TWENTY-FIRST ANNUAL

KALMAN

RESEARCH SYMPOSIUM

SATURDAY, APRIL 9, 2022

Bucknell UNIVERSITY

KALMAN RESEARCH SYMPOSIUM

INTRODUCTION

Spring 2022

Welcome to the twenty-first annual Kalman Research Symposium.

An important central element of the Bucknell experience is to offer our students in all disciplines the opportunity to engage in substantive out-of-the-classroom research and creative projects with faculty. As stated in the mission statement for Bucknell's Program for Undergraduate Research, these opportunities *allow students and faculty to participate in collaborative learning processes designed to dissolve the distinction between teaching and research, and to create a community of learners in which scholarship serves as the basis for teaching and learning.*

The symposium showcases the breadth and variety of undergraduate research taking place at Bucknell, as is evidenced by the abstracts of the projects contained herein. Visitors are encouraged to attend both the oral presentations as well as the poster session to interact with the scholars and to learn more about their work. In addition, more information can be found on the Kalman Symposium website, containing students' posters, slides and recorded presentations.

This symposium is named in honor of Ernest Kalman, who graduated from Bucknell in 1956. In addition to his service as a University trustee, Ernie's generosity to his alma mater has taken many forms, one of which was a significant gift in support of undergraduate research.

The ***Kalman Research Symposium*** features projects sponsored or supported by the following:

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- Susquehanna River Heartland Coalition for Environmental Studies
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- Tague Family Fund for Undergraduate Research in Biomedical, Biological and Biochemical Sciences
- The Katherine Mabis McKenna Environmental Internship Program
- The Tom Greaves Fund for Research and Curricular Development
- Thomas Spitzer Undergraduate Research Fund
- Undergraduate Research in Animal Behavior

Mariam Abdellatief '24

Faculty Mentor(s): Professor William Scott, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Design and Fabrication of a Caterpillar-inspired Soft Robot

The performance of rigid robotic systems has surpassed human and animal capabilities when performing precise predictable tasks; however, their performance in complex 3D environments is easily surpassed by animals in nature with soft deformable bodies. Robots with bio-inspired soft deformable bodies can adjust to complex environments and have the potential to be used in search and rescue missions, space-based projects, environmental monitoring, and in any task that requires accessing locations inaccessible by rigid robots. During this Summer, we sought to create a fully 3D-printed caterpillar-inspired soft robot using a new printing method that utilizes flexible filament instead of the usual rigid filament typically used for 3D printing. The key advantage to fully 3D printing the robot – as opposed to using silicone molding – is achieving precision and time efficiency. The robot is designed to grip cylindrical objects using three grippers that utilize the Fin Ray effect – a force transferring structure inspired by fish fins and crawls vertically and horizontally through propelling its elastic body segments. Results demonstrate the grippers' ability to support the robot's weight and show that the body segments need modification to provide more elasticity. The challenges to fully 3D printing the robot's grippers and body segments were also explored where the segments and the grippers each had a few different designs with varying parameters and shapes; each design was, then, printed a few times with varying print settings to test how the print settings affect the mechanical properties and structure of the parts. Two test apparatus were also developed to test the mechanical properties of the parts.

Asteri Aliaj '22

Faculty Mentor(s): Professor Deborah Sills, CIVIL & ENVIRONMENTAL ENGINEERING
Funding Source: Emerging Scholars

Wastewater Monitoring for SARS-CoV-2: Concentration and Normalization

Wastewater-based epidemiology (WBE) is an important tool that can be used to gather nearly real-time data to make important public health decisions. In light of the recent Covid-19 pandemic, researchers are concentrating, extracting, and quantifying the RNA of SAR-CoV-2 in wastewater. This is being done worldwide through various means mostly through government agencies and universities. A popular database that is in use is COVIDPoops, which is mapping WBE testing sites for SARS-CoV-2 mRNA. Such data can be critical in rapidly evolving situations. Concentrations of SARS-CoV-2 were normalized to wastewater strength to evaluate the extent of infection in a community associated with collected sewage. This research has two overarching goals: (1) Compare wastewater concentration methods for samples collected with passive samplers (e.g., tampons); (2) Evaluate parameters for normalizing concentrations of SARS-CoV-2. For this study, three methods of wastewater concentration are being evaluated: Ceres Nanotrap, Concentrating Pipette Select (Innova), and 4S salt-silica. Regarding Goal 2, we measured two viruses that are used as fecal indicators: Pepper Mild Mottle Virus (PMMoV) and cross assembly-phage (CrAssphage). The Pepper virus is diet-dependent, while CrAssphage is not. Initially, we assumed that it would be the better indicator. Due to a lack of access to the CrAssphage primer, the PMMOV became the default primer. We are still currently configuring the CrAssphage primer to work properly. The following common wastewater constituents were used as indicators: biochemical oxygen demand (COD), total organic carbon (TOC), suspended solids, and conductivity. pH was also measured but did not offer any benefit in regards to correlation. We are collecting wastewater every day from two manholes at Bucknell University, which serves approximately 300 students, and weekly from a local wastewater treatment plant. Bucknell's wastewater is collected using tampons due to its cost-effectiveness. Statistical tests are being conducted to compare wastewater concentration methods, and a correlation matrix will be created to evaluate the relationship of the two virus concentrations (PMMoV and CrAssphage) with the measured wastewater constituents. All statistical analyses are being done in R Studio. The correlogram created shows a high correlation between the wastewater parameters of COD and TOC & a fair correlation between TSS and Conductivity was found. We used Site 1 to portray these correlations since they were stronger. The concentrating pipette method was the better method in recovering PMMoV from wastewater samples for the heat-inactivated samples that were collected from Bucknell sites.

Will Amrhein '24

Faculty Mentor(s): Professor Keith Buffinton, MECHANICAL ENGINEERING
Funding Source: Department of Mechanical Engineering

Development of Pneumatic Membrane Valves for Soft Robotics

Soft robotics is a relatively unexplored area of engineering, yet it has the potential to be used in a wide variety of applications. The defining characteristic of a soft robot is that it is structurally flexible and thus able to interact with fragile objects and biological organisms without damaging or injuring them. Because this area of research is relatively new, an optimal control structure for a soft robotic arm has not yet been established. Previous approaches include connecting pressure sources through flexible tubes to each individual actuator, such as FREEs (Fiber Reinforced Elastomeric Enclosures). Each tube carries a variable pressure produced by a pressure regulator at the base of the arm, allowing precise control of the movements of each FREE. However, the thick tubes connected to each segment of a full robotic arm add significant extra stiffness and decrease the arm's flexibility. This project focused on the development of a different approach that uses individual valves on each segment of the arm to control the airflow to each FREE from a central supply tube with the individual valves controlled pneumatically with thin, capillary tubes. A membrane inside

each valve allows air to flow when the pressure is low in the capillary tube but stops the flow when the pressure is high. In this way, the valve works similarly to a transistor, allowing a small flow tube to control a high flow output.

Q Andrews '24

Faculty Mentor(s): Professor Meenakshi Ponnuswami, ENGLISH

Funding Source: Douglas K. Candland Undergraduate Research Fund

Reviving the Black Arts Movement

Was the Civil Rights Movement successful? Does the world need a resurgence of the Black Power Movement? My research consisted of different segments corresponding to the products I created for myself while trying to learn as much as I could about the Civil Rights Movement (CRM), Black Arts Movement (BAM), and Black Power Movement (BPM). My products included 3 simultaneously written journals that would serve in similar but expressively different ways of interpreting the sociopolitical conditions of these eras and movements. The 3 journals consisted of responses to literature, theatre, and media (specified by my professor within our research syllabus) including written responses, original poems, and notes for a play. I digested information about the different time periods involved in the political scope of the US from the late 1800s to-1980s. The bulk of what I learned can be summarized into historical, theatrical, and analytical categories. I watched documentaries, speeches, and interviews meant to inform viewers on the ideologies, methodologies, philosophies, and national/organizational reactions regarding CRM. I read and watched plays and dramas to not only become more knowledgeable about the time period but also to learn about the BAM and how art was weaponized to be an autonomous force for social change. It was definitely challenging to look back at plays from such a different time and interpret the meanings and symbols behind events I was born after but, I improved my ability to understand authors' and playwrights' symbols and subtle or subliminal messages left in their works.

