (*Crassostrea virginica*)

Author: Arvidson, Adeline
Advisor: Dr. Shelby Ziegler

As ecosystem engineers, oysters play an important role in regulating and maintaining coastal environments. Specifically, oysters provide habitat to various species through the formation of physical reefs and improve water quality through the filtration of excess algae, nutrients, and nitrogen from the water column. In recent years, various environmental stressors have caused a notable decline in the eastern oyster (*Crassostrea virginica*). These stressors, including warming ocean temperatures, infectious disease (e.g., Dermo and MSX), overharvesting, and pollution, have significantly impacted eastern oyster populations and reduced their ecosystem engineering functions. In order to mitigate these stressors and maintain oyster populations, habitat restoration has grown. In this study, we aimed to determine how temperature, predators, and disease affect the body condition and mortality of oysters from restored and natural oyster reefs. Adult oysters were collected from restored and natural oyster reefs in Back and Bogue Sounds in North Carolina and placed into various temperatures (22°C, 27°C and 31°C) and predator exposure treatments (predator cue or control) in a fully crossed design. Oysters were assessed daily for mortality and after 6 weeks, all live oysters were dissected, tested for Dermo and MSX infection prevalence and intensity using qPCR, and body condition index was measured. Preliminary results suggest that under high temperature conditions oysters from natural reefs had greater mortality than oysters from restored reefs under the same conditions. Ultimately, this project aims to provide insights necessary to improve future coastal restoration and management strategies to support the resilience of both ecosystems and economies dependent on the health of oysters.

C-26: Soil respiration unaffected by variation in microbial community source

Authors: DeJan, Elise; Langley, Adam
Advisor: Dr. Adam Langley

Soil microbes control major ecosystem processes, including the release of carbon dioxide into the atmosphere. An ongoing question in microbial ecology is whether differences in microbial community composition directly influences ecosystem function or whether environmental conditions play a larger role. Understanding this relationship is important for predicting how ecosystems respond to environmental changes. This study investigated how different microbial communities influence soil respiration under controlled environmental conditions. We built 48 soil microcosms and filled each with a common soil that had been pasteurized at 160°C. Then, we added microbial inoculum collected from 9 different sites: 3 forests, 3 wetlands, and 3 lawns, and left a subset as uninoculated controls, and measured CO_2 and CH_4 emissions. Plating revealed substantial variation among inoculum sources in the microbial community composition. However, neither the individual site nor the ecosystem type, from which inoculum derived consistently affected soil CO_2 or CH_4 emissions. Inoculated soils respired much more than uninoculated controls, even though the controls were not sterile. Overall, these findings show that the potential for soil microbial function does not vary meaningfully across

sites that differ greatly in land-use and plant composition. This high level of functional redundancy among soil microbial communities suggests that environmental factors matter much more for ecosystem function than biogeographical patterns of microbial diversity.

C-27: Using transcriptomics to dissect parasite developmental transitions
Author: Saxe, Leah
Advisor: Dr. Michael Povelones

Parasitic organisms undergo developmental transitions that enable them to adapt, invade, and optimize survival within their hosts. These transitions are marked by distinct molecular and morphological changes, yet the regulatory systems that govern these changes are not well studied. The trypanosomatid *Crithidia fasciculata*, a non-pathogenic mosquito parasite, transitions between a motile swimming cell fate and an adherent cell fate in vitro and in the mosquito hindgut. This provides a tractable model for studying developmental changes in parasites. Transcriptomic analysis of swimming and adherent *C. fasciculata* revealed dramatic changes in mRNA abundance between the two fates. However, it is not known whether there are distinct developmental stages as cells transition from swimming to adherent and from adherent back to swimming. This project aims to address this gap in knowledge by examining dynamic changes in transcript abundance by using both bulk mRNA sequencing in cells, collected in a time course and single cell mRNA sequencing from mixed cultures containing cells transitioning between both fates. These approaches will elucidate distinct transcriptional states and gene regulatory programs that drive parasite differentiation. This research could identify candidates that may inform strategies to disrupt disease transmission in these disease-causing trypanosomatids. Defining these transcriptional transitions will provide a foundation for understanding the mechanism for developmental changes in parasites, broadening the knowledge of vector-borne disease biology.

C-28: ZC3H8 Influence of the Oncogenic Phenotype: Driving the Epithelial-Mesenchymal Transition
Authors: Corretjer, Antonio; Schmidt, John
Advisor: Dr. John Schmidt

Breast cancer remains a significant global health challenge. Accounting for nearly 30% of all female cancers annually in the U.S., breast cancer has been linked to the overexpression of the ZC3H8 (Fliz) gene, which is associated with a poor clinical prognosis. While the ZC3H8 gene has been connected to the aggressive mesenchymal phenotype of mammary carcinomas, specific morphological transitions, such as the Epithelial-Mesenchymal transition (EMT), are still not well understood. This study aims to clarify the role of Fliz in the EMT process by comparing Fliz-out Control cells (FOC), a Fliz knockdown, to a Negative Control (NC) from a mouse mammary carcinoma cell line. The first goal of this project involves longitudinal morphological analysis and Scanning Electron Microscopy (SEM) to measure structural differences between the cell lines and provide detailed visual confirmation of the data. The second goal uses immunofluorescence to assess EMT markers E and N-cadherin, which are involved in the EMT hallmark "cadherin switch," where E-cadherin levels decrease while N-cadherin levels increase. I hypothesize that FOC cells will show higher circularity, due to contact inhibition, and increased E-cadherin levels, indicating that reduced Fliz expression helps cells maintain certain epithelial features. By further exploring the role of the ZC3H8 gene in the aggressive

phenotype, this research seeks to help identify new therapeutic targets that can reduce invasive behavior and limit metastasis.

Chemical and Biological Engineering

C-29: Assessing Positively Charged Nanoparticle Interactions with the HUVEC Membrane
Authors: Clark, Aidan; Wu, Jianlei; Bracaglia, Laura; Rodriguez-Rivera, Gabriel
Advisor: Jianlei Wu

Positively charged nanoparticles (NPs) are used as one of the drug carriers, and are expected to interact with the negatively charged cell membrane to deliver therapeutics to the cells, resulting in NP-cell association at the cell surface. These interactions can be detected using electrochemical impedance spectroscopy (EIS), where changes in impedance reflect alterations in cell-electrode properties caused by NP-cell contact. We hypothesized that the magnitude of the impedance response correlates with the extent of NP-cell interaction and, therefore, that EIS can serve as a rapid screening tool to identify NP formulations with the greatest potential for cellular association. To simulate human cells, Human Umbilical Vein Endothelial Cells (HUVECs) were used to test nanoparticle cellular association. By comparing baseline readings involving only cellular media and only HUVECs, one can determine the impact of nanoparticle addition in terms of changes in impedance measurements. It was determined that sufficiently charged nanoparticles do have a tangible effect on cellular association, and that NPs with a higher zeta potential, or surface charge, interact more effectively with the negatively charged cell membrane. Additionally, it was determined that other factors may also collude these results, such as cell age, temperature of the cellular media, sterility of the testing environment, and more.

C-30: Engineering Lipoic-Acid Crosslinked NorHa Microgels for Volumetric Muscle Loss (VML)
Author: Rosario Taveras, Trigal
Advisor: Dr. Gabriel Rodriguez Rivera

There are about 40,000 to 250,000 cases of volumetric muscle loss (VML) annually in the United States. VML is the traumatic loss of skeletal muscle due to numerous reasons. Current alternatives for VML include physical therapy, scaffold implantation, and functional muscle transfer, which fail to fully restore muscle function and frequently result in scar tissue formation. Granular hydrogels are promising injectable biomaterials because their microporous structure promotes cell infiltration, vascularization, and tissue remodeling. This study investigates whether lipoic acid-based granular hydrogels can improve skeletal muscle regeneration by restoring tissue function. The objective was to determine how varying microgel stiffness influences cell infiltration, and whether reversible lipoic acid chemistry provides mechanical recovery such as self-healing capacities. The gels were synthesized using hyaluronic acid, a natural polymer, and different ratios of a synthetic crosslinker (lipoic acid). Rheology characterized the mechanical properties of each microgel group. Microscopy was used to quantify pore sizes and porosity, and sprouting assays were performed to determine how well the cells penetrated through the differing microgels. Rheological characterization showed that all crosslink conditions rapidly gelled following crosslinking Increasing the crosslinker concentration resulted in a proportional increase in the storage modulus (G'), demonstrating tunable mechanical stiffness. Following swelling in saline, all crosslink conditions exhibited partial mechanical recovery, consistent

with the reversible chemistry of the lipoic acid crosslinker. Sprouting assays demonstrated successful growth of HUVEC and hMSC spheroids on all crosslink conditions. These findings demonstrate that lipoic acid-based granular hydrogels provide tunable mechanical properties while maintaining consistent porosity and cellular sprouting. These are essential findings that can be the early steps towards research that can alter someone's life forever.

D-31: Silencing the Silencer: Disruption of IFI16 Driven Repression

Authors: Capelle, Matthew; Mwangi, Leila; Elmer, Jacob
Advisor: Dr. Jacob Elmer

Gene therapies hold significant promise for treating genetic diseases by making a long term solution possible after a single treatment. However, their effectiveness is often limited by the human innate immune response that silence therapeutic DNA before it can be expressed. A major barrier is the protein IFI16, which recognizes foreign DNA and recruits the PML and SP100 proteins to establish repressive chromatin through SUMO-dependent interactions. This study will investigate the ability of a small-molecule inhibitor, DRUGX, to disrupt this IFI16–PML–SP100 silencing complex and prevent subsequent epigenetic repression. The project will determine whether DRUGX reduces DNA methylation and repressive histone trimethylation while increasing histone acetylation and transgene expression in mammalian cells. To accomplish this, plasmid-transfected cells will be treated with DRUGX and compared to untreated controls. DNA methylation will be quantified through bisulfite conversion and sequencing, and chromatin modifications will be assessed using chromatin immunoprecipitation, targeting both activating and repressing histone marks. Transgene expression and cell viability will be evaluated using microscopy, flow cytometry, and qPCR. By clarifying the epigenetic mechanism of DRUGX, this study aims to identify a potential strategy for overcoming IFI16-mediated silencing in plasmid-based gene therapies, which can be applied to viral gene therapies that are used in human treatments. The anticipated findings could advance the development of more effective gene delivery systems relevant to hemophilia, cancer, and other disorders requiring sustained therapeutic expression, thereby contributing to improved clinical outcomes and future gene therapy design.

D-32: Site-Specific Inhibition of IFI16, PML, and DAXX SUMOYlation with Novel Fusion Protein

Authors: Fernandez, Adriana; Elmer, Jacob
Advisor: Dr. Jacob Elmer

Crucial proteins that promote transgenic silencing like IFI16, PML, and DAXX are activated by SUMOylation, or the covalent addition of SUMO-tag protein modifications brought about by SUMO enzymes. Previous findings show SUMOylation inhibition increasing transgene expression, but we seek a more specific method that does not obstruct global SUMOylation. We designed a fusion protein that removes SUMO-tags from proteins specifically targeting our transgene, countering prior research on SUMO enzyme inhibition, protein knockouts, and small molecule inhibitors to decrease SUMOylation. The fusion protein is comprised of an N-terminus deSUMOylating protein (A), a sight specific C-terminus protein (B), and N- and C- terminal nuclear localization signals. Protein B targets methylated GATC motifs of our transgene, which are not found on host genomes. Silencing proteins in proximity will be de-SUMOylated by Protein A. To test this, we transformed synthetic plasmids

into DH5-alpha cells, performed PCR amplification of our DNA amplicon, and conducted various mRNA synthesis experiments. MRNA transcripts encoding the fusion protein were then electroporated into Human Foreskin Fibroblasts (HFF-1) cells and lipofected with a GFP plasmid after 48 hours. Currently, this project demonstrates a successful workflow with optimal mRNA output concentrations and functional mRNA fluorescence. We hypothesize that further GFP expression analyses through fluorescent microscopy and flow cytometry will show that the fusion protein's specificity and de-SUMOylating function will enhance transgene expression without adversely affecting host cell SUMOylation. In general, this project assesses the functionality of site-specific SUMOylation inhibition, furthering gene therapy research and prolonging treatments for numerous genetic disorders.

Chemical Engineering

D-33: Hydrothermal Carbonization and Thermal Activation of Brewers' Spent Grain
Authors: Petrucci, Sophia; Obed, Cubahiro; Bazrafshan, Hamed
Advisor: Dr. Christopher Kitchens

Brewers' spent grain (BSG), a major byproduct in the brewing industry, represents an abundant biomass resource with potential for conversion into valuable materials. This study investigates the conversion of BSG into activated carbon and evaluates its effectiveness as an adsorbent for water waste treatment. BSG is converted through hydrothermal carbonization followed by activation to produce porous carbon materials with high surface areas. The resulting activated carbons are characterized to assess properties relevant for adsorption performance. Their ability to remove two contaminants, methylene blue and 6PPD-quinone (6PPD-Q), was then evaluated under controlled batch adsorption conditions. Methylene blue was used as a model organic contaminant to assess adsorption behavior, while 6PPD-Q was selected because of its emerging environmental significance as a toxic product from tire wear. Adsorption experiments were used to demonstrate a waste-to-resource approach that combines valorization of an industrial byproduct with the development of carbon-based materials for contaminant removal from water.

D-34: Lipoic Acid-Crosslinked Granular Hydrogels Enhance Elastic Recovery for Volumetric Muscle Loss Repair
Author: Yazar, Mehtap
Advisor: Dr. Gabriel Rodriguez Rivera

Despite advances in tissue engineering and surgical procedures, the clinical alternatives for patients with significant loss of muscle fibers and surrounding tissues results in poor cosmetic and functional outcomes. To address this need, my group is developing injectable granular hydrogels that can fill voids in muscle tissues to regenerate muscle in a controlled or directed way to restore function. Unlike most bulk scaffolds, granular hydrogels have macroporosity that facilitates cell and vessel invasion. The result is an injectable implant that conformably fills irregular VML defects while immediately providing a network of interconnected channels for oxygen and nutrients diffusion. Our hypothesis is that using lipoic acid as a crosslinker will yield microgels that has more elastic recovery and mechanical resilience compared to dithiothreitol (DTT), a crosslinker mostly used in labs. By having more elastic recovery, the hydrogels will mimic the dynamic of muscle tissues better. Currently, I am

working on fabrication and characterization of microgel scaffolds with Norbornene-modified Hyaluronic acid and Lipoic Acid as a crosslinker using hydrogel synthesis, rheology techniques. Also, I am working on cell assays to compare toxicity of Lipoic Acid and DTT.