Rachel Anello, Julia McLagan, Qian Qian Mei '22

Faculty Mentor(s): Professor Regina Gazes, ANIMAL BEHAVIOR, PSYCHOLOGY

Approach Behavior to Species-Specific Sounds in Domestic Cats (Felis catus)

There have been studies to support that cats respond to cat-specific auditory stimuli. Researchers have found that cats listening to "cat music" respond with a shorter approach latency, more orientation, and more contact with the speaker than cats listening to regular classical music. Other studies have found that listening to "cat music" lowers the stress-related behaviors of cats during a veterinary exam when compared to classical music and silence. In this study, we focused on which elements within cat-specific music are most attractive to cats. These elements include an isolated purring track, an isolated suckling track, an isolated instrumental track, and the original track that combines these three elements. Subjects were thirty-two domestic cats (Felis catus) housed at The Scratching Post Cat Café in Lewisburg, PA. A speaker was placed in the center of the room, and one of the sounds was played for 10 minutes. We recorded all individual behaviors for one cat per trial, as well as the distance from the speaker for all cats at one-minute intervals. Three trials of each of the five conditions were conducted at night (8 pm) over a span of five weeks. Cats approached the speaker significantly more in the isolated purring condition than in any other condition. Cats additionally approached the speaker more quickly in the isolated purr and suckle conditions. This suggests that cats' interest in "cat music" may be best explained as an interest in species-specific sounds such as purring and suckling.

Sophie Bae '23

Faculty Mentor(s): Professor Keith Buffinton, MECHANICAL ENGINEERING

Funding Source: James L.D. and Rebecca Roser Research Fund

Finite Element Analysis, Representation, and Interpretation of Soft Robotics Kinematics and Dynamics

Rapid progress has been made in recent years to improve the accuracy, precision, and intelligence of robots as humans seek to use them to make their lives more comfortable and convenient. Robots are increasingly incorporated into our daily lives, as well as into industry and manufacturing, causing the market demand for them to grow. Despite the number of tasks robots can successfully perform, traditional rigid robots nonetheless have the potential to cause harm to humans and their immediate environment, creating safety concerns. These risks have led to the development of a relatively new field of robotics in which soft materials are employed to limit the possibility of damage and injury. Unlike rigid robots, soft robots have more degrees of freedom and the ability to adapt to their environments, allowing for a wider range of motion and tasks they can undertake. Unfortunately, analyzing the motion and the ability to apply forces of soft robots is challenging, primarily due to their nonlinear behavior and properties. For this project, we used finite element modeling techniques to explore the practicability of two types of soft robotic actuators: Fiber-Reinforced Elastomeric Enclosures (FREEs) and McKibben actuators. A comparison of experimental and finite element results confirmed the accuracy of the model and allowed the workspace achieved with a module comprised of multiple FREEs to be studied. Furthermore, we were able to establish a more effective soft robotic design by considering the role of each system parameter, maximizing the range of displacement and rotation of the actuators.

Anais Barnes '22

Faculty Mentor(s): Professor Christopher Martine, BIOLOGY

Funding Source: David Burpee Endowment, Wayne Manning Internship Fund

Conservation of a Rare Species: Taxonomic Uncertainty and The Potential Role of a Narrowly-Occurring Specialist Pollinator

Heuchera alba and H. pubescens (Saxifragaceae) are closely related species of the Appalachian Region of eastern North America that are difficult to distinguish morphologically. H.

pubescens is currently understood to occupy a range from Kentucky to Pennsylvania, with H. alba restricted to Virginia and West Virginia – plus a recently-recorded extension into Pennsylvania discovered with the help of Twitter. In addition to the discovery of H. alba in Pennsylvania, a pollinator known as the alumroot cellophane bee (Colletes aestivalis) was seen visiting its flowers – the first state record of this bee in over a century. The uncovering of H. alba, as well as its specialized pollinator in Pennsylvania, has challenged historical perceptions of Heuchera distributions in the state, particularly as this relates to current records for H. pubescent. Through our partnership with the Western Pennsylvania Conservancy, substantial fieldwork was completed this past summer, including the collections of H. alba samples and C. aestivalis at multiple sites. It was found that records for H. pubescens in the Susquehanna River Valley can instead be attributed to H. alba. This has potential implications for the assessment of the true distribution for both species and the genetic status of each species in the local region. Our lab will now use population genomics to generate measures of genetic diversity and population structure, to update the conservation status for each study species. We also hope to assess the link between genetic structure among H. alba populations and its reliance on a habitat-specific oligolectic bee.

Hannah Barnum ’24

Faculty Mentor(s): Professor Kevin Gilmore, CIVIL & ENVIRONMENTAL ENGINEERING
Funding Source: Program for Undergraduate Research

The Assembly and Initial Tests of the Green Roof Runoff Sample Collection System

Green roofs provide a variety of benefits, from reducing runoff that would otherwise cause flash floods to improving aesthetics. However, they also carry potential downsides, such as discharging nutrients into an otherwise clean runoff, which can cause eutrophication and dead zones in the receiving body of water. To explore the extent of this drawback, a multi-year examination plan has been laid out with this year’s portion putting a former student’s designed equipment, an Orifice Restricted Device (ORD), to use. The research was conducted in the Academic East building, where the runoff of four green roof plots was channeled from the roof to a lab. The newly constructed ORD was integrated with other devices to form a virtually autonomous system that could simultaneously measure, record runoff flow, and take samples of the discharge. The system was installed, programmed, and calibrated in the early weeks of research and was subsequently used to run tests during storm events. Runoff samples were evaluated for the concentration of nitrogen- and phosphorus-containing compounds and were compared against a control roof without modules. In the final week of research with a simulated storm event, it was found that the green roof module studied indeed demonstrated the benefits of decreasing overall runoff volume and decreasing phosphorus concentrations in the samples, but that the concentration of nitrogen-containing compounds in the runoff was increased. This summer’s work paves the way for future research when the green roofs will be tested further.

Allison Bergeron ’22

Faculty Mentor(s): Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Analyzing the Impact of Live Staking on Channel and Floodplain Morphology and Soil Carbon Sequestration in a First-Order Stream, Central Pennsylvania

Live staking is a stream restoration technique where live cuttings of riparian trees and woody shrubs are planted into stream banks and floodplains to revegetate degraded areas, decrease erosion and runoff, and provide bank stability. Here we present results from year two of a multi-year study investigating the effects of live staking a post-agricultural, unnamed tributary of Pine Creek located in Woodward, PA. Over 2000 live stakes were planted along the streambanks and floodplain in 2018-2019. In summer 2021, we extracted soil cores along transects perpendicular to the tributary, and we collected high-resolution topography along each transect using a Trimble RTK-GPS. We also measured the carbon content of each soil core on a CHN analyzer.

Soil sampling showed that the floodplain mainly consist of silt loam with charcoal, roots, and rusty-colored mottling. There are no major spatial trends in soil characteristics throughout the study site. The mean soil carbon percentage is 1.77%, which is low compared to other published studies of floodplain soil carbon in temperate regions. Channel analysis shows a relatively degraded stream, with low sinuosity and a silt-covered bed that is considerably incised relative to the floodplain elevation.

Compared to baseline data collected in 2020, the average soil carbon increased by 0.1% and channel dimensions have not changed. Overall, these results show that impacts from live staking on channel dimensions and soil properties are not seen after one year, although we hypothesize that soil carbon will increase in the future, given the low baseline values.

Nathaniel Bizzak ’23

Faculty Mentor(s): Professor Thomas Solomon, PHYSICS & ASTRONOMY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Density Distribution of Ellipsoidal Swimmers in a Kolmogorov Flow

We investigate the density distribution of ellipsoidal swimmers in a Kolmogorov fluid flow to determine if the swimming speed and shape of the swimmer affect the accumulation of bacteria in a specific region after coming to a steady-state within the flow. We investigate this process by using a set of coupled partial differential equations that have a stochastic process added to the equations of motion. This stochastic process provides the random fluctuations that are evident in real-life bacteria that we try to model by using ellipsoidal swimmers. To find the density distribution of these swimmers as they evolve in the Kolmogorov flow we use a Montecarlo process to solve the stochastic differential equations as each step in the Montecarlo simulation introduces a random variable from a distribution that is

the solution as stochastic differential equations produce a density function. In this research, we find that after ellipsoidal swimmers are allowed to evolve in the fluid flow until they converge that the accumulation of these swimmers in different parts of phase space is dependent on the shape and the swimming speed of the swimmers.

Michael Bolish '23

Faculty Mentor(s): Professor Katharina Vollmayr-Lee, PHYSICS & ASTRONOMY

Funding Source: National Science Foundation Grant (NSF)

Effects of Fixed Pins and Shearing in Granular Media

Currently, the jamming transition in granular media is well supported by theory and there is a broad understanding of the applicability as well. Using molecular dynamics simulations, we study the jamming transition of a two-dimensional sheared granular system. Shearing is implemented via freezing the top and bottom of the binary mixture to create a wall that can be sheared at a constant velocity. The system is a 50:50 binary mixture with purely repulsive harmonic interactions of size ratio 1:1.4. We will present preliminary results on the influence of the jamming transition due to shear and the addition of non-moving "pins". The size ratio of pins:small: large is 0.004:1:1.4 and pins are located on a square lattice. We investigate pressure and shear stress, as well as force distributions, and heat maps of the local shear stress. *We acknowledge the financial support from the National Science Foundation (DMR -1905737 and DMR-1905474) and XSEDE startup allocation (DMR-190064).

*Michaela Bracken '22

Faculty Mentor(s): Professor William Kerber, CHEMISTRY

Funding Source: Department of Chemistry

Synthesis of Fluorinated Fatty Acids for Use in Iron Oxide Nanoparticle Formation

Iron oxide nanoparticles are useful in several applications including imaging as contrast agents for MRI's, drug carrier delivery for target specific sites, and other biological therapeutic agents. Basic iron carboxylates of fatty acids can be used as precursors to nanoparticles. These complexes are important to study so that applications of iron oxide nanoparticles can be improved and built upon. If they contain a fluorine atom, basic iron carboxylates can be studied using 19F NMR to examine the structure and aggregation of these nanoparticle precursors. To accomplish this goal, fatty acids with a fluorine marker must be synthesized, due to their commercial unavailability. Our approach focused on an SN2-like fluorination of hydroxy fatty acids using XtalFluor-E. Sodium-12-fluorostearate was synthesized as an initial target from 12-hydroxystearic acid. This molecule was easily prepared but fell short of success due to the marker being too far away from the iron aggregation site. The position of the marker in the ligand is important and determines how well the activity can be monitored by NMR when reacted with iron. A second ligand, 6-hydroxy heptadecanoic acid, is being created that uses bromovaleric acid as the starting material. This synthesis, which is currently in progress, will require additional steps but will put the fluorine marker closer to iron to give a better read of the aggregation activity at the iron center.

Ryan Bremer '22

Faculty Mentor(s): Professor Claire Campbell, HISTORY

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

The Art Building is So Weird: Looking at Bucknell's Evolving Footprint

This research project uses landmark flood events—1936, 1946, 1972—as guides to track the evolution of Bucknell's campus footprint. Over this span, there has been a noticeable shift away from the Susquehanna River and towards Route 15 as the orienteer of campus. This shift is practical, of course, as a majority (if not all) of Bucknell visitors arrive from the highway; however, symbolically, it shows the desire for more land and expanse. In the literature and sources leading up to the university's 1946 centennial, there was a palpable sense of expanding outwards, and a desire to see how far the campus could evolve. As the bicentennial approaches within the next few decades, a similar prudently bold strategy seems to be emerging. The construction of Holmes Hall has made the Art Building obsolete, but also recently-constructed Academic East and Academic West have shown the direction in which the university's orientation is trending. This physical restructuring demonstrates the newer ideological ambitions of the University.

Cassandra Brown '22

Faculty Mentor(s): Professor Meenakshi Ponnuswami, ENGLISH

Pillars of Social Identity In the Manosphere

Individuals who participate in online forums find a sense of identity-based on the material they produce as well as consume. The Manosphere is an umbrella term that describes online groups of men that reject feminist ideology but actively engage with Red Pill Ideology. An exploration of what leads to feminist blaming discourse on forums was used to understand group formation and group differences across the Manosphere. Impactful sociopolitical events like the #Metoo movement and the official Reddit Ban of INCEL dedicated forums were then used as time points to understand how the Manosphere changes in response to these events. It was then explored how INCELs, MGTOW, and various antifeminist web pages used written and visual material to attract users and reinforce in-group dynamics.

Andrei Bucaloiu '22

Faculty Mentor(s): Professor K.A. Hays, ENGLISH

Because We Go: Poetry Exploring Memory and the Migrant Identity

I came to the United States from Romania with my parents when I was two years old. I struggle to remember this moment directly and I often find myself trying to bridge a personal gap between languages and cultures, between

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my memories and my parents' stories, and within my own emotional affect. This chapbook project serves to probe my own narrative and analyze my own position in the world as a multilingual and multicultural individual while aligning itself with a definition of memory that hinges on intergenerational storytelling, rather than lived experience alone. The poems vary in form and subject and are unified by a sense of longing and an exploration of how an immigrant child understands their position—displaced from home culture, and never fully planted in the adopted culture. This chapbook proposes that creative expression through poetry is a vital operation for young migrants seeking to better understand themselves, showing that memory and identity are not stagnant relics, but rather dynamic and ever-developing processes. This project is my story.

Andrei Bucaloiu '22

Faculty Mentor(s): Professor Fernando Blanco, SPANISH
Funding Source: Department of Spanish

Yo Soy Rumano (I am Romanian): An Autobiography Exploring The Effects of Memory and Trauma on the Formation of the Self

I came to the United States from Romania with my parents when I was two years old. This moment of cultural, linguistic, and geographic separation occurred before I was able to consciously recall it, yet it constitutes a traumatic experience, in the Freudian and Lacanian sense, that defines my positionality and serves as a primary space in which I seek to develop who I am. However, regardless of how much I have developed my ability to communicate in English, it is not the language of my emotional affect. At the same time, profound expression in Romanian is not possible for me, as my ability to write in Romanian has weakened considerably since I only ever speak the language in my home. This leaves me, and other migrants like me, struggling to understand our place in our family's migration stories—we are trying to claim our migrant identities without the proper language to understand our positions and process the corresponding trauma.

To solve this problem, I propose the writing of an autobiographical account and academic investigation in my third language, Spanish. Through this framework and creative exercise, I posit the weakening of my primary language as a mark of the trauma of youth migration and an open wound that I, as well as other migrants like me, carry every day, that can be resolved by exercising agency and learning/accessing a related third language as a process of working through or stitching up that open wound.

Justin Bye '22

Faculty Mentor(s): Professor Karen Castle, CHEMISTRY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Quenching of CO by Nitrogen Gas

NASA's Voyager and Cassini missions have sparked substantial interest in Titan, the largest moon of Saturn. This moon has a uniquely Earth-like, nitrogen-based atmosphere with CO being the fourth most abundant gas. This work was motivated by the need for robust non-local thermodynamic (non-LTE) models to describe Titan's upper atmosphere. CO is the main reservoir of oxygen in Titan's atmosphere and thus is important for understanding the atmospheric evolution and climate history of Titan. Some of the most important parameters for non-LTE models are rate coefficients for vibrational energy transfer processes involving CO. This project seeks to obtain accurate and precise measurements for the quenching rates of the first excited vibrational state of CO through collisions with nitrogen molecules. The results of this work should reduce uncertainty in non-LTE atmospheric models for Titan.

Ryan Caggiano '23

Faculty Mentor(s): Kat Wakabayashi, CHEMICAL ENGINEERING
Funding Source: Program for Undergraduate Research

Solid-State Shear Pulverization of Ultra-High Molecular Weight Polyethylene for Effective Mechanical Recycling

In the industry, there currently isn't a very efficient way to recycle high molecular weight plastics. Due to their high melt viscosities, commercial melting processes are very difficult to perform. One technique that has seemed to be proven useful in recycling these thermoplastics is Solid-State Shear Pulverization (SSSP). We used the SSSP technique on postindustrial UHMWPE, evaluated morphological and physical property enhancements done to the UHMWPE, and compared them to shredded flake material and virgin sheet material. To recycle the postindustrial UHMWPE, I used a low temperature, high shear, and compressive mixing technique called Solid-State Shear Pulverization (SSSP). This will be done with a KraussMaffei Berstorff ZE25-UTX intermeshing, co-rotating twin-screw extruder. The material was fed into the machine and pulverized by the 6 zones of screw elements. The material was re-fed and compared with material not re-fed to see the effects of this, with the same screw configuration. Thermal analysis was done using TA Instruments Q1000 differential scanning calorimeter, and thermogravimetric analysis will be done using TA Instruments SDT-600. The UHMWPE after being fed through the SSSP will be cold-pressed in a pellet press, then compression pressed using a Carver Model C press. The product of this was used for tensile tests using a Tinius-Olsen H5K-S universal tester in tension mode to see how the process has affected the samples' physical and morphological properties.