D-35: Magnesium Oxychloride Cement Characterization and Cement Preparation For 3D Printing

Authors: Theis, Megan; Davis, Felix; Kitchens, Christopher
Advisor: Dr. Christopher Kitchens

Magnesium oxychloride cement (MOC) is a potential alternative to ordinary Portland cement due to its lower calcination temperature, reduced carbon emissions, low density, and improved fire resistance. This study investigates the mechanical properties, hydrolysis degradation, and extrusion-based 3D printability of MOC to assess its potential for future sustainable construction applications. Compressive strength was evaluated using an Instron testing machine to compare formulations containing phosphoric acid, potassium dihydrogen phosphate, and no additives at all. Hydrolysis degradation was investigated over the course of six days using four commercial MOC boards. Chloride released into the runoff was quantified by titration, and the dried solid residues were analyzed using X-ray diffraction (XRD). MOC was also evaluated for its suitability for extrusion-based 3D printing using a Tronxy Moore 2 Pro clay printer. This was done by mixing homemade samples with additives such as wood flour, calcium carbonate, and phosphoric acid. Phosphoric acid produced the best compressive strength, peaking at 72.8MPa. Chloride release approached a plateau after approximately four to six days of hydrolysis testing, leaching around 0.1-0.13 grams of chloride at plateau. For 3D printing, formulations containing wood flour and calcium carbonate with particle sizes below 150 μm and phosphoric acid showed promise for improving consistency and extrudability, although further formulation optimization is required. These findings contribute to understanding the durability, mechanical performance, and processing requirements of MOC, supporting its continued development as a potential lower-carbon material for future construction applications.

D-36: Maximizing Production of Lithium Orthosilicate Composites

Author: Wisniewski, Sabrina
Advisor: Dr. Michael Smith

Carbon capture and storage are critical for reducing CO2 emissions and enabling low-carbon hydrogen through precombustion capture. Sorption-enhanced steam-methane reforming (SE-SMR) combines reforming and water-gas shift in one step at 550-650 °C, lowering costs and yielding near-pure CO2 for sequestration or industrial use, enabling a way to produce blue hydrogen. Lithium orthosilicate (Li4SiO4) offers high theoretical CO2 uptake capacity (36.7 wt%) and favorable thermodynamics but suffers from slow uptake kinetics and high operating temperatures. We have developed a composite n-Li4SiO4 with nanoscale Li2CO3 and Li2SiO3 domains, showing rapid uptake and stability over 80 cycles. We are now examining how lithium content and surfactant-mediated (citric acid) synthesis affect phase distribution. We are using XRD with Rietveld refinement to quantify Li2CO3 and Li2SiO3 and thermogravimetric analysis to measure uptake. In addition, we are also focusing on optimizing the product per volume in each batch by adjusting the synthesis methods with the ratio of solvent to reactant. Ultimately, this material will be incorporated into a single-step laboratory-scale SE-SMR reactor system for continuous hydrogen production with integrated CO2 capture.

D-37: Neutralization of and Heavy Metal Removal from Acid Mine Drainage Using Sustainable Food Waste

Authors: King, Patrick; Mozeleski, Luke; Oswald, William,
Advisor: Dr. Vito Punzi

Acid mine drainage (AMD) is runoff characterized by low pH and elevated concentrations of dissolved metals. Calcite is typically used to treat the water, but because the manufacturing process has high energy demands, there is a need to develop sustainable treatment approaches. This study evaluated eggshell waste (ESW) and shrimp tail waste (STW) as calcium carbonate-containing materials for acid neutralization and manganese and iron removal. The materials were tested separately in three-hour batch experiments using sulfuric acid solutions initially adjusted to pH 3, with and without added metals. Experimental conditions varied solid dose, particle size, raw or cooked solids, and solution ionic strength. The solution pH and metal concentrations were measured to assess treatment performance. Both materials successfully increased solution pH and removed metals, with smaller particles generally improving the rate of neutralization and manganese and iron removal. STW was more effective than ESW at neutralization and manganese removal, while both materials showed comparable effectiveness for iron removal. The presence of manganese slowed neutralization relative to solutions without added metals. Higher ionic strength generally accelerated neutralization and improved manganese removal by ESW, but reduced manganese removal by STW. In several cases, no major performance differences were observed between raw and cooked materials. These findings demonstrate the potential of ESW and STW as sustainable treatment materials for AMD and identify particle size, dose, and solution ionic strength as important factors affecting their performance.

D-38: Optimizing Zeolite Composition for CO_2 Capture from Commercial Streams

Authors: Rice, Kylah; Peer, Mahrokh; Coe, Charles; Smith, Michael
Advisor: Dr. Charles Coe

Current carbon capture and storage technologies are often limited by high costs and energy requirements, creating challenges for reducing carbon dioxide emissions. Zeolite aluminosilicates, particularly Faujasite, are promising alternatives to conventional amine-based sorbents because of their relatively low heats of adsorption, ability to be regenerated over repeated cycles, and compatibility with both pressure and vacuum swing adsorption processes. However, the relationships between zeolite composition and CO_2 adsorption performance are not fully understood, limiting the optimization of these materials for commercial applications. This study investigated how framework composition and extra-framework cation selection influence cyclic working capacity and heat of adsorption under varying temperature and pressure conditions, with current work targeting CO_2 capture from process streams associated with steam methane reforming. The results demonstrate that adsorption performance depends on the combined effects of framework composition, cation type, and process conditions, highlighting the importance of balancing working capacity and heat of adsorption when selecting zeolite compositions for specific commercial carbon capture applications.

Chemistry

D-39: Convergent/divergent total synthesis of the wortmannilactones
Authors: Westrate, Anastasia; Roos, Michelle; Trauner, Dirk
Advisor: Dr. Dirk Trauner (University of Pennsylvania)

Progress toward the total synthesis of the bioactive polyketide wortmannilactone E is described as part of a wider synthetic campaign targeting 10 related natural products. The designed route features a novel Achmatowicz rearrangement to access the dihydropyran fragment and a dehydrative cyclization to form the oxabicyclo[2.2.1]heptane system. Utilizing a convergent approach to couple these two fragments, current synthetic investigations have focused on establishing the dihydropyran pathway, with preliminary unoptimized step yields ranging from 45% to quantitative recovery. This work establishes a foundation for future optimization and divergent access to this series of natural products.

Chemistry and Biochemistry

D-40: Are Natural Cosmetics Safer? A Comparative Analysis of Heavy Metals in Natural and Conventional Makeup
Author: Figueroa, Sarah
Advisor: Dr. Vanessa Boschi

Within recent years, natural cosmetics have been marketed as a safer alternative to conventional cosmetics that can contain hazardous chemicals including heavy metals. However, little research has been published to determine if natural cosmetics contain similar hazards. Natural cosmetics may contain pigments derived from a variety of sources, including minerals and plant-based materials such as beets, carrots, and blueberries, which may contain heavy metals. In this research, 19 natural makeup products were selected to assess heavy metal content in a variety of different makeup types including eyeshadows, highlighter, lip products, and illuminators. Various pigments were selected to determine if heavy metal content correlated with certain colors. Additionally, 19 equivalent conventional cosmetic products were analyzed to provide a basis for comparison between natural and conventional makeup products. All samples were acid digested with nitric acid and peroxide and analyzed via ICP-MS for their Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Cd and Pb concentrations. Elemental concentrations in natural and conventional makeup samples were compared to determine statistically relevant differences and if heavy metals were greater in certain makeup types or associated with certain pigments or ingredients. These results are intended to help consumers make more informed decisions considering the lack of data related to natural makeup content.

E-41: Biofuels from Algae: Optimization of Lipid Extraction Methods Using Quaternary Ammonium Compounds
Authors: Minbiole, Reid; Brosman, Muriel; Eigenbrodt, Bryan
Advisor: Dr. Bryan Eigenbrodt

Algal biofuels have been gaining traction as a potential alternative energy source for over a decade, and as such, standard mechanical and non-mechanical processes for the breakdown of the algal cell wall have emerged. One such non-mechanical process involves the introduction of certain compounds to assist in disrupting the cell wall. This research primarily focuses on the introduction of various quaternary ammonium compounds (QACs) into the algae Nannochloris eucaryotum to determine the effectiveness of not only the compound type, but structural characteristics of the QACs that may increase recovery of extracted oils through the lysing of cells. Extracted oils from algal samples were characterized by gas chromatography coupled with mass spectrometry. The GCMS data reveals that an enhancement in lipid recovery of the algal cells exposed to QACs. The ability of these compound to disrupt the algal phospholipid bilayer aided in lysing of the cells and allowed for complete extraction of intracellular lipids. This can prove to be a less energy intensive process to extract lipids from algae for future biofuel generation.

E-42: Development and Characterization of Imidazolium-Based Quaternary Ammonium Compounds as Disinfectants

Authors: Weiss, Amelia; Elderbali, Jacky; Coster, Kai; Asante, Johanna; Dauzvardis, Fabian; Bezold, Elise; Wuest, William; Minbiole, Kevin
Advisor: Dr. Kevin Minbiole

Quaternary ammonium compounds, or QACs, have been a leading class of disinfectants since the 1940s due to their ability to lyse microbial cells. However, after nearly a century of continuous, near-ubiquitous use of QACs in settings such as hospitals, microbial resistance to such disinfectants continues to develop. This has given rise to greater difficulty in combating certain pathogens, such as S. aureus and E. coli. This paradigm necessitates the development of next-generation disinfectants. Our group has synthesized a wide variety of cationic biocides with a focus on innovative architectures, with the total number of synthesized compounds now exceeding 1000. We have recently begun the exploration of imidazole-based structures inspired by histidine residues in antimicrobial peptides found in biological media and have found promising indications of strong antimicrobial activity as well as modest eukaryotic toxicity. In our synthetic approach, we varied the terminal alkyl chain length, the bridging architecture, and the electronic structure of the imidazolium groups of the compounds presented herein. In this fashion, we interrogate the structure-activity relationship between these imidazolium compounds and their antimicrobial activity.

E-43: Development of Aerosol Jet Printing Technology to Enhance Electrode Performance in Alternative Energy Fuel Cell Devices

Authors: Bender, Domenic; Gust, Finley
Advisor: Dr. Bryan Eigenbrodt

Solid oxide fuel cells (SOFCs) are a highly efficient and renewable energy source capable of operating on a variety of fuels from natural gas to hydrogen, achieving fuel conversion efficiencies up to 80-90%. This research involved the development of a custom aerosol jet 3D printing (AJP) instrument and its integration in the fabrication method for nickel-yttria-stabilized zirconia (Ni-YSZ) anodes. This AJP 3D printing system offered greater precision and control when compared to conventional fabrication methods, like screen printing, used for these devices. Using the custom AJP system, optimal printing parameters were found to produce thin, multilayer electrode structures with tunable microstructure. This approach enables targeted engineering of the three-phase boundary (TPB),

enhancing catalytic activity, fuel diffusion, and overall electrode and fuel cell performance. Scanning electron microscopy (SEM) was used to analyse the printed structures in comparison to the screen-printed electrodes. By illustrating a scalable and controllable fabrication method, this research advances the development of high-performance SOFCs and supports the adoption of SOFCs as a sustainable and resilient energy technology. In addition to microscopy, standard electroanalytical techniques were utilized to assess electrochemical performance in these 3D-printed devices and compare them to conventionally fabricated devices. Future research will investigate the formulation and aerosol jet printing of a cathode ink to compare its structure and performance with the screen-printed cathodes to further advance fully printed SOFC electrode fabrication.

E-44: Do STI1 helix interactions mediate proteasomal degradation
Author: Zazzali, Federica
Advisor: Dr. Daniel Kraut

The yeast ubiquitin-proteasome system relies on ubiquitin-shuttle proteins to transport misfolded, polyubiquitylated proteins to the proteasome for degradation, supporting proteostasis and biomolecular stress responses. Dsk2 is a primary shuttle protein in this pathway and contains a ubiquitin-like domain (UBL) to bind the proteasome, a ubiquitin-associating domain (UBA) to bind polyubiquitin chains, and a central intrinsically-disordered region (IDR). Within this region, an STI1 domain dynamically binds three transient amphipathic helices embedded within the IDR. It is suggested to similarly bind similar amphipathic or hydrophobic helices of substrates. Our project studies whether binding between the Dsk2 STI1 domain and helices of ubiquitin-independent substrates is sufficient for protein degradation to occur. While ubiquitination is necessary for the UBA domain to bind substrates, it may not be required for substrate binding to the STI1 domain. This would provide an alternative mechanism for Dsk2 substrate recognition in the absence of ubiquitin. To study this, we have designed six potential Dsk2 client protein substrates for degradation via STI1-helix domain interactions. Degradation assays compare reactions containing Dsk2, substrate, and proteasome with controls lacking each component individually. No significant degradation was observed for these substrates, using both WT and mutant Dsk2 lacking internal transient helices. Ubiquitination of substrates allowed degradation, but there was no apparent effect of Dsk2, suggesting interactions between the STI domain and helices are too weak to mediate or modulate degradation. Current experimentation includes anisotropy with substrates and Cy5 labeled Dsk2 to measure the direct interaction between the shuttle protein and substrates containing helical regions.

E-45: Electronic effects in cobalt(III) *N*,*N*'-bis(salicylidene)ethylenediamine (salen) complexes for the copolymerization of CO_2 and propylene oxide
Author: Wickham, Grace
Advisors: Dr. Scott Kassel; Dr. Jared Paul

Cobalt-based *N*,*N*'-bis(salicylidene)ethylenediamine (salen) complexes have been used to convert carbon dioxide, a major greenhouse gas, into useful polymers through CO_2/epoxide copolymerization. This work explores the electronic effects of varying electron-donating and electron-withdrawing substituents on a salen framework through the synthesis and characterization of a series of cobalt(III) complexes with the general formula $[Co(R\text{-sal-dap})(4\text{-MePy})_2]BF_4$, where R-sal-dap is derived from 1,2-diaminopropane and a substituted salicylaldehyde derivative (R = H, 4-methyl, 4-

methoxy, 4-trifluoromethyl, and 3,5-di-tert-butyl). Target complexes were isolated as cationic cobalt(III) tetrafluoroborate salts bearing two axial 4-methylpyridine ligands. The isolated complexes were characterized by ^{1}H NMR, IR, UV-visible and photoluminescence spectroscopies, X-ray crystallography, mass spectrometry and cyclic voltammetry. Systematic ligand modification provides an effective strategy for tuning the electronic properties of the complexes. The complexes were evaluated as catalysts for CO_2/PO copolymerization to investigate ligand substituent effects on overall polymerization performance.

E-46: Functional Analysis of the PII–NAGK Interaction

Authors: Perez Lugo, Omar; Palenchar, Peter
Advisor: Dr. Peter Palenchar

Nitrogen (N) availability determines plant growth and development, supporting the synthesis of amino acids, nucleotides, chlorophyll, and other biomolecules. Understanding the mechanisms that sense and regulate nitrogen metabolism is therefore important for understanding plant growth under varying conditions. PII is a conserved signaling protein in photosynthetic organisms that senses cellular nitrogen status and regulates nitrogen metabolism through protein–protein interactions. In plants, PII interacts with N-acetyl-L-glutamate kinase (NAGK), an enzyme involved in arginine biosynthesis. Structural studies indicate that a conserved arginine residue forms a salt bridge at the PII–NAGK interface, suggesting an important role in stabilizing the protein complex and regulating enzyme activity. Sequence analyses conducted by our research group reveal that this conserved arginine residue is replaced by cysteine in members of the genus Arachis (peanut), indicating evolutionary divergence. Additionally, AlphaFold modeling predicts that a threonine-to-lysine substitution in Arachis PII may allow formation of an alternative intramolecular salt bridge. Recombinant PII and NAGK from Arabidopsis and Arachis have been successfully expressed and purified. NAGK enzymatic activity has been assessed using hydroxylamine colorimetric assays and phosphorus-31 nuclear magnetic resonance (^{31}P NMR) spectroscopy. Together, these approaches aim to provide insight into the functional consequences of naturally occurring amino acid substitutions and their potential role in regulating arginine biosynthesis.

E-47: Growth of *Pseudochloris wilhelmii* in Media Containing Microplastic Monomers and Formation of Fatty Acids

Authors: Brosman, Muriel; Arcati, Vincent; Wagner, Skylar; Minbiole, Reid
Advisor: Dr. Bryan Eigenbrodt

Despite growing sentiment in favor of environmental remediation, there are still significant amounts of pollution that plague ecosystems across the globe. Among the litany of contaminants infecting the air and water, the two most prevalent are fossil fuels and microplastics, which are deeply ingrained into everyday energy and production networks. However, research suggests that brackish microalgae *Pseudochloris wilhelmii* represents a solution to both sides of this problem, metabolizing microplastic monomer caprolactam to biosynthesize fatty acids. Weekly cell counting and fluorescence spectroscopy offer "semi-qualitative" data to track cell growth and lipid production, with more concrete methods like gas chromatography-mass spectroscopy and confocal fluorescence microscopy offering secure, visible data points. All methods were used to determine how nitrates and ε-

caprolactam in seawater media affected *P. wilhelmii's* development and fatty acid synthesis, finding promising data that indicates *P. wilhelmii* can be sustained by microplastic monomers alone.

E-48: High-Throughput Experimentation and Molecular Simulation Reveals Stereochemical Dependance of Cyclic Peptide Macrolactamization

Authors: Sharafi, Edreece; Minbiole, Luke; O'Reilly, Matthew
Advisor: Dr. Matthew O'Reilly

Cyclic peptides are among the smallest macrocyclic peptides and have attracted interest in medicinal chemistry due to their diverse biological properties. However, their synthesis remains a challenge, particularly during head-to-tail macrolactamization. In this work, the mixed-stereochemistry cyclic tetrapeptide massiliamide and its all-L diastereomer were synthesized by solution-phase peptide synthesis. Efficient cyclization conditions were identified through high-throughput experimentation (HTE) arrays, using LC-MS analysis to rapidly screen reaction outcomes. Surprisingly, the mixed-stereochemistry peptide cyclized efficiently across nearly all conditions tested, while the all-L diastereomer required substantial optimization. Only one out of more than 100 combinations of reaction conditions produced the all-L peptide in comparable yields to its LDLD diastereomer. Large-scale cyclization with these desirable conditions ultimately produced the all-L and LDLD diastereomers in 70% and 89% yields, respectively. The distinct cyclization behavior of the two stereoisomers motivated molecular simulations to investigate the relationship between linear precursor conformation and cyclization efficiency. Computational analysis revealed that differences in the distance between the C- and N- termini of a linear peptide can predict macrolactamization productivity. Correlating these distances to an overlap score provided a numerical metric reflecting cyclization success. Together, this work demonstrates synthetic and computation progress towards understanding and improving cyclic peptide synthesis, addressing the constraints that currently limit the field.

E-49: Investigating the effects of electron-donating and electron-withdrawing bipyridine ligands on the spectroscopy and DNA photocleavage activity of Ru(II)-DPPN complexes

Author: Sage, Evan
Advisor: Dr. Scott Kassel

Ruthenium(II) polypyridyl complexes are promising photosensitizers because they exhibit strong metal-to-ligand charge-transfer absorption, long-lived triplet excited states, and the ability to generate singlet oxygen. The complex $[Ru(bpy)_2(DPPN)]^{2+}$ (bpy = 2,2'-bipyridine; DPPN = benzo[*i*]dipyrido[3,2-*a*:2',3'-*c*]phenazine) has been used in the photocleavage of pUC18 DNA, making it a useful standard for investigating metal-based photodynamic therapy (PDT) agents. This work focuses on the synthesis, characterization, and photochemical evaluation of substituted $[Ru(R_2\text{-}bpy)_2(DPPN)]^{2+}$ and related Ru(II) complexes where R = OMe or Cl, corresponding to 4,4'-dimethoxy-2,2'-bipyridine and 4,4'-dichloro-2,2'-bipyridine, respectively. Isolated complexes were characterized by ^{1}H NMR and UV-visible spectroscopy, mass spectrometry, and cyclic voltammetry. DNA photocleavage studies were carried out using supercoiled pUC18 plasmid DNA under 440 nm blue light irradiation, with activity monitored by agarose gel electrophoresis through the conversion of the supercoiled form to the relaxed circular form.

E-50: LC-MS/MS Method Development for the Separation and Detection of Derivatized Sugars

Authors: Barrera, Alan; Lagalante, Anthony
Advisor: Dr. Anthony Lagalante

Sugars play a critical and dual role in biological, medical, and industrial fields, serving as both a vital energy source and a key biomarker for metabolic health. In human physiology, carbohydrates are the primary fuel for cellular function and are essential in diabetes management, where monitoring blood glucose levels is crucial to prevent complications and chronic organ damage. The quantitation and identification of sugars remain fundamental to advancing science and global health. Analyzing carbohydrates using liquid chromatography coupled with electrospray ionization tandem mass spectrometry (LC-ESI-MS/MS) poses significant challenges due to the unique physical properties of sugars. Their high hydrophilicity and lack of UV-absorbing chromophore make it difficult to retain them on traditional reversed-phase C18 columns, necessitating specialized techniques like hydrophilic interaction liquid chromatography (HILIC). Additionally, chromatographic separation is complicated by the existence of isomers and anomeric mutarotation, which can result in overlapping peaks. Neutral sugars also do not readily ionize, thereby requiring complex sample derivatization for effective detection in mass spectrometry. This research project aims to develop an LC-MS/MS method for the separation of native sugars, accompanied by post-column derivatization for enhanced ionization and detection. The study investigates various rapid derivatizations of sugars, particularly in an atmospheric pressure chemical ionization (APCI) chamber. Data collection involved mixing sugars with a reagent solution, and 3-fluorophenylboronic acid (3-FPBA) was identified as a suitable reagent. Targeting cis diols may prove more effective in creating sugar derivatives due to the inherent preference of sugars for ring conformation.

F-51: Quantifying electrophilicity of endogenous NRF2 activator kynurenine-carboxyketoalkene (Kyn-CKA) and its potent deaminated derivative DEAN

Authors: Titzer, Patrick; Eggler, Aimee
Advisor: Dr. Aimee Eggler

The NRF2 transcription factor plays a critical role in the cytoprotective response to oxidative and electrophilic stressors. Activation of NRF2-regulated cytoprotective gene expression by electrophiles derived from dietary or pharmacological sources helps prevent and treat an expansive range of chronic diseases. An endogenous electrophilic tryptophan metabolite, kynurenine-carboxyketoalkene (Kyn-CKA), was recently shown to activate NRF2. Furthermore, deaminated Kyn-CKA (DEAN) has demonstrated significantly faster conjugation with Keap1 Cys151, a known target for Class I electrophiles in NRF2 activation. While Kyn-CKA and DEAN's active site reaction kinetics are known, each activator's inherent electrophilicity was yet to be quantified. We sought to determine this by observing both Kyn-CKA and DEAN's reaction with N-acetyl cysteine (NAC) using fluorescence spectroscopy. We calculated a reaction rate constant for Kyn-CKA + NAC by examining RFU/time (excitation: 396nm, emission: 490nm) immediately after solution initiation at different NAC concentrations, fitting the curves to a first-order decay equation, and taking the slope of the resulting k values of each curve. Since DEAN is not inherently fluorescent, we determined the reaction rate constant for the fluorescent probe monobromobimane (mBBr) + NAC, then added different concentrations of DEAN to obtain several increased k_{obs} values. We subtracted k_{mBBr} from the slope

of these values to obtain k_{DEAN}. We calculated that $k_{Kyn\text{-}CKA}$: 6.517E-6 $\mu M^{-1}s^{1}$ and k_{DEAN}: 9.044E-5 $\mu M^{-1}s^{-1}$. Quantifying inherent electrophilicities of NRF2 activators provides valuable insight on their potency, but also their affinity for non-target nucleophiles, especially when comparing these values to their kinetics for Keap1 C151.

F-52: Structure–Reactivity Relationships of DEAN Kyn-CKA Derivatives Targeting Keap1 C151

Authors: Pan, Angela; Kassahun, Nathanael
Advisors: Dr. Aimee Eggler; Dr. Matthew O'Reilly

DEAN Kyn-CKA is an electrophilic molecule containing an α,β-unsaturated carbonyl capable of reacting with nucleophilic cysteine residues. Aromatic substituents with varying electron-donating and electron-withdrawing properties may alter the electronic characteristics of this scaffold and influence its reactivity. This project investigated how structural modifications to DEAN Kyn-CKA derivatives affect their synthesis and cysteine reactivity. Derivatives were synthesized through microwave-assisted reactions and reflux esterification, then characterized using chromatography, NMR, and LC-MS. The effects of aromatic substitution and esterification were evaluated, with chromatography used to separate desired products from side products and compounds with differing alkene configurations. Biochemical reactivity toward Keap1 C151 was assessed using an IC_{50} competition assay in which derivatives competed with the fluorescent cysteine-reactive probe monobromobimane (mBBr) for reaction with the C151-containing BTB domain. Fluorescence measurements were used to determine the concentration required for 50% inhibition. Separately, reaction kinetics with N-acetyl-L-cysteine (NAC), a model thiol, were measured to determine the observed reaction rates (k_{obs}) of the derivatives. Synthesis produced several isolable aromatic-substituted derivatives and methyl esters, although esterification also yielded acetal derivatives and compounds with differing alkene configurations, highlighting the importance of purification and structural characterization. Biochemical assays revealed differences in cysteine reactivity among the tested derivatives. The methoxy-substituted methyl ester AP-10 F24–26 exhibited an IC_{50} of 0.87 μM and reacted with NAC approximately eight times faster than the corresponding DEAN compound, while AP-3 and AP-5 exhibited IC_{50} values of 0.25 and 0.59 μM, respectively. These findings demonstrate that structural modifications influence both the synthetic outcomes and cysteine reactivity of DEAN Kyn-CKA derivatives, providing insight into structure–reactivity relationships that may guide the development of electrophilic compounds targeting Keap1 C151.

F-53: Synthesis and characterization of 4,4'-dihydroxy-2,2'-bipyridine ruthenium(II) complexes with electron-donating and electron-withdrawing ancillary ligands

Author: Moore, Gavin
Advisor: Dr. Scott Kassel

This work reports the synthesis and characterization of a series of tris-bipyridine substituted ruthenium complexes with one of the bipyridine ligands being 4,4'-dihydroxy-2,2'-bipyridine (4,4'-bpy$(OH)_2$). The other two ancillary ligands have varied substitutions in the 4 and 4' positions to make complexes with the formula $[Ru(N,N\text{-bpy})_2(4,4'\text{-bpy}(OH)_2)]^{2+}$, where *N,N*'-bpy = 4,4'-dimethoxy-2,2'-bipyridine, 4,4'-dichloro-2,2'-bipyridine, and unsubstituted 2,2'-bipyridine. The ancillary ligands have different electron-donating and electron-withdrawing properties which directly impact the

spectroscopic and electrochemical properties of these complexes. In addition, deprotonation of 4,4'-dihydroxy-2,2'-bipyridine provides a further means to modify the electronic properties of the complexes. These complexes were characterized by ^{1}H NMR, IR, and mass spectrometry, UV-visible and photoluminescence spectroscopy, and cyclic voltammetry. The effects of pH on the spectroscopic and electrochemical properties of the isolated complexes will also be presented.

F-54: Synthesis and Characterization of Disubstituted Alkyl- and Aryl- Viologens
Authors: Kubicz, Gregory; Milbourne, Cael; Kassel, Scott; Paul, Jared
Advisors: Dr. Scott Kassel; Dr. Jared Paul

Viologens are disubstituted N,N'-4,4'-bypridine salts widely known for their electron-accepting abilities. Due to their reversibly reducible nature, researchers have studied viologens in energy-storage applications, photocatalysis, and molecular electronics. Substituents have been shown to influence viologen redox behavior; namely, paraquat is a disubstituted methyl viologen designed as an herbicide. Understanding how substituents affect the thermodynamic properties of viologens can lead to classifying a library of compounds with desirable redox behavior. Specifically, this project investigates alkyl viologens containing p-benzyl groups and aryl viologens containing p- and 3,5-phenyl groups, incorporating both electron-donating and electron-withdrawing substituents to determine their influence on reduction thermodynamics. Comparison of their electron-accepting abilities and reduction potentials traces substituent effects on electron-transfer behavior. Thus, the characterization through cyclic voltammetry and spectroelectrochemistry identifies the redox properties of these compounds and how they change depending on substituent influence. UV-visible absorption spectroscopy and photoluminescence measurements provide information about their absorption properties and potential for light-driven electron transfer. Viologen characterization allows for the investigation of the relationship between various substituents and thermodynamic properties, guiding the development of viologen-based systems for photochemical and energy-storage technology.

F-55: Synthesis and Characterization of Salicylaldehyde Diamine Ligands and Zn2+ and Ni2+ Complexes of the Ligands
Author: Gregory, Matthew
Advisor: Dr. Scott Kassel

A series of Salen based ligands and their tetradentate Ni2+ and Zn2+ metal complexes were prepared with varying salicylaldehyde derivatives 4-R-sal-pda, (R = methyl, diethylamino (Et2N), and chlorine) and diamine backbones, (R = 1,2-ethylenediamine (en), 1,2-diaminopropane (pn), 1,2-diphenyl-1,2-ethylenediamine (DPEN), 2,3-diaminomalenitrile (DAM), and 4,5-dimethyl-1,2-benzenediamine (DMPDA)). The goal of the work is to investigate the effects of different backbone structures and salicylaldehyde derivatives on the electronic structure of the associated metal complexes. The 4-Me-sal-R ligands and their metal complexes were characterized by 1H NMR and UV-visible spectroscopy, and electrochemistry. Gaps in the literature were found providing an opportunity to prepare and characterize several new compounds. A comparison of the electronic and structural effects of the salicylaldehyde / diamine framework will be presented.