Tabitha Chilton '22

Faculty Mentor(s): Professor Christopher Camuto, Professor K.A. Hays, ENGLISH

Swimming In Circles, Creative Nonfiction Exploration and Essay

Over the past year, as I've ventured into Creative Nonfiction, I've found that it calls for an extensive amount of research in reflection of the self. While recounting events of my childhood in strange and creative ways, I've had to look into old test grades, family photos, scribbles in coloring books, searching and scouring the material of my past to find inspiration and factual realities. I have hauled up, many nights, in the library inside my mind, sorting through filing cabinets, lists, memories, odd specific details, flipping through pages, looking for a piece of myself that I want to shine a light on. Of course, this isn't research in the sense that we think of

off the top of heads, research is an investigation, at its core and I have investigated. Through thought, meditation, and contemplation, I have researched myself, my thoughts, fears, anxieties, and desires, trying to find what I'm longing for or gnawing at below the surface. My mind is a trove of infinite materials to study and areas of opportunity for uncovering something about my past, my emotions, my motives; I am searching and I always will be, for weird feelings to poke at and universalize. To give a voice to the voiceless, to give rise to a feeling that you didn't know you felt, that is why I look and search, uncover and investigate. I have researched, found facts and feelings, that allowed me to reach new conclusions.

Peter Cholnoky '22

Faculty Mentor(s): Professor John Enyeart, HISTORY
Funding Source: Bobko-Dennis Fund for Undergraduate Student Research

With Regards From Eagles and Condors: The U.S. Assistance of Operation Condor

Ranging from plenty of geographical backgrounds, the U.S. secret invasion of countries has been subject to heavy investigation and documentation. In particular, they've traditionally focused on countries that were having an increase in socialist policies. While civilians of these countries have often known of some level of foreign involvement in assassinations, coup d'états, and wildly inaccurate propaganda, that information has been largely drip-fed to the public and scholars under the guise of national security. In fact, covert operations in Latin America have largely relied on first-hand accounts until significant push is made for the Central Intelligence Agency and other government departments have had orders to publish documents. Specifically, in the case of Operation Condor, documents in the last five years have made an extraordinary effort in piecing together a secretive and elusive part of history. Documents ranged from propaganda tactics to named targets of torture and assassination. Scholars coordinate between primary documents published across the major Condor operating countries alongside documents released by the CIA, FBI, the Department of the Interior, and others to paint a picture of what really happened during those years. I looked to investigate a series of primary documents released in 2019 in conjunction with research into covert operations during the earlier years of the Cold War in order to construct a more cohesive account of how involved the U.S. was in Operation Condor, and exactly what steps were taken to make sure that Operation Condor was as successful as possible.

Sophia Cooksey '25

Faculty Mentor(s): Professor Adam Burgos, PHILOSOPHY
Funding Source: Presidential Fellowship

Feminism Versus Socialism Through the Eyes of the Young Lords

For my research project, I will be presenting a Google Slides presentation on the Young Lords, a Puerto Rican activist group from the late 1960s and early 1970s. In my presentation, I will briefly provide some context and background as to who the Young Lords were, what their priorities were, and how they went about achieving their goals. I then will zero in on the feminism and socialism aspects, what they meant for the group, how these things worked together and against each other in the 1960s and 70s, and how this pertains to today. I will detail how these things differed in a comparative perspective looking both at progress on the island of Puerto Rico and on the mainland United States. Additionally, I will be presenting on some important influential figures in the feminist movement from the Young Lords and why their legacy is so important to research today. My goal is to bring these things together in a way that gives the audience a sense of familiarity with the group and a better understanding of what feminism was in the late 20th century and what it is today, as the word is widely misunderstood. Some of my research materials will include Iris Morales' Through the Eyes of Rebel Women", excerpts from Palante, a Young Lords publication from the 60s and 70s, and more.

Cindy Cortez '24

Faculty Mentor(s): Professor Stephen Buonopane, CIVIL & ENVIRONMENTAL ENGINEERING
Funding Source: Program for Undergraduate Research

Communicating Impacts of Building Characteristics on Space Heating and Cooling using Models and Simulation

The focus of this research project is to explore and communicate the impact of building characteristics on the energy consumption of space heating and cooling by using physical models and computer simulations. This research varied the following physical characteristics—the color of the building, insulation, thermal mass, window arrangement—and measured their impact on space heating and cooling. It does not target other energy consumption factors or sources.

Jonathan Dankwa '23

Faculty Mentor(s): Professor Kenneth Mineart, CHEMICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Investigating The Effect of Penetrant Identity on Micelle Formation and Release Time From Organogels

Polymers have grown in significance because of the potential to alter their chemical structure to achieve desired material properties and control the rate of chemical release. Current applications of polymers are in transdermal patches such as nicotine patches. Research has shown that sodium dioctyl sulfosuccinate (AOT) forms a reverse micelle in mineral oil and could be promising in acting as a controlling agent in the release of chemicals from polymers. A reverse micelle is a sphere of aggregated molecules formed by interactions between the molecule and solvent. The solvent in this research is mineral oil which is mixed with the Styrene ethylene Butylene styrene (SEBS) polymer to form an organogel. This poster demonstrates whether Solsperse 3000 and Solsperse 9000 formed reverse micelles in the solvent and the time for full release in different concentrations of SEBS polymer (10wt% - 40wt%), using an infrared spectroscopy-based method to measure their release

rates. The average diffusivities of Solsperse 3000 and 9000 were measured to be 9.87E-09 cm2/s and 9.96E-09 cm2/s respectively over approximately 300 hours, similar to the release time of AOT. The diffusivity of the solsperse molecules were higher than AOTs 4.61E-09 cm2/s by a factor of two. Additionally, the diffusivities of the Solsperse molecules were compared to oleic acid's 6.21E-08 cm2/s which differed by a factor of ten. Solsperse 3000 and 9000 did not form reverse micelles as confirmed by the structural information from dynamic light scattering. H-NMR also suggested that the Solsperse 3000 and Solsperse 9000 were similar molecules.

Vy Dao '24

Faculty Mentor(s): Professor Alex Kelly, COMPUTER SCIENCE
Funding Source: PPL Undergraduate Research Fund

Methods of Improving the Ethical Aspects of Artificial Intelligence

Development in artificial intelligence (AI) has progressed at a rapid rate in the past decade and continues to progress. However, this rapid rate of development has led to several ethical concerns due to the perpetuation of bias by AI that has been insufficiently addressed. This has negative consequences as artificial intelligence is used to aid important decision-making processes such as job applications and healthcare treatment plans. This article examines the factors that contribute to the lack of bias mitigation practices of AI from several scholarly pieces of literature published within the past six years. The factors identified include the lack of representation of minorities within the field of AI research, a need for incorporating AI education in fields that utilize AI tools, and the lack of proper and uniform establishment of AI ethical regulations and guidelines. The literature strongly indicates a pressing need for future AI research to use a more interdisciplinary approach to allow for a diverse set of perspectives and expertise.

Riley DeBaecke '23

Faculty Mentor(s): Professor Jeremy Chow, ENGLISH
Funding Source: Douglas K. Candland Undergraduate Research Fund

Unsettling Happiness: Blackness, Gender, and Affect in The Woman of Colour and its Media Afterlives

The eighteenth-century propagates a universal possibility that all may pursue and attain happiness through personal progress within their lifetimes. Similarly, the Declaration of Independence classifies happiness as an "unalienable right," yet many people waste years struggling to obtain it because of the happiness of many stems from the suffering of others. By closely reading the character of Olivia Fairfield in The Woman of Colour (1808), Dr Chow and I unsettle the eighteenth century's utilitarian purview of happiness to account for happiness otherwise that Black and mixed-race women experience. We consider happiness as a possible effect, and I will reveal how emotion, feeling, and intersubjectivity converge within Black affect to create blackened happiness. I will detail my research process from my class with Dr Chow to publication in a forthcoming journal. I will teach the audience how Olivia diverges from whitened forms of happiness, contextualizing this within our modern understanding of happiness. I will anchor contemporary scholarship on The Woman of Colour and foreground the novel as a foundational eighteenth-century text that brought mixed-race women to the forefront of abolitionism. Additionally, I contrast The Woman of Colour with the British period film Belle (2013) to examine how racialized effect comes to light in different mediums. By closely reading the character of the film's Dido Elizabeth Belle (Gugu Mbatha-Raw) next to Olivia Fairfield, I will delineate how contingencies of happiness influenced Black and mixed-race women in their pursuit of happiness in a world that demanded their acquiescence to heteronormative domesticity.