F-56: Synthesis and Characterization of Substituted Cobalt (III) Terpyridine Compounds

Authors: Carter, Olivia; Kassel, Scott; Paul, Jared
Advisor: Dr. Scott Kassel

The focus of this work is the synthesis and characterization of homoleptic cobalt(III) terpyridine compounds. The ligands were prepared from previously developed methods, combining 2-acetylpyridine and a 4' substituted benzaldehyde to form the 4' substituted phenyl terpyridine complexes. The substituents [H (hydrogen-unsubstituted), Me (methyl), MeO (methoxy), CF_3(trifluoromethyl), F (fluoro), Me_2N (dimethylamino)] were chosen to span a range of electron donating (Me, OMe, Me_2N) and electron withdrawing (CF_3, F) properties. A new method was developed to prepare the cobalt complexes from these ligands using a non-standard cobalt(III) starting material. The compounds were characterized in aqueous and non-aqueous environments using ^{1}HNMR, UV-visible, and photoluminescence spectroscopies and electrochemistry to investigate the range of their electronic properties. Future work will explore the possibility of heteroleptic cobalt (III) terpyridine compounds for use in photocatalysis.

F-57: Synthesis and characterization of tetra-pyridoacridine (tpac) polypyridyl ruthenium (II) complexes with electron-donating and electron-withdrawing groups
Authors: Buettner, Kaja; Kassel, Scott; Paul, Jared
Advisor: Dr. Scott Kassel

Ruthenium-polypyridyl complexes exhibit the ability to efficiently absorb light, making them promising candidates for applications in solar energy conversion, photocatalysis, and chemical biology. The purpose of this work is to probe how ligand electronics control excited state behavior. A series of bimetallic ruthenium complexes were prepared with a tetrapyrido[3,2-a:2,3 c:3,2-h:2,3-j]acridine (tpac) bridging ligand and ancillary 2,2' -bipyridine (bpy) ligands bearing electron donating (methyl) and electron withdrawing (Cl) groups. The isolated complexes were characterized using ^{1}H NMR, UV-visible, and photoluminescence spectroscopy, cyclic voltammetry and spectroelectrochemistry, and mass spectrometry. Insights into excited state dynamics of the complexes will be presented.

F-58: Synthesis of enantioenriched nitrogen heterocycles using chiral auxiliaries
Authors: Sutter, Zach; Sargent, Carter
Advisor: Dr. Matthew O'Reilly

Nitrogen heterocycles have prominent pharmaceutical relevance and are found in therapeutics impacting myriad disease states. Many methods exist toward preparation of piperidines, pyrrolidines, azetidines, and aziridines, but general approaches that access these ring systems with stereocontrol can be limited. Toward broadening the options, development of an approach originating with a tert-butanesulfinimine bearing a terminal alkene could provide a platform for ring closure through halocyclization. Grignard addition to the imine provides access to various substitution options off the imine carbon, and a variety of protecting group strategies were employed to tune the nitrogen for successful halocyclization. The method has been attempted toward the preparation of 3, 4, 5, and 6-atom heterocycles, with various outcomes. Most successful outcomes involved the synthesis of C2,C4-disubstituted azetidines and C2,C5-disubstituted pyrrolidines. These methods provided moderate diastereocontrol (as high as 6:1) to highly enantioenriched heterocyclic products, with the protecting group transformations and halocyclization occurring in yields up to 90%. The larger and smaller ring

systems were problematic, with similar reagents causing unexpected reactivities and/or decomposition. Overall, this synthetic pathway has proven to be very promising and continual development will focus on the different ring sizes and scope of the reactions.

F-59: The substantial shift in the pK_a of KEAP1 sensor cysteine C151 is equally dependent on three surrounding basic residues
Author: Meng, Kerry
Advisor: Dr. Aimee Eggler

Oxidative and electrophilic stress contribute to every chronic disease. The NRF2 transcription factor defends cells against these stressors. The KEAP1 protein represses NRF2 repressor by targeting it for degradation. The KEAP1 BTB domain has a cysteine (C151) electrophile sensor that when modified activates NRF2. Optimization of the KEAP1-NRF2 pathway could lead to treatment for multiple chronic diseases including cancer, diabetes, and arthritis. Simultaneous mutation of three basic residues (K150, K131, R135) near C151 to Met has been demonstrated to cause loss of sensor ability, though the mechanism is unknown. We show that WT BTB C151's pK_a is 6.4 ± 0.1 under minimum salt conditions, resulting in substantially more deprotonated thiol at physiological pH, 7.4, making C151 more available to react with electrophiles. Each of three single mutants (K150M, K131M, R135M) raises C151's pK_a to between 7.5 and 7.7. We hypothesize that all three residues lower C151 pK_a additively under minimum salt conditions. The pK_a was also tested at a higher salt concentration. As expected, the WT BTB pK_a increased to 7.1. Interestingly, K131M and R135M had similar values (7.6, 7.4) to their low salt values, suggesting that under high salt, at most two residues contribute to C151 pK_a. Further testing of double mutants and the triple mutant is in progress to elucidate the precise contributions of residues to stabilize the cysteine thiolate.

Civil and Environmental Engineering

F-60: Lightweight Multi-Sensor Lane Detection and Obstacle Avoidance for an Autonomous F1/10 Vehicle
Authors: Kim, Abigail; Bondoc, Sophia
Advisors: Dr. Arash Tavakoli; Dr. Nathaniel Chodosh

Autonomous vehicles rely on perception systems to navigate safely and respond to changing environments. This project focuses on developing a lightweight, low-cost system for lane detection and obstacle avoidance on an autonomous F1/10 vehicle. The goal is to improve autonomous navigation while maintaining efficient real-time performance. The RoboRacer platform is built on a Traxxas 4x4 chassis and uses an NVIDIA Jetson Orin Nano, LiDAR sensor, VESC motor controller, and servo steering system. ROS 2 connects the hardware and software components and supports vehicle control and testing. The proposed perception system will combine RGB video, depth sensing, and inertial measurement unit (IMU) data to improve environmental awareness. A lightweight vision-language model will also be explored to support lane detection and obstacle avoidance. Our work so far has included configuring the vehicle's hardware and ROS 2 software, establishing manual driving and steering control, and testing autonomous driving in simulation and on the physical vehicle. Initial experiments have explored obstacle avoidance and emergency braking, with wall following also being investigated as an additional navigation method. Future work will focus on developing and evaluating

the multi-sensor perception system, testing lane detection and obstacle avoidance, and assessing the vehicle's ability to navigate safely and reliably in real time.

G-61: The Role of Visual Microscopy in Microplastic Characterization: Complementing Raman Spectroscopy for Environmental Sample Analysis
Authors: Jung, Priscilla; Otto, Juli; Ferry, Catherine; Forgione, Erica; Good, Kelly
Advisor: Dr. Kelly Good

Microplastic characterization in environmental samples is challenging due to contamination introduced during sample collection, processing, and laboratory analysis. This study examines the role of visual microscopy in characterizing suspected microplastics in water samples collected from three sites along the Mohawk River in New York. Visual microscopy was used to count particles and document physical characteristics, including size, shape, color and morphology. These observations revealed recurring particle patterns consistent with potential laboratory contamination, including white and clear particles associated with paper towels, Kimwipes, and rinse bottles, as well and pink and blue fibers associated with the laboratory coats. Suspected contamination accounted for a substantial proportion of visually identified particles and increased the time required for particle characterization. Identifying these patterns through microscopy informed the implementation and reinforcement of laboratory cleanliness and quality assurance/quality control practices. Reducing laboratory contamination was estimated to decrease the overall sample workflow by approximately 16 hours per sample. While subsequent Raman spectroscopy was used to determine particle composition, visual microscopy provided important physical characteristics and contamination patterns that were less readily distinguished through spectroscopy analysis. These findings demonstrate that visual microscopy remains an essential component of microplastic research by supporting contamination identification, improving analytical efficiency, and providing physical efficiency that complements chemical identification techniques.

G-62: Understanding Human Decision-Making in Intersection Design Through Virtual Reality
Author: Neely, Laila
Advisor: Dr. Arash Tavakoli

Intersections are among one of the most safety critical parts of the transportation system. Despite significant advances in intersection design research, the complex relationship between design characteristics and human behavior has received comparatively limited attention. This study investigates how people experience intersections and how design changes may impact perceived safety, comfort, and accessibility for all road users. This project will address that gap by creating an immersive virtual reality framework that allows users to experience and evaluate multiple intersection design alternatives. Leveraging on site photography and field observations, this study first develops a pipeline to create 3D environments from real-world locations within Unity software. The virtual Unity based environment will then be connected to an omnidirectional treadmill equipped with a virtual reality headset so participants can physically walk while navigating the simulated space. The study will test and refine this system to ensure it is comfortable and realistic. Alternative designs of intersections will then be developed based on community input. Volunteers will then use the simulation to walk through different intersection designs, and their movements, decisions, and reactions will be recorded. This

process will help understand how design features influence perceived risk, navigation choices, and overall user experience. By centering human behavior and emotional responses in the design process, this study will provide a proactive, cost-effective framework for evaluating infrastructure before construction and will support more inclusive, equitable, and safer transportation design.

Computing Sciences

G-63: An Evaluation of Adversarial Scenarios in AI-Generated Text Detection
Author: Bellenger, Jake
Advisor: Dr. Maurício Gruppi

Large Language Models (LLMs), such as those powering ChatGPT, have become deeply integrated into daily life. With this, distinguishing human from AI-generated text presents academic, ethical, and security-related issues. While detection software has emerged to discern authentic from inauthentic work, adversarial attacks pose a significant risk to detection accuracy. Adversarial attacks are deliberate changes to inputs, aiming to obscure the nature of the text. Existing literature primarily evaluates detectors on purely AI-generated material rather than modified AI text, leaving a critical gap in understanding real-world detector reliability. To address this gap, our project evaluates four open-source, state-of-the-art detectors—RADAR-Vicuna-7B, HC3-RoBERTa, and fine-tuned BART-base and RoBERTa-base models—against 11 adversarial attacks drawn from the RAID benchmark dataset. We evaluate each model on 1,000 randomly selected AI texts and 1,000 corresponding modified texts per adversarial attack from RAID. Additionally, we replicate RAID's attacks onto the HC3 dataset and perform the same experiment. We measure respective accuracies, aggregate results, and determine that "Homoglyph" (replacing select Roman characters with similar Cyrillic ones) and "Zero-Width Space" attacks (interspersing the text with invisible characters) are the most detrimental to detection. These results demonstrate how slight, sometimes visually imperceptible perturbations may completely change a detector's output—and underscore the importance of character-level normalization in future detectors.

G-64: Are Structural Linguistic Indicators of Media Bias Stable Across Time and Topic?
Author: Vo, James
Advisor: Dr. Maurício Gruppi

Media bias shaped how audiences perceived political, social, and global issues, yet it remained unclear whether measurable linguistic differences between news outlets were stable or dependent on context. This research investigated whether structural linguistic indicators of media bias, including lexical diversity, part-of-speech distributions, and punctuation patterns, remained consistent across time and topic. Building on Phase 1 of this work, which developed computational pipelines to extract linguistic features from large-scale news data and identified measurable stylistic differences across outlets, this study analyzed articles from the NELA-GT dataset. Topics were identified using an online BERTopic pipeline that was implemented to support incremental topic modeling over time, allowing emerging topics to be tracked as new articles were processed. Temporal variation was examined by segmenting articles into time windows and periods of significantly increased media attention based on publication-volume spikes. Features were then aggregated by topic and time period to test whether structural linguistic patterns remained stable across topical domains, temporal contexts, and their interaction. If

these differences persisted, they suggested a consistent stylistic fingerprint associated with outlet bias. If they shifted substantially, they suggested that the observed patterns were more context-dependent than stable properties of how outlets wrote. The findings helped inform the development of more robust and interpretable computational media bias detection systems.

G-65: Mapping Habitats using User Reported Observations
Author: Grosh, Alexander
Advisor: Dr. Maurício Gruppi

Effective habitat conservation begins with knowing where habitats are located. One of the most important resources on habitat locations are ecoregion maps, which map the general ecosystems of an area - this is based on soils, geology, climate, general vegetation and wildlife, and several more biotic and abiotic factors. While accurately showing distinct geographical regions, they give little information as to the specific species that live in each region, and many species distributions seem to not follow the ecoregion boundaries. With the rise of citizen science and the use of apps like iNaturalist to report species sightings, there is the potential for a new type of ecoregion map based entirely on species distribution. The goal of this work is to create a tool that makes a species-based ecoregion map of any state/country that is inputted. This will be done using iNaturalist species data and clustering techniques that focus on how close a given area is to the nearest sighting of a species. Initial testing shows that the species ecoregions vary greatly from the traditional ecoregions, and the hope is that this computational method will offer new quantitative insights into biodiversity and support species conservation efforts.

G-66: Refining Shots Gained in Golf
Author: Taylor, Noah
Advisor: Dr. Nathaniel Chodosh

Measuring skill within golf is difficult due to the unique nature of the game. Almost every shot presents different obstacles, whether that be trees blocking the path to the hole or having to hit off of uneven terrain, so objectively stating that one shot is 'better' than another is challenging. The closest method of trying to do so comes in the form of a metric called shots gained. Devised by Mark Broadie, the metric is described by the formula expected_shots(before) - expected_shots(after) - 1, where expected_shots is a function taking two parameters: the terrain a shot is being hit off of and the distance to the hole (typically in yards). For a given terrain/distance input, an 'expected' number of shots to complete the hole is output based on millions of previous PGA Tour shots. This is calculated for before a shot is hit and for the endpoint of the shot. This metric does not account for terrain between the shot and the hole – hitting from the fairway over a large lake is much more challenging than hitting from the fairway without any obstacles. As a result, another parameter to the expected_shots function was added with the intention of improving the metric for short shots (within 100 yards of the hole) with many obstacles between the shot location and the hole. After experimenting with several different options, it was found that taking a 10 degree cone distribution of the terrain between the shot and the hole produced the best results.

G-67: Temporal Analysis of Named Entity Connectivity and Influence in News Corpora
Author: Brownell, Adam

Advisor: Dr. Maurício Gruppi

Named-Entity Recognition (NER) allows the extraction of entities—including individuals, objects, and locations—from large, unstructured collections of data. This study aims to explore how centrality between named entities evolves in news corpora, determining if centrality represents major news events or can predict trends of influential actors. Entities are extracted through NER and natural language processing tools and are then implemented into a network graph as nodes with graph-modeling software. Relationships and word-proximity determine connectivity, identifying central nodes within the developed network graph. Additionally, by comparing temporal snapshots, identifiable changes in connectivity are documented over time, demonstrating community evolution and the potential emergence of central entities. In conclusion, the results of this research demonstrate how the combination of large-scale named-entity extraction and network graph analysis uncovers temporal trends and influence in entities. Capitalizing upon this, this approach provides a scalable method to identify temporal patterns and develop scalable frameworks of how real-world objects shape and define one another.

G-68: Understanding Dorm Room Accessibility: An Opportunity for Smart Technology
Author: Baker, Ambyr
Advisor: Dr. Sarah Cooney

As institutions of higher education seek to improve accessibility and inclusion, there remains a gap between students' lived experiences of dorm accessibility and the technological solutions available in campus housing. This study investigates the challenges college students encounter in on-campus dormitories to inform the design of future assistive technologies. Particular attention is given to students with disabilities, temporary injuries, and other individual needs. This research centers student perspectives to better understand lived experiences within university housing. An anonymous survey of Villanova University students and alumni examines how barriers in residential environments affect students' daily lives and identifies opportunities for technological assistance. A literature review explores historical barriers in higher education and existing technological approaches to inclusive living environments. Findings from both components will inform the proposed design of a low-cost smart dorm room incorporating Internet of Things (IoT) technologies, embedded sensors, and automated environmental controls. The proposed system will explore opportunities to improve students' interactions with physical features of their living spaces. By integrating student experiences with research on assistive technologies, this study aims to identify practical approaches to residential accessibility that promote autonomy and inclusion.

Electrical and Computer Engineering

G-69: A Fully Open-Source 900 MHz Low-Noise Amplifier in 180 nm CMOS
Authors: Parra, Andrew; Burnett, David
Advisor: Dr. David Burnett

Open-source process design kits enable fully reproducible integrated circuit designs, yet open-source design flows remain largely focused on digital circuits, and analog and RF reference designs are scarce. This work addresses that gap by designing a complete 900 MHz superheterodyne receiver in the

GlobalFoundries GF180MCU 180 nm CMOS process, developed entirely with open-source tools. Schematics are drawn in Xschem to generate netlists, simulated in Qucs-S with ngspice, and laid out in KLayout. In simulation, the LNA achieves 20 dB of gain at 907 MHz with a 3 dB bandwidth of 230 MHz, drawing 5.3 mA from a 3.3 V supply. Post-layout verification is in progress. This block will be part of a complete receiver chain including LNA, mixer, local oscillator, IF amplifier and filter, analog-to-digital converter, and digital demodulator. Future work will redesign the receiver in Yokogawa's Minimal Fab, a rapid-prototyping semiconductor process, to enable quick-turnaround fabrication and physical verification.

G-70: Efficient Hardware Acceleration of the Number Theoretic Transform for NIST-Selected Post-Quantum Cryptography Scheme ML-DSA

Author: Corjuc, Zachary
Advisor: Dr. Jiafeng Xie

Recent developments in quantum computing technology have highlighted vulnerabilities in existing public-key cryptosystems. Module-Lattice-Based Digital Signature Algorithm (ML-DSA) is a DSA that NIST has approved for standardization due to its theoretical security against quantum computers. A significant bottleneck in hardware implementations of ML-DSA is polynomial multiplication over a quotient ring. One of the most effective methods for performing the negacyclic convolution is the utilization of the Number Theoretic Transform (NTT). Two primary architectures of implementing the transform exist: parallel (all stage calculations performed in parallel, butterflies reused across stages) and pipelined (sequential calculations, one butterfly unit per stage). The presented design is a partial-parallel design, computing the NTT calculations of each stage with a limited number of butterfly units. Additionally, the proposed architecture utilizes a radix-2 configuration, which is commonly pursued due to its basic butterfly unit and ability to be implemented via a simple memory access pattern. The proposed design is simple, featuring a single radix-2 butterfly, DRAM-stored twiddles (reused for inverse NTT) and 2 BRAMs for coefficient storage. However, improvements can be made, notably through a greater parallelization of butterfly calculations, less calculation-intensive memory access pattern and more efficient modular multiplication algorithm.

H-71: Intelligent Channel Selection in Crowded Spectral Environments via Pessimistic Collision Extrapolation

Authors: Rich, Ava; Burnett, David
Advisor: Dr. David Burnett

This research addresses interference in crowded 2.4 GHz wireless environments by developing adaptive algorithms that improve channel selection for low-power Internet of Things wireless devices. The Pessimistic Collision Extrapolation (PCE) algorithm estimates future interference by partitioning observed data into fixed 1-minute segments, identifying the segment with the highest collision rate, and extrapolating that worst-case rate forward. Rather than assuming future conditions mirror a historical average, PCE deliberately overestimates interference to avoid selecting channels that experience damaging bursts, achieving a 9.5% reduction in mean absolute prediction error over a naive baseline. Two enhancements extend this foundation. Rolling retraining replaces the original one-shot decision with updates every five minutes using a sliding window of recent observations, allowing the algorithm to adapt as conditions evolve. Dynamic chunk sizing alters the fixed 1-minute segment length by evaluating five candidate sizes (20s, 30s, 1 minute, 2 minutes, 5 minutes) at each update,

splitting the 10-minute training window in half and selecting whichever size best predicted the second half from the first. Across 264 retraining decisions spanning a 23-hour dataset, dynamic chunk sizing reduced mean absolute prediction error by 55.2% compared to the fixed-chunk approach, demonstrating that adaptive calibration improves interference forecasting in congested networks.

H-72: Transmission Time Shift (TTS): An Intelligent Approach to Collision Reduction in Congested Wireless Environments
Authors: Grande, Vivianna; Burnett, David
Advisor: Dr. David Burnett

Wireless communication is increasingly worsened in crowded environments, where thousands of devices compete for limited spectrum resources along the 2.4 GHz ISM band. Although such environments are often assumed to yield very poor wireless performance, recent measurements suggest that opportunities still exist for reliable communication in low-power Internet-of-Things devices. This research investigates the intelligent Transmission Time Shift (TTS) algorithm, which seeks to exploit these opportunities to improve wireless performance in highly congested settings by adapting transmission timing based on short-term collision estimates, reducing predicted interference events by 10.9% compared to default timeline of one packet exchange every 10 seconds. This supports the prospect of live collision detection methodology that can be implemented into online wireless systems, dynamically adjusting transmission timing and channel selection in response to real-time spectral observations across multiple devices to enable more resilient communication in increasingly dense spectral environments.

Geography and the Environment

H-73: Examining the Social and Geographic Predictors of Exotic Pet Expo Distribution
Author: Arcuri, Paolo
Advisor: Dr. Ryan Almeida

The commercial trade of exotic animals within the pet industry is a widespread activity that has implications for biodiversity and conservation of native species. Within the United States, the trade of exotic reptile and amphibian species is influenced by geographical climate, socio-economic trends, and demographic patterns while being regulated by state and federal laws. Although much of this trade is done legally, it raises conservation concerns related to the risk of overexploitation of wild populations, the introduction of invasive species, and the transmission of zoonotic pathogens to native populations. Reptile and amphibian expositions are key locations where consumers, hobbyists, and commercial vendors gather to display, buy, and sell exotic pets. Little research has examined the factors influencing expo density, like government restrictions on trade and local exposure to herp populations. This poster will examine the distribution of reptile and amphibian trade shows across the United States from 2022 through 2026 to investigate the relationship between the density of these expos and local exposure to reptiles and amphibians, government regulations on trade, and other socio-demographic patterns. By identifying spatial patterns in the exotic pet trade, and evaluating the factors associated with these patterns, this poster aims to improve understanding of the social and environmental conditions underlying the industry's distribution. The findings may help identify areas of further investigation,

including exposition hotspots in West Virginia or herp-rich states like Texas, and inform future monitoring and conservation efforts.

H-74: Historical Chromium Deposition and Speciation Across Tidal Wetlands of the Delaware River Estuary
Author: Bennett, Casey
Advisor: Dr. Nathaniel Weston

Historical industrial activity has contributed to substantial chromium contamination in the Delaware River Estuary. However, its long-term accumulation, speciation, and geochemical controls in the estuary's tidal wetlands remain largely unknown. This study investigates historical chromium accumulation and speciation across six tidal wetlands along the Delaware River, spanning urban-to-rural and freshwater-to-saline gradients. A sediment core was collected at each site, and lead-210 (^{210}Pb) radiometric dating was used to establish sediment chronologies. Total chromium concentrations were quantified using inductively coupled plasma mass spectrometry, while hexavalent chromium (Cr(VI)) was quantified using UV-Vis spectroscopy. Particle size, organic matter content, pH, and redox potential were also analyzed to evaluate their potential influence on chromium speciation. Preliminary results from Big Timber Creek, a freshwater site near Philadelphia, reveal consistently elevated Cr(VI) concentrations throughout the sediment core chronology, despite geochemical conditions indicative of an overall reducing environment. If similar trends are observed at the remaining sites, it would suggest that Cr(VI) may persist in wetland sediments under reducing conditions and be enhanced in oxidizing conditions.

H-75: Incentives for Sustainable Gardening Practices Across the United States
Authors: Wang, Eliana; McLaughlin, Eileen; Shakya, Kabindra
Advisor: Dr. Kabindra Shakya

Turfgrass lawns are often seen as status symbols and a cultural norm in the United States. However, their maintenance is unsustainable because, compared with native vegetation, non-native turfgrasses sequester less carbon, require more water and chemical inputs, and support less biodiversity. In drier regions, outdoor irrigation can strain local water supplies. To address local environmental problems, many programs across the United States are encouraging homeowners and communities to adopt sustainable landscaping and gardening practices in lawns and green spaces. Sustainable landscaping reduces water consumption and runoff. Sustainable gardening integrates native plant species, uses organic practices, provides wildlife habitats, and promotes biodiversity. Popularizing these practices can reduce the harmful environmental impacts of turfgrass lawns and help combat climate change on a broader scale. To understand how sustainable gardening programs can address local environmental concerns, we compiled 255 programs in the United States to identify their objectives and how they incentivize target audiences to adopt them. We found almost half of the programs offer financial incentives in the form of rebates or grants. Climate challenges shaped some trends in objectives; for example, water conservation is a main objective in drier regions. These findings can serve as a reference for cities, counties, and organizations looking to launch sustainable landscaping or gardening programs.

H-76: Quantifying Tidal-Current Asymmetry and Impacts on Material Transport in the Plum Island Estuary, Massachusetts, USA.

Authors: Hall, Siena; Weston, Nathaniel; Johnson, Erin
Advisor: Dr. Nathaniel Weston

In this study, we investigated tidal-current asymmetry in the Plum Island estuarine system in Massachusetts, USA. Tidal salt marshes are coastal ecosystems that protect shorelines, improve water quality, sequester carbon, and provide wildlife habitat. They rely on sufficient sediment supply to maintain elevation relative to sea-level rise. The velocity of estuarine water flow during flood and ebb tides is important in suspended sediment dynamics within estuarine systems. The purpose of this study was to investigate how tidal-current asymmetry influences patterns of suspended sediment concentration and net sediment flux. Tidal-current asymmetry is defined as differences in the velocity of tidal flow across the estuarine system between flood and ebb tides. We assessed the strength and structure of tidal flow in cross-sectional transects across the mouth of Plum Island Sound during full tidal cycles using an acoustic doppler current profiler. We collected water samples at several locations and depths to correlate water velocity with suspended sediment concentration through each tidal cycle. We observe clear tidal-current asymmetry, with stronger asymmetry on the ebb tide. Tidal asymmetry was also observed to increase through each tidal period, reaching maximum asymmetry just before the subsequent high or low tide. Along with suspended sediment concentration measurements, these measurements will demonstrate how net sediment exchange and availability is regulated between marshes and the coastal ocean. Quantifying tidal-current asymmetry improves our understanding of the transport of sediment within estuaries, marsh accretion potential, and the long-term resilience of coastal wetlands to sea level rise.

H-77: Storm- Driven Mobilization of Anthropogenic Litter in Urban Stream Systems

Authors: Nearpass, Catherine; Diaz-Santana Gaytan, Federico; Salanitri, Nicholas; Conly, Ken; Henderson, Keith; Goldsmith, Steven
Advisor: Dr. Steven Goldsmith

Rivers play a critical role in transporting anthropogenic litter (AL), including macroplastics (> 5mm in diameter), from land-based sources to the ocean. However, recent studies have suggested that most of this material introduced to watersheds is retained and broken down into microplastics, which can be easily ingested by aquatic organisms or enter the water supply. For example, macroplastics and other forms of AL are typically transported in streams during high-flow (e.g., storm) events and can be entangled in riparian vegetation. While some studies have used video cameras to determine the amount of AL transported in a river system during a storm event, this approach does not capture the material sequestered or dislodged from riparian zones. The Wissahickon watershed (164.92 km^2) in Philadelphia, PA, experiences a disproportionately high amount of AL pollution. However, it's currently unknown how much AL pollution is transported from the watershed during storm events. This study used a combined approach of GoPro™ cameras deployed during storm events and mass-balance sampling within the adjacent floodplains before and after to provide one of the most accurate delineations of AL transport in river systems to date. All visible debris items within each river segment, and observed during each storm event, were counted and categorized via the NOAA Marine Debris Checklist to determine the relative influence of AL sources. The results of this experiment help to inform litter intervention strategies in upstream areas and cleanup events associated with riparian areas.

H-78: The biological traits that help explain the relationship between the wildlife trade and reptile invasion.

Author: Leonardis, Matthew
Advisor: Dr. Ryan Almeida

The wildlife trade ships reptiles all over the world, making the pet trade a huge threat to biodiversity, specifically through the introduction of invasive species. All reptiles have biological traits that are molded by their native environment, but when these species are introduced to non-native ecosystems, these same traits can hurt or help them survive in a new place. The traits that this study focuses on are body size, temperature and precipitation seasonality, diet, and number of native habitat types. Reptiles can also be more or less likely to be traded based on these same biological traits. The link between biological traits and trade prevalence is well studied. However, the link between biological traits, prevalence in the pet trade, and the trend that these traits make a species more likely to become invasive is a logical next step that has yet to be studied. To study this link, this study used national, government data and data collected in person at regional exotic pet stores and expos in the mid-Atlantic region near Philadelphia. These data sets combined gave us 12,060 reptile species that had biological trait data. 1740 of these species were determined to be in the wildlife trade. 198 of these species were determined to be invasive globally using data from Capinha et al.'s data on invasive reptiles and amphibians. Using these data sets, we were able to run statistical models demonstrating the relationships between traded biological traits and invasive biological traits.