Emily Deschler '22

Faculty Mentor(s): Professor Mark Haussmann, BIOLOGY
Funding Source: Department of Biology

Exploring How Life History Affects Stress Responses

When an organism encounters a stressful stimulus, the endocrine system activates a physiological stress response through a cascade of hormone signaling, which functions to promote short-term survival by mobilizing and reallocating energy. In vertebrates, glucocorticoids (GCs) are released during the stress response. However, vertebrates vary greatly in their life histories, which in turn may require differentially regulated stress responses. Vertebrate species fall along a continuum of slow to fast life histories. Those with slow life histories tend to have slower growth rates, later maturation, larger size, fewer offspring, and longer lifespans. Alternatively, those with fast life histories tend to have faster growth rates, earlier maturation, smaller size, more offspring, and shorter lifespans. Although quail are classified as having faster life histories compared to other vertebrates, there is still ample variation among quail species. We are developing a comparative quail model to investigate whether stress responses differ based on where a specific quail species falls on the life-history continuum. Specifically, we categorized how stress responses differ using three distinct measures. We predict that species with slow life histories will be able to turn off a stress response more rapidly compared to species with fast life histories. Our initial results show that the Blue Scale quail (fast life history) recovered more quickly from stressors, in comparison to the Chinese Button quail (slow life history). I will discuss the interpretations and implications of these results in further detail.

Raegan Dunwoodie '22

Faculty Mentor(s): Professor Matthew McTammany, BIOLOGY
Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Effect of Leaf Detritus on Nutrient Uptake in Agricultural Streams

Nutrient loading from agricultural runoff in streams of Pennsylvania causes eutrophication in streams of Pennsylvania and the Chesapeake Bay. Riparian management can help reduce nutrient loads to streams, but adding coarse particulate organic matter (CPOM) to mimic natural annual leaf fall could increase demand for nutrients in agricultural streams and therefore increase nutrient

retention by streams and decrease downstream transport of nutrients. The objective of this project was to quantify how differing amounts of leaf detritus affect nutrient uptake in an agricultural stream compared to a forested stream. We incubated experimental mesocosms containing rocks and different amounts of CPOM in streams for three weeks to accumulate microorganisms. We then brought the mesocosms into the lab and measured phosphorus uptake and respiration in individual tanks. Phosphorus was added to each tank for initial concentrations of 100 µg/L, after which water samples were collected at specified intervals to assess nutrient uptake rate. Oxygen concentrations were measured over time to estimate respiration rate. Mesocosms with higher amounts of CPOM had significantly higher phosphorus uptake and microbial respiration rates. Phosphorus uptake was similar between the agricultural stream and the forested stream, which suggests that CPOM additions to any stream can make a quantitative difference in the amount of phosphorus taken up by microbes, resulting in lower nutrient export from stream reaches with higher amounts of leaf detritus.

Marion Duval '25

Faculty Mentor(s): Professor Moria Chambers, Professor Sarah Smith, BIOLOGY
Funding Source: Presidential Fellowship

Resisting Antibiotic Resistance: Analyzing Antimicrobial Activity of Insect Cecropins

The prevalence of antibiotic-resistant bacteria is rising as the number of new approved antibiotics decreases, creating a global crisis of infections unable to be treated by antibiotics. However, many insect species have naturally occurring antimicrobial peptides (AMPs) which are short amino acid chains that are not prone to the development of bacterial resistance. My goal is to determine how the amino acid sequence of AMPs affects their specificity, focusing on one of the largest classes of insect AMPs, cecropins. I took sequences of approximately 200 cecropins and grouped them based on their hydrophobicity and amphiphilicity. This allowed me to separate the AMPs into about 6 core groups with distinct hydrophobic and amphipathic signatures. These signatures are influenced by the specific amino acids in the peptides. I then used sequence alignment to identify which amino acids were highly variable or conserved within each group. As a result, I identified two common changes that occur in cecropins that may affect peptide antimicrobial activity. First, the introduction of a glycine into the center of the amino acid likely makes the peptides more flexible. Additionally, the switch from a hydrophobic amino acid to a negatively charged amino acid likely influences the interaction with the bacterial cell membrane. In the future, I plan to test how these key amino acid shifts influence their ability to kill clinically important bacterial species by performing minimum inhibitory concentration (MIC) assays.

Michael Dwyer '22

Faculty Mentor(s): Professor Bekele Gurmessa, PHYSICS & ASTRONOMY
Funding Source: Program for Undergraduate Research

Microscale Mechanics and Structural Organization of Cross-Linked Actin Networks

Actin, a globular protein, is a major component of the cytoskeleton. In the presence of ATP and magnesium, G-actin polymerizes into filamentous actin (F-actin), which plays crucial structural and mechanical roles in cell stability, motion, replication, and muscle contraction. Most of these mechanically driven structural changes in cells stem from the complex viscoelastic nature of cross-link actin filaments. Although numerous previous studies, how actin networks respond to local nonlinear stresses are not well understood, particularly at the molecular level. Here, we use optical tweezers to impart local nonlinear strains and measure the resulting stresses during and following the strain of cross-linked actin networks. In particular, we actively drive a microsphere 10 micrometers through cross-linked actin networks at a constant speed and measure the resistive force that the network exerts on the bead during the following strain. We determine the viscoelastic response of the phalloidin stabilized actin network by varying the concentration of dynamic crosslinker, alpha-actinin. Furthermore, we simultaneously image the network via fluorescence laser scanning confocal microscopy to characterize the networks' structural change and heterogeneity as the density of cross-linking protein increases in the presence and absence of phalloidin. Our results shed light on how cells undergo morphological changes through varying crosslinker densities.

Olivia Dyer '22

Faculty Mentor(s): Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Schotz Family Interdisciplinary Fund

Visual Characterization of Aponeurosis Microstructure

The aponeurosis is a tendinous sheath-like tissue found in many muscle-tendon units that cover the muscle belly and transition into the tendon. Little research has been done to understand how collagen fiber microstructure contributes to aponeurosis stiffness and mechanical function. The goal of this study was to use scanning electron microscopy (SEM) to characterize the microstructure of aponeurosis tissue by comparing waviness values measured in unstretched and stretched tissue. It is hypothesized that the waviness of the collagen fibers will decrease after the tissue has been stretched. Porcine shoulder tissue was dissected to obtain 40x10 mm specimens. Unstretched samples (n=10) were fixed in 10% formaldehyde, while stretched samples (n=10) were fixed at five percent strain. Images were taken at 50, 100, 1k, and 3.5k magnification. The waviness of the stretched and unstretched aponeurosis was quantified as the ratio of the true length of the collagen fiber to the tangent of two

endpoints of that same collagen fiber. Aponeurosis exhibited a hierarchical structure, similar to that of tendon or ligament, with collagen-rich fascicles, fibers, and fibrils. Waviness in the collagen fibers was observed at lower magnifications (100 μm), while at higher magnifications the sheet-like structure of the collagen fibrils was seen (1,000 μm). Unstretched tissue exhibits a high degree of waviness or collagen crimp (1.17 ± 0.21) compared to tissue that has been fixed under a five percent stretch (1.05 ± 0.06, p = 6.615e-08). Future work will include using computational modeling to study the effect of collagen structure on aponeurosis mechanics.

Lielt Endashaw '22

Faculty Mentor(s): Professor Emek Uçarer, INTERNATIONAL RELATIONS
Funding Source: Helen E. Royer Undergraduate Research Fund

Positive Peace and International Organizations: The United Nations and its Peacekeeping Efforts

This paper underlines positive peace as an elemental concept and offers some insight into how its encouragement may establish sustainable, peaceful relations between opposing groups within areas of civil instability. This paper hypothesizes three main ideas; 1) the discrepancies in the economic, political, and social conditions of a country will hinder the United Nations' efforts in achieving positive peace; the better these conditions are, the more likely that the United Nations will have a positive trajectory towards positive peace outcomes through its peacekeeping efforts; 2) the lack of intervention or sudden withdrawal of peacekeeping efforts in such cases will result in the return of spoiler activity, which is defined as the use of violence to attain or maintain influence over matters and thwart the peace process; 3) international organizations are best equipped to manage these critical issues as they utilize enforcement mechanisms rather than only monitoring mechanisms. This paper will undertake a comparative analysis of the United Nations Mission in South Sudan (UNMISS) and the United Nations Multidimensional Integrated Stabilization Mission In The Central African Republic (MINUSCA) as case studies. The findings of this research indicate that the United Nations' efficacy in bringing about positive peace varies and is dependent on the status of the existing political, social, and economic circumstances in the host countries. Additionally, the findings also indicate that if the United Nations establishes enforcement mechanisms such as charter-based and convention-based mechanisms, the United Nations will make stronger strides towards positive peace.

Bayasgalan Erdene-Ochir '24

Faculty Mentor(s): Professor Jigjidsuren Batbaatar, Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Quantifying Moraine Degradation as a Relative Dating Technique

When moraines degrade, two distinct changes in their morphology occur 1) weathering of boulders on the moraine surface leads to fewer and smaller boulders over time; 2) initially sharp crests of the moraine become gentle over time as erosion transports material downhill. These two attributes of moraines, surface roughness and the sharpness of the crest, are important parameters to characterize the evolution of glaciated landscapes but they have not been quantified. We established two metrics to quantify these attributes of moraine morphology using high-resolution elevation data and compared them against publicly available cosmogenic ages. The surface roughness of the moraines is proportional to the number and size of the boulders, and we quantified it by calculating the standard deviation of slope determined from 1-m LiDAR data. For example, each boulder on the moraine surface produces a local slope, and a large number of boulders on a young moraine should lead to the high variability of slopes, measured in degrees. Second, we quantified the sharpness of moraine crests by measuring the maximum curvature along crest-perpendicular transects. Young moraines tend to have sharp crests resulting in high values of the maximum curvature, compared to gentle crests of old moraines with low curvature values. We analyzed only the surfaces of well-dated lateral moraines with five or more cosmogenic ages per moraine. Preliminary results show a weak negative temporal correlation in the surface roughness and the sharpness of the moraine crests. However, the correlation is more apparent at the 100,000-yr scale than at the 10,000-yr scale, probably because most of the moraines date to ~16–22 ka. The correlation between these morphologic metrics and age can be improved by analyzing older moraines from a variety of climate conditions. This new relative dating technique can be used for mapping glacial landscapes in other planets, such as Mars.

Brooke Ewer '24

Faculty Mentor(s): Professor Eric Kennedy, BIOMEDICAL ENGINEERING
Funding Source: Program for Undergraduate Research

Playground Safety Standards Reimagined: Field Data Investigation of Impact Attenuation Methodology

Many different playground surfaces are used in the United States for fall-related injury protection, yet falls onto the surface account for over 70% of serious playground injuries. Playground standards assess the impact attenuation performance of surfacing materials through metrics of Head Injury Criterion (HIC) and maximum acceleration (g-max). However, these safety standards utilize a compliant/non-compliant criterion that may imply that all compliant surfaces provide similar levels of protection. A new testing methodology was developed with an emphasis on the calculated risk of severe head injury. The analysis included the sensitivity of the safety metrics, the inclusion of all drop data, and rating surfaces through a tiered performance criterion.

This was performed on a randomized sample of playgrounds collected by the National Program of Playground Safety. The relationship of both HIC and g-max as compliant/non-compliant metrics was analyzed. Only three points were non-compliant by g-max yet compliant by HIC. The rest of the data were non-compliant by both metrics or HIC only, demonstrating the insensitivity of the g-max criterion

compared to HIC. An additional comparison was performed between the current protocol of eliminating the first of three drops from the evaluation versus the inclusion of all test data. Scores were confirmed to be statistically the same, and suggest that all drop test data be included for evaluation. Ultimately, a performance criterion was proposed that would simplify interpretation and provide increased insight into different levels of performance.

Ben Fink '24

Faculty Mentor(s): Professor Kevin Gilmore, ENVIRONMENTAL ENGINEERING
Funding Source: Program for Undergraduate Research

Separation of Valuable Resources From Food Waste Through Elutriation and Centrifugation at Bucknell

I studied two food fermentation-separation methods: Elutriation and Centrifugation. Elutriation takes place in a mixed tank (gravity thickener) with feedstock (food waste) and bacteria. Fermentation can yield Volatile Fatty Acids (VFA). The bacteria break down the food waste and produce VFAs. Then the liquid is added to the tank to dilute the concentration of the bacteria to make it easier to separate the feedstock from the water/VFA. The goal of this system is to optimize our product (VFA) and sell it for a profit. This was done computationally in Excel. We mixed different ratios of underflow and overflow to determine the greatest profit.

Centrifugation uses centrifugal force to separate the feedstock from VFA/water. We completed two different types of centrifugation experiments. We used a sludge-like substance (feedstock) and mixed the samples with water at different rates to dilute the mixture (from most concentrated to least concentrated) to determine which would have the best outcome. In both variations of our centrifugation experiments, we spiked the samples with VFA to see how it would impact the separation of solids. Both times we found that our higher diluted samples (less concentrated) did a poor job separating. We considered factors such as how spiking the samples with VFA affected the PH of the samples, or if the compounds of the VFA had too much of one chemical, which can cause poor separation. We still do not have a definitive answer but are discussing our findings with professionals in this field.

Marla Forfar '24

Faculty Mentor(s): Professor Sarah Smith, BIOCHEMISTRY/CELL BIOLOGY
Funding Source: Physical Science Scholars Program

Inhibition of Bacterial Growth by Antimicrobial Peptides

Antibiotic resistance of bacteria is a growing crisis in medical systems around the world. A new approach to try and combat antibiotic-resistant bacteria is through the use of antimicrobial peptides (AMPs). AMPs are short (20 - 80 amino acids) chains of amino acids that are produced by a wide variety of organisms, including insects, which are divided into a number of families based on their amino acid makeup. We have synthesized three AMPs from the cecropin family of Drosophila melanogaster to better understand what characteristics allow AMPs to kill different strains of bacteria. We then used these peptides to measure the minimum inhibitory concentration, or the concentration of peptides at which bacteria can no longer grow, on six different bacterial species at two different temperatures (25 °C and 37 °C). We found that Cecropin B inhibited bacterial growth at the lowest concentration for most pathogens tested and that the antimicrobial activity was overall best at room temperature. In the future, to follow up on the temperature dependence, we are working to analyze the structural differences of the peptides at each temperature to see if this explains the difference in inhibition between temperatures.

*Andrew Funovits '22

Faculty Mentor(s): Professor Karen McGrath, ACCOUNTING & FINANCIAL MANAGEMENT
Funding Source: PP&L Undergraduate Research Fund

Investigating Premiums in Eco-Certified Properties in New York, Chicago, and Los Angeles

Using a data set of LEED-certified commercial office properties and their non-certified counterparts within the three largest markets, New York, Chicago, and Los Angeles, this paper aims to identify an increased sales price for LEED-certified properties. LEED is one of the largest eco-certifications in the United States and attempts to measure the overall human and environmental impact of a building, of which energy efficiency is included.

Data and Methodology:

The data for this analysis was gathered from the Costar and LEED for all commercial office properties in the three markets. All LEED-certified properties sold between 1998 to May 2020 in New York, Chicago and Los Angeles were identified and matched to those in the database of LEED and certified properties. Furthermore, data for comparable properties within these three MSAs were collected by submarkets containing a certified office property to conduct a regression analysis. A hedonic regression analysis was conducted while controlling for building age, height, size, class, and location by submarket.

Results:

The result of this research shows that there is a significant correlation between the sales price and LEED certification of commercial office properties within the New York, Chicago, and Los Angeles markets. Previous literature has found that there is a premium in sales price for LEED Certified properties as well. Although the results of this research indicate that a LEED certification is accompanied by an increased sales price, this data is ultimately part of a larger data set that will include the entirety of the United States.