H-79: The Dirt on Microplastics: Microplastic storage in riverbed sediments in the Darby-Cobbs Creek Watershed, Philadelphia, Pennsylvania

Authors: Diaz-Santana Gaytan, Federico; Nearpass, Catherine; Salanitri, Nicholas; Goldsmith, Steven
Advisor: Dr. Ryan Almeida

Rivers are an important delivery system for microplastics (MPs; < 5mm in diameter) to coastal areas. However, some MPs can be left behind during transport in riverbed sediments. Once deposited in sediments, these MPs can chemically degrade and leach harmful chemicals into the environment, including metals, phthalates, and bisphenols. These contaminants can then be incorporated into ecosystems and our water supply. Despite these environmental health risks, few studies have examined watershed-scale controls on the delivery and storage of MPs in riverbed sediments. This investigation analyzes the relationship between impervious surface cover (ISC) and MP concentration and character in riverbed sediments in a watershed that traverses a rural to urban gradient. In Summer 2026, 18 samples of riverbed samples were collected from the Darby-Cobbs Creek Watershed in the greater Philadelphia area. Samples were collected from the watershed. Samples were pre-treated with 10% H2O2 and followed by three sequential density separations in a 0.35 g mL NaCl solution. The resulting supernatant was filtered through 0.45µm polycarbonate filter and analyzed using a stereomicroscope. MP concentrations and character were compared to the relative ISC in the upstream area using GIS analysis. Additionally, the study results were placed in the context of the existing literature for MPs in streambed sediments as well as the results of a previously collected sediment core from the mouth of the watershed. The study results provide insights into the source and distribution of MPs in freshwater systems.

H-80: Understanding Nitrogen Fixation of Intertidal sediments in the Plum Island Estuary, Massachusetts.

Authors: Kurtz, Liam; Weston, Nathaniel; Johnson, Erin
Advisor: Dr. Nathaniel Weston

Nitrogen is a crucial nutrient in a coastal mash system such as the Plum Island Ecosystem. Over multiple decades, this site has been studied for a variety of different nutrients and processes but there is still a large quantity of nitrogen in the system that is unaccounted for. Previously, another researcher discovered that the heterotrophic nitrogen fixation of both high and low elevation marshes accounts for about 2.2 g N m-2 yr-1, accounting for roughly half of the unknown budget. This study attempts to further narrow down the unknown nitrogen budget by quantifying the heterotrophic nitrogen fixation of intertidal sediments within the marsh ecosystem. We determined rates of nitrogen fixation by incubating 4 cores each at 11 sites in various locations around the system. We incubated 2 cores from each site in a light incubation and 2 cores from each site in a dark incubation. We used the acetylene reduction activity to quantify the amount of nitrogen fixation that was happening at each site. We also did a photosynthesis test to see if there are any other signs of activity within our sediment samples. After doing these incubations in May and July of 2026 we found that while the intertidal sediment is fixating nitrogen, it is not fixating enough nitrogen to make a huge difference in the unknown part of the nitrogen budget. However, we have seen slight seasonal variations in nitrogen fixation between spring and summer.

Hematology/Oncology

I-81: Investigating the role of SETD2's modulation of p53.

Author: Caccavelli, Dominic
Advisor: Dr. Frank Mason (Vanderbilt University Medical Center)

SETD2 is a histone methyltransferase that deposits the H3K36me3 mark and contributes to active transcription, alternative splicing, and DNA damage repair through homologous recombination. SETD2 is frequently mutated in clear cell renal cell carcinoma and has been reported to be required to activate the tumor suppressor p53 in human osteosarcoma cells. However, it remains unclear whether SETD2 regulates p53 in non-cancerous cells and whether it does so through H3K36me3 or a more direct mechanism. To address this, we depleted or inhibited SETD2 in wild-type human retinal pigment epithelial (WT RPE) cells for either 1 hour, a window too short for loss of H3K36me3 and designed to reveal direct, mark-independent effects, or 72 hours, to test the effect of losing the epigenetic mark. SETD2 was targeted by dTAG degradation or by EPZ catalytic-site inhibition. Cells were then treated for 6 hours with nutlin or the DNA double-strand break inducer camptothecin to activate p53. Western blotting for downstream effector p21 and total p53 showed that p21 induction depended only on the presence of the p53 activator and was unaffected by SETD2 loss at either time point, and total p53 did not differ by SETD2 status. These results suggest that SETD2 is not required for p53 pathway activation in RPE cells, in contrast to prior findings in osteosarcoma cells, and raise the possibility that the SETD2-p53 relationship is cell-type dependent. Future work will compare this pathway in cancerous and non-cancerous cell types.

Mathematics and Statistics

I-82: Mathematically Modeling Environmental Pathways in Community-Associated Infection
Authors: Weidemann, Ricky; Dickinson, Leyla; Wood, Nicole
Advisor: Dr. Cara Sulyok

Clostridioides difficile is a bacterium that is one of the leading causes of infectious diarrhea and remains a major public health concern. While mathematical models have been widely used to study *C. difficile* transmission in healthcare settings, less work has addressed community spread, particularly through environmental exposure and pathogen transport between public and domestic spaces. This work develops an ordinary differential equations model to investigate community-level transmission of *C. difficile*, focusing on environmentally-mediated pathways. Our model extends the classical SIR framework by incorporating spore densities on public, transitional, and household surfaces, capturing movement and accumulation within each location. Global sensitivity analyses were performed to identify the most influential parameters on incidence of colonization, and simulations were used to evaluate the relative contributions of transmission pathways. By clarifying how *C. difficile* may spread through a community, this work provides a foundation for interventions aimed at reducing community-acquired infections and protecting vulnerable populations, including individuals taking antibiotics and older adults. This work highlights high-impact intervention points, targeting environmental and behavioral factors that inform practical, low-cost mitigation strategies to reduce community-acquired infections.

Mechanical Engineering

I-83: F1 Tenth Racing
Authors: Lange, Mason; Janos, Rachael
Advisor: Dr. Stephen McGill

Autonomous vehicles have to sense their surroundings, make decisions, and control their motion in real time, often at high speed and with little margin for error. RoboRacer (formerly F1TENTH) is an open-source, 1/10-scale autonomous racing platform. Since 2016 it has been used in university courses and in an international competition series, which makes it an accessible testbed for autonomy research. In this project, we built a RoboRacer vehicle from the ground up. We assembled the chassis and integrated its sensors and onboard computer, then configured the software and driver stack so that each part communicated reliably. We validated the vehicle under manual teleoperation and made initial attempts at autonomous driving, recording the hardware and software problems that affect real-world deployment. Building on this foundation, we are now developing autonomous navigation algorithms in the f1tenth_gym simulator, which will let us test control and planning strategies safely before deploying them on the physical car. This work gives us a validated hardware and software platform and a clear path from simulation to on-vehicle autonomy.

I-84: Mobile Manipulation
Authors: Nerrow, Harold; Whitticom, James

Advisor: Dr. Stephen McGill

Mobile manipulation refers to a robotic system that has two major components: a robot that may or may not be autonomous (mobile) and an articulated robotic arm (manipulator). The Husarion Panther is a high-mobility outdoor robotic platform that provides the rugged base required to transport and stabilize the robotic manipulator across diverse environments. The Robotis OpenMANIPULATOR-PRO is a high-performance robotic arm featuring a modular design and professional-grade actuators that allow for precise multi-axis movement and physical interaction with objects. To complete the Mobile Manipulation project, documentation for setup was followed stemming heavily from the Robotis OpenMANIPULATOR-Pro electronic manual and the Husarion Panther electronic manual. Specific results included physical manipulation of the Robotis OpenMANIPULATOR-Pro through inverse kinematic systems, generation of specifically desired motion packages to be stored and called for the OpenMANIPULATOR-Pro, and physical manipulation of the Husarion Panther bot using a Logitech gamepad with off-road and mecanum wheels. Prior to this project, neither student had coded in Python or worked with robotic systems. There were many obstacles along the way, particularly with the need for using older software such as ROS Noetic rather than any ROS 2 due to compatibility issues. However, through processes of trial and error, self-research, guidance from others, and artificial intelligence, both students were able to develop their abilities and accomplish the intended goals. Overall, the students attribute the yearlong project as a valuable learning experience and introduction to robotics.

I-85: Software Tool Development to Promote Sustainable Practices by the Controlled Environment Agriculture Industry
Author: Miller, Eden
Advisor: Dr. Aaron Wemhoff

Controlled Environment Agriculture (CEA) systems offer benefits such as year-round crop production and increased yields but require significant energy and water resources. As the industry expands, accessible tools are needed to evaluate and improve the environmental sustainability of these systems. This project focused on expanding an existing MATLAB-based calculator, previously limited to a single geographic location and crop type, into a more flexible, Python-based web application applicable across the United States. The application was developed using Python, providing an interactive interface that allows users to select geographic location, greenhouse dimensions, and crop type. It calculates five key sustainability metrics: total energy consumption, total water usage, carbon footprint, water scarcity footprint, and Scope 1 and 2 water footprints. Climate inputs were obtained from the National Renewable Energy Laboratory's NSRDB TMY3 dataset, incorporating hourly solar radiation, dry-bulb temperature, and relative humidity data. 15 U.S. cities were selected to represent the ASHRAE climate zones. Additionally, crop-specific parameters for ten crops were compiled from horticultural literature, including irrigation rates, stomatal resistance, and photosynthetic photon flux targets. Preliminary results demonstrate that energy consumption generally decreases as climate zones become colder, while water loss through evaporation also tends to decrease. However, comparisons between cities indicate that temperature alone does not explain differences in resource consumption. Regional aridity and annual precipitation also influence energy and water demands. Overall, this application provides an accessible tool for evaluating how geographic, climatic, and operational factors affect CEA sustainability and supports more informed decisions to improve resource efficiency and reduce environmental impacts.

I-86: Structural Health Monitoring in Aircraft Structures Through Ultrasonic Guided Wave Analysis

Author: Colocho, Amos
Advisor: Dr. Sridhar Santhanam

Aircraft structures experience significant fatigue during service, which is why frequent inspection and maintenance are essential to ensure safety. However, many defects, such as small cracks around bonded joints, are difficult to detect through routine visual inspection. To address this challenge, Structural Health Monitoring (SHM) is used for more consistent and reliable defect detection. This research focuses on using ultrasonic guided waves to detect and characterize defects within aluminum lap joints. Guided waves are transmitted and received across the bonded interface, and their reflections and transmissions are analyzed to understand how damage can influence wave behavior. Signal processing techniques are used to interpret data received from the guided wave and applied to identify features associated with defects within the lap joint. Experimental data is compared with Abaqus/FEA simulations to observe patterns linked to edge reflections and interfacial damage. These comparisons can provide insight into how guided waves interact with adhesive layers, supporting their use for defect detection. Future work will include the use of machine learning models to classify defect types based on signal features. Additionally, exploring alternative bonding configurations to study how joint composition can affect detectability. Overall, this research advances non-destructive testing and develops a data-driven SHM system to aim for long-term structural reliability for aircraft structures.

I-87: Unlocking the Potential of Hydrogen: Tackling Pipeline Challenges

Author: Nguyen, Khoi
Advisor: Dr. Andrew Lee

Hydrogen could play a key role in cleaner energy, but its use in steel pipes poses a major challenge. When hydrogen enters steel, it can weaken the metal and cause premature failure, a process known as hydrogen embrittlement. To help study this risk, this project designed and built a low-cost, modular tensile testing stage with 3D-printed parts and a built-in chamber for electrochemical hydrogen charging. Unlike standard tensile tests that use steel charged before testing, this stage can also charge a sample as it is stretched. This allows the steel to remain exposed to hydrogen during loading and helps limit hydrogen loss between charging and testing. The stage uses a motor to apply load, a load cell to measure force, and Python code to run tests and calculate displacement from motor rotation. These data are used to plot stress-strain curves and compare steel tested with and without hydrogen exposure. Following assembly, the tensile stage was successfully tested and validated through preliminary trials. Results showed a clear reduction in peak tensile stress for hydrogen-charged specimens, consistent with the expected effects of hydrogen embrittlement. The completed design and documentation were shared with Gu's Lab at Stanford University, where the tensile stage has been replicated to support further research and development. By pairing in-situ charging with an affordable, modular, and simple test setup, this project offers a practical research tool for future studies of steel under hydrogen exposure and can support research on safer hydrogen transport and storage.

Medicine and Pathology, Microbiology and Immunology

I-88: Investigating *SNX4* in Trastuzumab-Deruxtecan Resistance in HER2+ Breast Cancer

Authors: Park, Sophia; Steele, Julia; Wilander, Ben; Balko, Justin
Advisor: Dr. Justin Balko (Vanderbilt-Ingram Cancer Center)

Breast cancer is the most prevalent cancer diagnosis for women globally, with around two million new patients diagnosed each year. In around fourteen percent of all breast cancers, there is an upregulation of human epidermal growth factor receptor 2 (HER2), a trans membranous receptor responsible for cell growth and division. Previously, researchers developed an antibody-drug conjugate, trastuzumab deruxtucan (T-DXd), also known as Enhertu®, which recognizes HER2+ tumor cells and releases DNA replication inhibitors to stop tumor proliferation. While this method has shown clinical promise, patients can still develop T-DXd resistance over time and have cancer recurrence, though the mechanisms behind drug resistance remain unknown. To investigate this problem, the Balko lab engineered HER2^{x} , a novel tumor receptor which recognizes and binds T-DXd *in vivo* mouse models. When treated with T-DXd, around two-thirds of HER2^{x} tumor-bearing mice experienced full or partial tumor regression. Mice with tumor regrowth during treatment were studied for genetic mutations. Using whole exome sequencing, we identified a single nucleotide polymorphism in the gene, sorting nexin 4, *SNX4*. This gene has been previously implicated in endocytic recycling but remains largely unstudied in cancer biology. In this project, we investigate the role of *SNX4* in T-DXd resistance.

Nursing

I-89: Long Term Health Effects of Prematurity

Authors: Kelly, Michelle; King, Kathryn; Ng, Caitlyn; Ingledow, Lauren; Brace, Margaret
Advisor: Dr. Michelle Kelly

Background: The preterm birth rate in the United States (US) has remained roughly 10% for the last 3 decades while preterm birth survival has steadily increased to approximately 95% for all but the smallest/youngest of infants. This means that all healthcare teams, regardless of population age or specialty are caring for people born preterm. Much of the preterm adult health outcomes literature is based on non-US countries with national birth registries. Purpose: The purpose of this study was to explore the health experience and outcomes of adults born preterm. Methods: Using community-based participatory research principles, an electronic survey was developed for an international audience with the assistance of an adult born preterm advocacy group. A convenience sample of English speaking participants over 18 years of age, and born < 37 weeks of gestation. In addition to demographics, participants were asked if their health was an ongoing concern, experienced chronic conditions or symptoms, used medications and if they attributed their health to being born early. Descriptive and inferential statistics were conducted. Results: The sample (N=80) consisted of adults with a mean age of 40 (SD 12.3), mostly from the US (69%) and born less than 32 weeks of gestation (78%). Health was an ongoing concern, with 86% reporting having chronic conditions and 75% taking medications to treat those conditions. A significant difference based on gestational age was found for

having a chronic condition with 92% born <32 weeks, compared to 63% of those born >32 weeks (p=.008). Sixty-seven percent of participants were never asked if they were born preterm. Additional results include the most common types of chronic conditions and medications used. Conclusions / Implications: This sample provides further support for the importance of preterm birth as a contributor to lifelong chronic health conditions and the need for healthcare teams to incorporate this history into symptom management and treatment.

I-90: When Caring Becomes Personal: A Secondary Analysis of Family-Based Countertransference in Emergency Nursing

Author: Lopez, Lana
Advisor: Dr. Elizabeth Dowdell

Background: Emergency nurses routinely care for patients in trauma and crisis. These encounters can become emotionally challenging when nurses see parallels with their own family or history. Purpose: To explore how emergency nurses describe patients with similarities to family members and how this shapes their perspectives and emotional responses. Methods: Secondary analysis of transcripts from 53 full-time registered nurses in an urban Level I trauma center emergency department. Braun and Clarke's six-step thematic analysis was used. Codes on family-based identification, emotional responses, personal experiences, and emotional regulation were grouped into themes, refined through discussion with a faculty mentor. Results: Four themes emerged: (1) identification of patients with family members, (2) emotional burden and psychological impact on nurses, (3) personal experiences shaping empathy and judgment, and (4) self-awareness and regulation of countertransference. Nurses described seeing their children, siblings, and parents in patients, leading to grief, crying, intrusive memories, and sleep difficulty. Personal experiences with addiction and trauma increased empathy and reduced judgment. Nurses consciously "checked" themselves to separate personal emotions from patient care. Conclusions and Implications: Countertransference can positively and negatively affect emergency nurses. Personal experiences may increase empathy and patient-centered care but also contribute to emotional exhaustion. Greater awareness may support nurse wellbeing and compassionate care.

Philosophy

J-91: Investigating the Causes and Barriers to Food Insecurity Screening and Closed-Loop Referral in Pennsylvania Pediatric Dental Offices

Authors: English, Eileen; Napier, Stephen
Advisor: Dr. Stephen Napier

Pediatric food insecurity significantly elevates the risk for early childhood caries, yet structured nutritional screening remains largely absent from routine dental practice. This ongoing pilot study investigates screening behaviors, workflow barriers, and referral familiarity among pediatric oral healthcare providers in Pennsylvania. Preliminary analysis of an initial cohort reveals strong clinical awareness of the caries–nutrition link, contrasted by persistent operational obstacles: chairside time constraints, administrative bandwidth, and an absence of standardized referral pathways to food assistance programs (SNAP/WIC). To address these clinical gaps, we outline an evolving chairside screening and referral framework, informed by initial provider input, designed to integrate non-

stigmatizing screening into routine visits. Active survey dissemination remains open to expand sample size toward N=25 with findings directly informing an adaptable toolkit for clinical practice.

Physics

J-92: Characterizing Blazar Variability Using Recurrence Analysis of TESS Light Curves
Authors: Delyani, Devin; Phillipson, Rebecca
Advisor: Dr. Rebecca Phillipson

Blazars are a class of AGN powered by supermassive black holes that launch relativistic jets aligned with the observer's line of sight. Their extreme variability across the electromagnetic spectrum provides a unique probe of jet physics and black hole accretion, but the physical origin of this variability remains poorly understood. It is unclear whether the two broad sub-classes of blazars, flat-spectrum radio quasars (FSRQs) and BL Lacertae objects (BLLs), exhibit distinct variability behaviors that reflect different accretion states and jet–disk configurations. In this study, we analyze optical light curves from the Transiting Exoplanet Survey Satellite (TESS) full-frame images for a sample of 358 blazars. We extract light curves using the Quaver pipeline and analyze their variability using recurrence analysis, a nonlinear time-series technique that recognizes recurring dynamical patterns. We present a comparison of the recurrence plots across blazar subclasses to pinpoint systematic differences in variability patterns that indicate distinctions in the underlying physical mechanisms. The results of this study can provide new insight into the physical drivers of blazar variability, while testing recurrence analysis as a diagnostic tool for distinguishing accretion states in stochastic systems.

J-93: Investigating the Intrinsic Variability in the Obscured State of GRS 1915+105
Authors: Landry, Blanche; Philipson, Rebecca
Advisor: Dr. Rebecca Philipson

X-ray binaries (XRBs) are systems in which a black hole or neutron star accretes matter from a companion star, producing bright and highly variable X-ray emission. Changes in these systems' light curves provide information about accretion physics in strong gravitational fields. One of the most dramatic examples of this is GRS 1915+105, a black hole system known for extreme variability and multiple dynamic accretion states. In 2018, this system entered an unusual low flux or "obscured" state that differed significantly from its historical behavior, in both overall luminosity and its energy spectrum. In this study, we investigate whether the dynamical structure of GRS 1915+105's variability changed during this event. We construct recurrence plots from the light curves of archival NICER observations of the source before and during its obscured state to analyze how the recurrence structure (a probe of the underlying dynamical system) changed. This investigation will provide us a picture of the physical nature of the low-flux episode of GRS 1915+105, and a framework for connecting the intrinsic variability of low-luminosity states to the accretion environment in XRBs more broadly.

J-94: Probing the Mo^{5+} Magnetic Environment in Ba_2YMoO_6 via Gd^{3+}-Tracer Broadband EPR
Authors: Colgan, Patrick; Solodovnyk, Artur; Carlo, Jeremy; Dietrich, Scott
Advisor: Dr. Scott Dietrich

Double perovskites have emerged as a highly promising material family in quantum information systems (QIS) as a platform for various types of qubits. In particular, Ba2YMoO6 has garnered considerable interest due to its frustrated magnetic behavior of the Mo5+ spins on a face-centered-cubic sublattice of edge-sharing tetrahedra. Frustration leads to a valence bond glass state at low temperatures where Mo spins form dimers while leaving behind a small percentage of unpaired orphan spins. While both the orphan spins and the dimers are qubit candidates, a better understanding of the magnetic Mo environment is needed for them to be realized in QIS applications. Thus, we study the density and collective magnetic properties of orphan spins via electron paramagnetic resonance (EPR). We use broadband transmission EPR measurements over a frequency range 0.1-18 GHz to get a detailed picture of the magnetic environment. This increased spectral information comes at the cost of a loss in sensitivity compared to cavity EPR. To overcome this limitation, we study the doped compound Ba2Y1-xGdxMoO6 with $x \leq 0.1$ which uses Gd3+ as a tracer signal for the Mo behavior. Gd^{3+} is the ideal EPR tracer since its half-filled-shell ground state has zero orbital angular momentum, giving an isotropic $g \approx 1.99$ independent of crystal field, couples strongly to its six nearest Mo, and its narrow line places the broadening well above the noise floor for the broadband technique. We compare each Ba2Y1-xGdxMoO6 with its isostructural analog Ba2Y1-xGdxNbO6, which substitutes the EPR-active paramagnetic Mo5+ with EPR-silent diamagnetic Nb5+ to isolate the effect of the Mo environment. EPR linewidths scale linearly with Gd concentrations which is consistent with reduced Gd-Gd dipolar broadening. This study demonstrates the usefulness of using tracer-based broadband EPR to explore potential QIS magnetic platforms.

J-95: Recurrence Analysis of X-ray Light Curves in Radio-Loud and Radio-Quiet AGN
Authors: Ustiashvili, Marita; Phillipson, Rebecca
Advisor: Dr. Rebecca Phillipson

Active Galactic Nuclei (AGN) are extremely bright regions at the centers of galaxies powered by supermassive black holes. Some AGN produce strong radio emission from jets and are classified as radio-loud, while others are radio-quiet. The underlying mechanisms that generate AGN jets and their connection to the accretion environment is still not fully understood. This study examines differences between radio-loud and radio-quiet AGN through their X-ray variability. X-ray light curve data from the Rossi X-ray Timing Explorer (RXTE) AGN Timing and Spectral Database are analyzed using recurrence plots to characterize patterns in their variability. Additional X-ray observations from NICER and Swift are also being analyzed for radio-loud sources. The resulting variability measures and other source properties are compared to investigate possible correlations and differences between radio-loud and radio-quiet AGN. This analysis provides insight into the relationship between X-ray variability, accretion processes, and jet production in AGN.

J-96: Variability of M87* and its Relativistic Jet with the Hubble Space Telescope
Authors: Mozumder, Efaz; Neilsen, Joseph; Haggard, Daryl; Sheridan, Christopher; Nowak, Michael; Markoff, Sera; Principe, Giacomo; Cui, Yuzhu
Advisor: Dr. Joseph Neilsen

M87* and its relativistic jet are among the key targets of the Event Horizon Telescope (EHT), which images shadows of black holes. Despite years of observations, the particle accelerations within the jet of M87* are still not well understood, inhibiting proper analysis of the EHT images. Using Hubble observations from 2022 to 2026 along 4 different optical and UV wavelengths, we analyzed images of

M87*, modeling a core-Sérsic profile to subtract a galaxy and isolate the core. Along with this, Gaussians and larger elliptical regions were modeled on the core, HST-1, and other structures throughout the jet. Aperture photometry was performed on these newly-isolated point sources to obtain fluxes and measure the optical-UV spectral index. These results help create accurate EHT models of accretion flow and relativistic jet of M87* along with assisting in EHT's 2026 movie campaign, designed to detect variability of M87* on a dynamic timescale.

Political Science

J-97: Boots to Ballots: The Effect of Veteran Status on Electoral Success in Party Nomination Races

Authors: Kliewer, Nicol; Seibert, Destiny
Advisor: Dr. Nicole Kliewer

This project explores how military service affects the electoral success of candidates in United States congressional primary elections. While military backgrounds are often seen as politically advantageous, most research indicates mixed success (McDermott and Panagopoulos 2015; Richardson 2021; Somit and Tanenhaus 1957; Teigen 2017). Voters respond favorably to military backgrounds, but it fails to overcome other characteristics, such as party identification, although the impact is most effective in races where candidates are least likely to win–Democrats running in deeply Republican districts (Kliewer 2022). Despite these patterns, military veterans are regularly overrepresented in US Congressional elections. This project examines whether voters in primary elections drive the overrepresentation of veterans later in the electoral cycle. There is some evidence to support this intuition. Primary voters often base their choices on perceptions of electability and viability (Abramowitz 1989). Additionally, veterans participate in primaries at disproportionately high rates, sometimes voting at twice their share of the voting-age population (Teigen 2006). This suggests that primary voters may be especially receptive to veteran candidates. Moreover, primary elections attenuate the effect of party identification in states that do not use multiparty primaries. Prior survey research shows that voters rate military candidates far more favorably when they are exposed to two candidates from the same political party. We find preliminary evidence that while voters express a preference for military veterans and veterans are running in primary elections at an elevated rate, there's mixed evidence of their electoral success.

J-98: Leveling the Playing Field? Right to Counsel and Inequality in Philadelphia Eviction Court

Authors: Arora, Dakshta; Kenney, Lance
Advisor: Dr. Lance Kenney

Eviction is increasingly understood not only as a consequence of poverty but as a process that reproduces housing instability and inequality. This study examines Philadelphia's eviction system and asks how the city's Right to Counsel (RTC) program addresses the structural disadvantages tenants face in landlord-tenant court. It situates contemporary eviction within a longer history of racialized housing inequality, while recognizing that present patterns of eviction do not simply reproduce the geography of historical redlining. The project then considers how inequalities that exist outside the

courtroom interact with a legal institution that is formally designed to treat parties equally. Marc Galanter's distinction between repeat players and one-shotters provides the primary theoretical framework for examining the advantages landlords may possess through greater institutional experience, resources, and legal knowledge. Michel Foucault's theories of governmentality and institutional power further illuminate how inequality can operate through routine procedures, while Giorgio Agamben's work provides a lens for examining the gap between possessing formal legal rights and being able to use those protections effectively. Philadelphia's RTC program offers an important intervention into these dynamics by providing eligible tenants with legal expertise and institutional knowledge. This study argues that RTC can mitigate important procedural inequalities within eviction court, while also examining the limits of legal representation as a response to structural housing inequality.

Psychological and Brain Sciences

J-99: Aspartame Increases Susceptibility to a Subset of Stress-induced Behavioral Alterations in C57BL/6 Mice

Author: Virone, Anthony
Advisor: Dr. Benjamin Sachs

Aspartame is a widely consumed artificial sweetener whose metabolites may influence neurotransmitter systems involved in stress and anxiety. This study examined whether chronic aspartame exposure increases susceptibility to stress-induced behavioral changes in C57BL/6 mice. Male and female mice received either standard, filtered water or 0.03% aspartame-water mixture for 30 days, followed by a three-day variable stress paradigm or a non-stressed control condition. The mice then underwent several behavioral tests, including: light-dark emergence, open field, forced swim, and novelty-suppressed feeding. In the light-dark emergence test, aspartame significantly reduced time spent in the light, and a stress-by-aspartame interaction altered latency to first enter the light, suggesting treatment-dependent changes in anxiety-like behavior. In the open field test, stress reduced center-zone exploration, while sex-by-stress and sex-by-aspartame interactions showed that behavioral responses differed between males and females. Aspartame also significantly altered feeding latency in the novelty-suppressed feeding test, with a sex-by-aspartame interaction indicating sex-dependent effects. In contrast, the forced swim test showed no significant main effect of aspartame. Overall, aspartame produced its strongest behavioral effects in novelty-suppressed feeding, moderate effects in light-dark emergence, more subtle sex-dependent effects in the open field test, and no significant aspartame-related effects in the forced swim test. These findings suggest that chronic aspartame consumption increases susceptibility to a subset of stress and anxiety-related behavioral alterations, with several effects depending on sex and behavioral context. Further amygdala analyses are ongoing.

J-100: Basic Psychological Needs: A Framework for Understanding the Gap Between Insight and Behavior Change in Psychotherapy

Author: Halsband, Kalyani
Advisor: Dr. Rebecca Brand

Insight is a key element of psychotherapy, yet self-awareness does not always lead to the ability to meaningfully alter maladaptive behavior or thought patterns. Basic Psychological Needs Theory (BPNT), a sub-theory of Self-Determination Theory, provides a framework that might give insight into how to close this gap between insight and behavior change. This theory upholds that there are three basic needs that are essential for flourishing and vitality: autonomy, or the feeling of agency and volition; relatedness, which pertains to a sense of belongingness and warmth; and competence, which refers to the experience of effectiveness and mastery. We conducted a review of the psychotherapy literature through the lens of BPNT to understand how the three basic needs are present in psychotherapy and whether competence is neglected relative to the needs for autonomy and relatedness. We argue that there is a great deal of agreement about autonomy and relatedness in the literature, but less focus on competence. Specifically, we argue that patients' basic need for competence has been neglected in psychotherapy treatment, yet is the key to gaining the ability to change one's behavior. This research will help bridge the science-to-practice gap by contributing to practitioners' knowledge of how they can best support their patients, which will ultimately increase the effectiveness of psychotherapy. Based on this review, we developed an empirical study examining mental health practitioners' prioritization of autonomy-, relatedness-, and competence-supportive techniques. This work identifies competence support as a potentially overlooked component of effective psychotherapy and provides a testable direction for future research.