***Website only: kalmansymposium.scholar.bucknell.edu/**

Ariana Gambrell, Hannah Goldberg, Hannah Holt, Megan Kopitsky, Lily Shorney, '22, '23, Graduate Student, Dr. Erica Delsandro, and Dr. William Flack

Faculty Mentor(s): Professor Bill Flack, PSYCHOLOGY
Funding Source: Program for Undergraduate Research, Psychology Undergraduate Research

Did Mitigating COVID-19 Mitigate Campus Sexual Assault? Differences in Victimization Rates based on Gender and Sexuality

Hookup and party culture are risk factors for campus sexual assault (CSA). COVID-19 mitigations supposedly lessened the prominence of these factors. Comparing the results from a campus climate survey conducted from 2018 to 2021, COVID-19 mitigation strategies clearly did not decrease CSA overall, in fact, there may have been an overall increase. Key findings indicate that rates of sexual violence for women, men, LGBTQ+, and heterosexual/cisgender students varied in terms of potentially increasing, decreasing, or remaining consistent depending on identity and type of violence experienced. Additionally, victims were more likely to be women, and LGBTQ+ students were overrepresented in the victimization prevalence rates compared to their portion of the student population. This highlights the importance of further investigating factors for CSA given the continued prevalence of the issue despite COVID-19 mitigations, with special attention to accurately assessing violence experienced by different social identity groups.

Abby Gearhart '23

Faculty Mentor(s): Professor Benjamin Hayes, CENTER FOR SUSTAINABILITY & THE ENVIRONMENT
Funding Source: U.S. Geological Survey

Developing a Database of Stream Restoration Projects in Pennsylvania to Identify Historical Trends, Advances, and Future Directions/ Strategic Challenges

By conservative estimates, over 1.2 billion dollars has been spent on stream restoration in Pennsylvania over the past 40 years, yet little is known about the project outcomes and how restoration technologies have varied with location and time. Improving restoration designs and setting watershed priorities relies on making information readily accessible to the public, which is a primary goal of this project. Data were gathered from the state, federal, and foundation databases on 5,198 projects completed from 1916 to 2020 in 66 of 67 counties in the state. The data was organized into spreadsheets and relational databases within a geographic information system (GIS) framework. The resulting database architecture followed that of the National River Restoration Science Synthesis (NRRSS) database compiled in 2005, which included up to 15 different intents for any given project. The data were categorized by project intent (e.g., goals of the restoration effort), cost, year completed, watershed, and other details. Various watershed groups and state and federal agencies did not organize their data in accordance with the NRRSS database, which makes it difficult to compile a single database for all projects. Results from this study will help environmental agencies and natural resources managers implement adaptive management techniques in their restoration strategies as well as provide a more effective data reporting scheme that includes information on why projects were done, how it was planned, specific activities, types of professionals involved, and how the project will be monitored and evaluated, what successes and failures were identified, and project constraints.

Kareen George '22

Faculty Mentor(s): Professor Raphael Dalleo, ENGLISH, LATIN AMERICAN STUDIES
Funding Source: Humanities Fellowship

Paradoxical Paradises

This independent study hopes to investigate how the nuances of tone and word choice in tourism-related Caribbean literature correspond to the true attitudes of Caribbean natives. I apply W.E.B Dubois' concept of the double consciousness of oppressed people as a lens for understanding Caribbean people's participation in the industry. The tourism industry, particularly the way it operates in the Caribbean, is notably exploitative. The demographics of the native Caribbean people versus the tourists give rise to an interesting power dynamic, reminiscent of colonialism. The success of the Caribbean's tourism industry is largely due to its' citizens' knowledge of this exploitation and the way they can manage their emotions and behavior to maintain the false image of the perfect paradise that visitors expect. To acquire a holistic understanding of this dual-sided disposition, an analysis was performed on pieces from three different genres of Caribbean Literature, namely Prose, Drama, and Poetry. The three selected pieces of literature for this study are A Small Place by Jamaica Kincaid, Smile Orange by Trevor Rhone, and "On a Coral Cay" by Marion Bethel. These three pieces give an account of three different forms of the same Caribbean attitude of double consciousness as it relates to the Tourism industry. " For my presentation, I will be focusing on Rhone's Smile Orange, as it is the piece that most embodies this notion of double consciousness, as expressed through humor.

Grace Ginder '25

Faculty Mentor(s): Professor Moria Chambers, BIOLOGY
Funding Source: Presidential Fellowship

A "Sick" Understanding: Determining the Impact of Antimicrobial Peptides on Pathogen Resistance in Immuno-Compromised Drosophila Melanogaster

Animals and microbes constantly interact, forming relationships that can persist over a lifetime. Microbial persistence can occur with pathogens as well, creating chronic infections despite the resolution of symptoms. In Drosophila melanogaster, chronic infection with bacterial pathogens provides partial non-specific protection against secondary acute infection. Yet, the mechanisms behind this protection are unknown. One potential explanation is that higher levels of antimicrobial peptides (AMPs) produced during chronic infection are responsible for the protection. My goal was to repeat these dual infection experiments in fruit flies missing some of their AMPs and see if protection was diminished. However, I first needed to determine whether fruit flies missing some AMPs could survive and sustain a chronic infection. I injected wild-type and two different strains of mutant flies, missing 10 AMPs

(Δ10) and 14 AMPs (Δ14), in the abdomen with Providencia burhodogranariae D. I recorded the resulting survival over seven days post infection. While some fruit flies missing AMPs became chronically infected, a large proportion of the flies died even from this normally non-pathogenic infection. This result demonstrates the overall importance of AMPs in controlling infection, and the significant difference in survival between the Δ10 and Δ14 flies emphasizes the importance of those four AMPs to the immune response. In the future, we plan to test the contribution of AMPs to protection using mutants missing fewer AMPs or drug inducible systems that can downregulate AMPs after chronic infection is established.

Bret Hatzinger '24

Faculty Mentor(s): Professor Dabrina Dutcher, Professor Timothy Raymond, CHEMICAL ENGINEERING, CHEMISTRY
Funding Source: Program for Undergraduate Research, James L.D. and Rebecca Roser Research Fund

Water Uptake of Monoterpene Aerosol Mixtures Produced in an Environmental Chamber

Understanding secondary organic aerosol (SOA) properties are essential in understanding cloud formation, which represents a significant uncertainty in the context of global climate modeling. Monoterpenes and sesquiterpenes are classes of semi-volatile organic compounds (SVOCs) of both biogenic and anthropogenic origins, emitted into the atmosphere. These compounds, when oxidized, contribute to the formation of SOA. It has been found that half of all total fine organic aerosol can be attributed to monoterpene oxidation. The resultant aerosol particles may also act as cloud condensation nuclei and contribute to cloud growth. Understanding the water uptake ability, or hygroscopicity, of these compounds improves our knowledge of their radiative effects, which can be used to improve climate models. Given that the SOA terpene precursors rarely occur in the atmosphere in isolation, an understanding of their group hygroscopicity will prove more valuable than any individual measure. To this end, the hygroscopicity of aerosols created from the oxidation of 14 different terpenes was measured using a cloud condensation nuclei counter (CCNC). A single parameter hygroscopicity (κ) value for the aerosol products from each compound was determined and then the compounds were combined in various mixtures. A span of mixture types, from similar (high/high) to contrasting (high/low) in value were analyzed. While not every possible combination was chosen for experimentation, mixtures were intentionally selected so as to provide a wide base of meaningful data. Preliminary results show that as more SOA precursors are introduced into the reaction mixture, κ values trend towards a central value, approximately 0.14.

Hannah Heinemann '23

Faculty Mentor(s): Professor Esra Kose, ECONOMICS
Funding Source: Culliton Family Fund for Undergraduate Research

The Political Economy of Upward Bound

This research endeavor studies the initial years (1966-1969) of Upward Bound, a federally funded War on Poverty program designed to increase college attendance and preparedness for low-income and first-generation high school students via tutoring, mentoring, and additional enrichment activities. The method of inquiry was regression analysis to determine which political and poverty factors motivated program funding per capita. Our paper was modeled after Bailey and Duquette (2014), which sought to understand the factors that influenced funding for the War on Poverty Community Action Programs. We applied their regression formula using the program data that we merged with the relevant political and poverty variables to assess the economic and political climate of each county. The main findings of the analysis reveal the poverty indicators, specifically for each level of income below the poverty line (designated at $3K) were statistically significant, increasing funding for each share per capita. For each share of nonwhite residents, a county received a greater amount of funding. For political variables, the size of population per capita was not found to hold any significance. For counties that experienced a change in share of Democratic voters between the 1960 and 1964 elections, it received greater funding; meanwhile, counties that voted democratic in the 1964 election were linked to receiving slightly less funding. The presence of a major committee member/leader in the 89th Congressional House allocated greater funding to their home districts.