K-101: Belonging in Brother- and Sisterhood: Studying Conformity and Senses of Belonging in Villanova's Panhellenic and Multicultural Greek Life

Author: Lee, Ianna
Advisor: Dr. Bradley Hughes

Human beings are social animals who need to fulfill their fundamental need of belonging. Belonging in undergraduate means young adults forming communities, far from familiar homelife. Greek life is a uniquely cultural and social college organization known for its peculiar customs all in the pursuit of brother- and sisterhood. This research investigates, through the context of Villanova Panhellenic and Intercultural Greek life, how conforming to a group's social norms affects one's sense of belonging; it also specifically focuses on whether this "belonging" effect is moderated by diversity, tightness/looseness of the group's social norms, and members' adoption of these norms. The research aims to better understand the social effectiveness of these popular young adult communities. Through the recruitment of sisters and brothers from the Interfraternity Council's organizations, the National Panhellenic Conference's organizations, and the Intercultural Greek Council, participants will complete self-report measures of cultural tightness/looseness, conformity, and belonging in a designed psychological survey. Qualitative data collection and analysis of this population's psychological states contributes to a more comprehensive understanding of an integral aspect of undergraduate life within many American universities. By examining their feelings, we better understand young adult socialization and the conformity one undergoes for the ultimate human goal of belonging.

K-102: Differential Gene Expression Following Sub-Chronic Variable Stress in Low-Serotonin Mice

Author: Bork, Thomas
Advisor: Dr. Benjamin Sachs

Serotonergic signaling in the brain is critical for mediating stress responses. The raphe nucleus, the brain's primary source of serotonin, is a key region for understanding stress-induced molecular changes. This study investigated differential gene expression in the raphe nucleus of Tryptophan Hydroxylase 2 (R439H) Knock-in Mice following a five-day sub-chronic stress paradigm. The paradigm included restraint (days 1 and 4, 1 hour), forced swim (days 2 and 5, 12 minutes at 25°C), and tail suspension (day 3, 1 hour). Mice were divided into control and stress groups and differentiated according to genotype (WT or KI). Following stress, quantitative PCR was performed on cDNA synthesized from raphe RNA with primers targeting the following genes: *Gr (Nr3c1)*, *Sgk1*, *Fkbp5*, *Creb1*, *Zbtb16*, *Slc22a8*, *Dnm2*, and *Gapdh* (endogenous reference control). A two-way Analysis of Variance was used to evaluate qPCR data. In female mice, main effects of genotype on the expression of *Gr* and *Sgk1* were observed alongside a main effect of stress on the expression of *Creb1*. There was a trend toward a main effect of stress on the expression of *Slc22a8* that was not statistically significant. In male mice, no main effects were observed, but there were non-significant trends toward main effects of stress on *Gr*, *Sgk1*, *Zbtb16*, and *Fkbp5*. There were no significant interactions between genotype and stress for female or male mice. These findings highlight potential molecular pathways involved in sub-chronic stress response.

K-103: Early life stress protects against adult-stress-induced increases in anxiety-like behavior in mice

Authors: Leicht, Kaitlyn; An, Su Bin; Sachs, Benjamin
Advisor: Dr. Benjamin Sachs

Early life stress (ELS) is linked to adverse consequences, including increased rates of mental illness, but mechanisms linking ELS to psychopathology are not well known. Mouse models of ELS have produced conflicting reports regarding long-term effects. The current work examines whether neonatal maternal separation combined with early weaning (NMSEW) alters susceptibility to behavioral changes induced by three days of sub-chronic stress (3DS). Stress effects were measured by body weight and sleep, behavior in the novel object recognition test (NORT), open field test (OFT), social interaction test (SIT), and SPT. Our results suggest that NMSEW protects against anxiety-inducing effects of 3DS. In the OFT, 3DS reduced center time in control mice, but not NMSEW mice, suggesting a protective effect of ELS. Surprisingly, mice exposed to ELS had increased body weight at post-natal day 17 compared to controls, suggesting maternal care may not have been impaired. No group differences in body weight were observed following 3DS, but a 3DS by sex interaction was observed, with males increasing weight while females decreased weight. Both ELS and 3DS increased number of sleep episodes without impacting total sleep time, indicating disrupted sleep architecture rather than sleep duration. These findings do not support reports that NMSEW increases susceptibility to adult stress. Instead, they suggest that NMSEW may confer resilience to a subset of stress effects. Because the findings do not align with clinical data linking ELS to adverse consequences, they suggest reconsidering the use of NMSEW as a translationally relevant model of ELS in humans.

K-104: Effects of Antibiotic Treatment and Stress on Gene Expression in the NTS and Amygdala and Behavior in Male Mice

Authors: Blanke, Marlene; Sachs, Benjamin
Advisor: Dr. Benjamin Sachs

Antibiotic treatment has been well documented to cause microbial depletion, behavioral changes, and changes in gene expression in major brain regions. However, effects on gene expression in specific regions related to emotional centers remain unanalyzed. This study examines how antibiotic treatment and stress affect gene expression in the nucleus of the solitary tract (NTS) and amygdala, as well as behavioral outcomes in male mice. Mice were assigned to four experimental groups: control-water, control-stress, antibiotics-water, and antibiotics-stress. Antibiotic-treated mice received two weeks of broad-spectrum antibiotics, followed by a three-day stress paradigm consisting of restraint stress, tail suspension, and fox urine exposure. Brain tissue was collected from the NTS and amygdala, and gene expression was assessed using real-time quantitative PCR (RT-qPCR). Target genes included BDNF, TNF, IL1B, GR, FKBP, CRH, and SLC1A1, which are involved in neuroplasticity, inflammation, and stress-related signaling. In the NTS, two-way ANOVA revealed a significant main effect of antibiotic treatment on IL1B expression ($p = .028$) and significant main effects of stress on BDNF ($p = .040$) and FKBP expression ($p = .012$). Visual trends suggested increased IL1B expression and reduced BDNF expression following stress, alongside increased FKBP expression. Similar expression patterns were observed in the amygdala, although most did not reach statistical significance. A separate cohort underwent behavioral testing to assess effort-related decision-making and voluntary running-wheel activity. Preliminary observations suggested reduced wheel running during stress exposure, although behavioral analyses remain ongoing. These findings provide preliminary insight into how antibiotic treatment and stress may influence neural pathways involved in gut–brain communication and stress responses.

K-105: Exploring Farm Biodiversity: Patterns of Animal Species Observed
Authors: Gray, Suzanne; Nath, Nikhy
Advisor: Dr. Suzanne Gray

This research focused on observing bird species on a farm to better understand bird diversity within an agricultural environment. Farms can provide important habitats for birds by offering food sources, nesting areas, and shelter. The purpose of this study was to identify bird species present on the farm, examine patterns in bird diversity, and explore how agricultural environments support bird populations. Field observations were conducted to document the bird species found on the farm. These observations allowed for the identification of different species and provided information about the variety of birds living in or visiting the agricultural landscape. Recording bird species can help researchers better understand the bird community in this environment and identify patterns in species presence and diversity. Birds play important ecological roles, including controlling insect populations, dispersing seeds, and supporting the balance of local ecosystems. Farms may provide resources that attract different bird species, although the types of birds present can depend on available food, vegetation, shelter, and nesting opportunities. Studying birds in agricultural settings can therefore contribute to a better understanding of the relationship between land use and biodiversity. Overall, this research highlights the importance of field observations in studying bird diversity on farms. By documenting the bird species observed, the study provides a foundation for further research into bird populations, habitat use, and the role of agricultural environments in supporting local wildlife.

K-106: Investigating Effects of SSRIs on Histone Serotonylation in Mice with Impaired Serotonin Synthesis
Authors: Irrgang, Paige; Sachs, Benjamin
Advisor: Dr. Benjamin Sachs

This project focuses on the effects of SSRIs on histone serotonylation in the raphe nucleus of Tph2 mutant mice, a newly discovered epigenetic factor in stress-related genes. Individuals who have mutations in the brain serotonin producing Tph2 enzyme exhibit impaired responses to SSRI treatment, but the mechanism behind which remains largely unknown. In previous studies, mice with mutations in the Tph2 enzyme were found to have depleted amounts of extracellular serotonylation following treatment with Fluoxetine. Intracellular serotonin has the ability to modify H3K4me3 histone proteins, thus regulating the transcription of stress-mediating genes in the raphe nucleus. Given that Tph2 knock in mice show decreased levels of extracellular serotonin after treatment with Fluoxetine, we hypothesize that the subsequent decrease in intracellular serotonin will result in decreased levels of histone serotonylation following Fluoxetine treatment. This study uses western blotting to identify potential differences in serotonylated histone levels in the brains of wild type and Tph2 knock in mice after control or Fluoxetine treatment. Through this, this project aims to fill the gap in knowledge of why certain individuals show non-response to SSRI treatment, which could, in turn, have broader implications on how antidepressants are used to treat serotonin-related disorders.

K-107: Most Of Your Friends Are White? Examining Black College Students' Racial Shared Reality with Black Peers Who Have Diverse Friendship Networks

Authors: Andrews, Keoni; Yantis, Caitlyn
Advisor: Dr. Caitlyn Yantis

Friendship network racial diversity shapes interpersonal perception. For example, Black individuals perceive other Black people as "less Black" (i.e., identity denial) when they have mostly White (vs. mostly Black) friends. The current study extends this work by testing the role of racial shared reality (RSR) in this process: Black people's perceived consensus about race and racism with White people (Yantis et al., 2025). In this pre-registered experiment, Black American college students recruited via Prolific (N = 267) evaluated the social media profile of a Black individual whose closest friends were either mostly Black (4 Black, 1 White) or mostly White (4 White, 1 Black). Replicating past work, participants assumed the target with mostly White (vs. Black) friends had a weaker Black identity and reported less friendship interest with them. Additionally, participants assumed less RSR with the target who had mostly White (vs. Black) friends. RSR also partially explained the effect of friendship networks on both identity denial and friendship interest. Therefore, RSR has the potential to exacerbate or attenuate the threat that interracial friendships pose to intra-racial relations.

K-108: Nova Café: An innovative English proficiency test

Authors: Saleeby, Sophia; McLaughlin, Drew; Toscano, Joseph
Advisors: Dr. Drew McLaughlin; Dr. Joseph Toscano

English proficiency examinations are important for gauging the language abilities of research participants, students, and prospective employees. However, current examinations are either overly condensed to conserve time, resulting in poor estimates of language ability, or take a long time to administer, score, and receive results. Additionally, most current examinations are not engaging and lead to participant boredom. This project addressed two main questions: (1) How can we test English proficiency in a more comprehensive manner that doesn't require excessive time? (2) Is there a way to make testing English proficiency more engaging to retain participant interest? The innovative Nova Café test will serve as a shorter, more engaging substitute for longer examinations while maintaining

measurement accuracy to address these concerns. Participants complete a set of gamified tasks, with thematic graphics to improve participant interest and motivation, that emulate real-world language use situations. The test takes approximately 30 minutes to complete and measures participants' English language abilities across reading, listening, and writing domains. The Nova Café test data showed high correlations with commonly used standard measures, which shows that it performed similarly to these tests in measuring English proficiency. In future applications, users will be able to administer the finalized online Nova Café test in a wide variety of settings to test English proficiency. Additionally, the stimuli can be translated to create Nova Café versions to test proficiency in languages other than English.

K-109: The Role of Sleep in Memory Processes in Pigeons

Authors: Derenzo, Ellery; Qadri, Muhammad
Advisor: Dr. Muhammad Qadri

Memory consolidation is an essential cognitive function that supports adaptive behaviors for many animal species. The processes supporting memory consolidation occur in slow wave sleep in mammals during the stages of sleep without rapid eye movement (REM). Here, we investigated the role of sleep on memory and learning in pigeons. Avian models show the same multi-stage sleep patterns as shown in humans, yet it is unknown whether sleep affects memory consolidation in the same ways. We trained pigeons (n=3) to complete a picture response association task in the morning and evening using a touchscreen equipped operant chamber. New images were learned either in the morning and tested in the evening or learned in the evening and tested in the morning. The retention intervals between these study and test sessions therefore occurred either during a period of extended sleep or of typical daytime wakefulness. One pigeon was successfully trained to be able to compare the overnight to within-day retention interval. Change in accuracy from the learning to the testing session was analyzed in a preliminary examination of the effect of sleep on memory. While initial data shows a pattern consistent with a relationship between sleep and memory consolidation, it currently does not reach statistical significance. If continued data collection remains consistent with this observation, it could suggest a preserved relationship between sleep and cognition across mammalian and avian models.

K-110: "You have to pick one": How Monosexism Norm Expression Impacts Identity Invalidation Among Bisexual Individuals

Author: Baker, Caitlyn
Advisor: Dr. Caitlyn Yantis

Bisexual individuals experience unique forms of stigma rooted in monosexism, the assumption that legitimate sexual identities are exclusively heterosexual or homosexual. Past research demonstrates that bisexual individuals frequently experience identity invalidation. The current study extends this work by testing how explicit monosexist statements affect bisexual individuals' identity invalidation, identity concealment, and private collective self-esteem. We also investigated whether negative outcomes are exacerbated when monosexism is expressed by a straight person versus a gay or lesbian person. This pre-registered experiment used a 2 (monosexist vs. neutral) × 2 (straight vs. gay/lesbian commenter) between-subjects design, Bisexual participants (N = 354) reported greater identity invalidation, greater identity concealment, and lower private collective self-esteem following a monosexist (vs. neutral) comment, but these effects were not moderated by commenter identity. This

research examines how monosexist norms communicated by both sexual majority and minority individuals may shape bisexual individuals' experiences of identity invalidation, concealment, and collective self-esteem.

Sociology and Criminology

L-111: The Impact of School Climate on Bullying Victimization Among Eighth-Grade Students

Author: Landau, Jennifer
Advisor: Dr. Allison Payne

Bullying is unwanted aggressive behavior which persists over time and can negatively affect middle school students' social, emotional, and academic outcomes. The school climate may impact their experiences with bullying, necessitating the examination of the relationship between school climate and bullying victimization and perpetration. The present study examined this relationship among eighth-grade students by using data from the 2019 Trends in International Mathematics and Science Study (TIMSS), which included students' daily experiences. School climate was measured using students' responses to their safety, belonging, fairness, and pride at school. Bullying victimization was measured through physical, online, and verbal bullying. Responses were recoded into binary variables and correlations and regressions were conducted in SPSS. Gender was used as a control variable. Results indicated that there was a significant negative correlation between school climate and bullying victimization ($r=-.263$, $p<.001$), verbal bullying ($r=-.227$, $p<.001$), physical bullying ($r=-.248$, $p<.001$), and online bullying ($r=-.193$, $p<.001$), which suggests that students who reported a more positive school climate reported lower levels of bullying victimization. These findings may inform future research on school climate and bullying victimization, with the goal of creating a safer school environment for middle school students.