Rebecca Heintzelman '24

Faculty Mentor(s): Professor G.C. Waldrep, ENGLISH

Four Modernisms: Research in 20th Century Creative Writing

This work stemmed from a class entitled Four Modernisms, in which we explored the work of poets T.S. Eliot, Gertrude Stein, Aimé Césaire, and Paul Celan. Our research started with close readings of many of their texts, which were discussed at length during class time. Using what we had learned, we constructed critical analyses of each of these poets and their writing, and with those analyses, we created our own responses to their work to gain a deeper understanding of how their styles worked. Our final goal was to create our own opera libretto in the style of Gertrude Stein, mirroring her Four Saints in Three Acts. In place of saints, presidents were used as the groundwork for our collaboration. The final product was a culmination of our creative work from the semester. This work combined literary research with historical research as we sought to learn more about our chosen presidents and convey their lives and personalities through the lenses of four vastly different modernist poets. This kind of research is unconventional, but it is an integral part of what it means to be a writer. The work I will be sharing is a selection of my own work from this course, which was written in the voice of Theodore Roosevelt. My work combines allusions to his life with specific literary conventions as they were used by Eliot, Stein, Césaire and Celan.

Verona Hendricks '22

Faculty Mentor(s): Professor Donna Ebenstein, BIOMEDICAL ENGINEERING
Funding Source: Department of Biomedical Engineering

Methods to Investigate Substrate Effect for Nanoindentation of Soft Biomaterials

Nanoindentation, also known as depth-sensing indentation, is a technique that presses a small tip into the surface of a material to probe local mechanical properties. During the indentation process, load and displacement are monitored

during the loading and unloading of the indentation probe. While nanoindentation testing was developed for testing hard materials, in recent years new methods have been developed that allow the measurement of accurate mechanical properties from soft materials, such as soft tissues, using nanoindentation (Ebenstein & Pruitt, 2006). Over the years, some guidelines were developed to ensure accurate data collection on hard materials so that people around the world would be able to reproduce the same results. For example, when testing hard materials, there are established "rules of thumb" for how thick a sample needs to be to ensure that indentation is measuring the properties of the sample material and not being influenced by the material below the sample; this is a phenomenon known as the "substrate effect." For hard materials, the rule of thumb is to not indent more than 1/10 of the sample thickness to avoid the substrate effect. However, similar guidelines have not yet been established for soft material indentation. This study aimed to develop and evaluate two different methods to determine the minimum sample thickness necessary to ensure accurate modulus measurements in soft biomaterials. The two methods were static bead indent tests and microindentation.

Ian Herdt '22

Faculty Mentor(s): Professor Paul Botelho, MUSIC
Funding Source: Bobko-Dennis Fund for Undergraduate Student Research

Development of Software Instruments, Virtual Effect Programs, and Computer-Aided Music Composition

Through pursuing this research project, I explored a variety of technologies present in the intersection between Computer Science and Music. I focused on the development of different types of music software, including instruments, effect programs, and composition algorithms.

I worked primarily with a JavaScript API called the WebAudio API, which specializes in the control, manipulation, and production of audio. Through the utilization of this API, I learned the basics of developing a simple multi-parameter software synthesizer, as well as how to expand upon and alter the instrument to fill different roles. I also researched granular samplers, software instruments capable of breaking apart a sound sample into multiple short grains (1-100 ms clips) and manipulating those grains to provide new compositional and timbral opportunities. The final application of the WebAudio API that I learned about was creating entirely virtual guitar effect pedals, which attempt to emulate the functionality of both analog and digital circuits that guitarists utilize to alter the timbre of a guitar's signal.

My research then shifted focus to the utilization of the music programming language ChucK to pursue the development of the algorithmic composition. I learned how to write code that would in turn "write music" for me, by making a multitude of decisions about what notes to play as opposed to having a human composer do such. The code currently produces more ambient, atmospheric soundscape music, as opposed to more contemporary and conventional genres, but could theoretically be fine-tuned to follow compositional themes of different genres of music.

Geoffrey Hewett '23

Faculty Mentor(s): Professor Rebecca Switzer, CHEMISTRY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Impact of Disease-Associated Mutations on Intermolecular Interactions Involved in DNMT1 Localization and Activation

DNA methylation is an important epigenetic modification influencing gene expression and abnormal methylation patterns are associated with several diseases. DNA methyltransferase 1 (DNMT1) is an epigenetic regulatory enzyme that maintains DNA methylation patterns across cellular generations. The replication foci targeting sequence (RFTS) domain of DNMT1 is an endogenous inhibitor of DNA methylation activity and must be removed from the active site for efficient methyl transfer to occur. UHRF1, an E3 ubiquitin ligase, is an important regulator of the localization and activation of DNMT1 in cells. Several domains in UHRF1 can interact with the RFTS domain of DNMT1 and remove it from the active site allowing for efficient catalysis. Mutations in the RFTS domain are associated with ADCA-DN, a neurodegenerative disease characterized by global hypomethylation and site-specific hypermethylation. The present work aims to investigate the impact of disease-associated mutations on UHRF1-mediated DNMT1 regulation. UHRF1 domains known to interact with the RFTS domain were isolated. The binding of UHRF1 domains to the RFTS domain is being assessed in isolation and the presence of DNA using isothermal titration calorimetry and fluorescence polarization assays. Weaker binding interactions observed with mutant RFTS domains would suggest the disease-associated mutations diminish UHRF1's ability to localize and activate DNMT1 at correct sites in the genome. Impaired localization and activation at proper genomic loci can help explain the abnormal methylation patterns observed in ADCA-DN patients.

Duncan Hill '24

Faculty Mentor(s): Professor Kenny Mineart, CHEMICAL ENGINEERING
Funding Source: Emerging Sc.-James L.D. and Rebecca Roser Research Fund

Characterizing Styrenic Triblock Copolymer with Static Light Scattering

Light scattering refers to the process in which a wavelength of light hits a particle and scatters in a pattern. This pattern can be interpreted to allow us to understand the characteristics of said particle. For my research, we used a known measurement technique called static light scattering (SLS) which measures the intensity of this scattering at multiple angles and multiple concentrations. This technique allows us to calculate constants such as the molecular weight, the A2 virial coefficient, and the radius of gyration of the scattered particle. Using this information, the measured polymer characteristics are used to explore the relationship between the structure and behavior of the polymer. The instrument used for these measurements is the BI-200SM Goniometer. The beginning part of the research project was to assemble, align, and calibrate this instrument for use. As soon as the instrument was prepared, we performed the SLS procedure on multiple polymers supplied by Kuraray America and Kraton Polymers. Using solutions of known concentrations, and by measuring the scattered intensity at

multiple angles, we can organize the data into a Zimm plot. This Zimm plot is organized such that we can easily determine the important constants of the polymers by observing the trendlines of the data. Seventeen different styrenic triblock polymers were characterized using this instrument. A procedure for future measurements using the instrument was also developed. This instrument is currently being used in further research opportunities of the dynamic light scattering (DLS) behavior of polymer gels.

Yang Hong '23

Faculty Mentor(s): Professor Kelly Bickel, MATHEMATICS
Funding Source: National Science Foundation Grant (NSF)

Graphs, Adjacency Matrices and Stable Polynomials

Our research concerns the interplay of undirected graphs and stable polynomials. Stable polynomials, which are polynomials with restricted zero sets, are used in a variety of mathematical fields. Here, a stable polynomial p is defined as a two-variable polynomial that satisfies p(z_1,z_2) being not equal 0 if (z_1,z_2) is in D^2, where D^2 is the unit disk {(z_1,z_2) in C^2: |z_1|,|z_2| < 1}. In this research, we use adjacency matrices of undirected graphs to construct stable polynomials and investigate the relationships between the shapes of the graphs and the zeros of the polynomials. In a variety of situations, we establish the existence and location of polynomial zeros on the boundary of D^2 and characterize how the zero set of a stable polynomial could approach those boundary zeros. We also pose and examine conjectures about more generalized and complicated cases. Using our results, one can build polynomials with specific boundary zeros and identify the boundary zeros implied by given polynomial properties.

Julia Illiano '22

Faculty Mentor(s): Professor Julie Gates, BIOLOGY
Funding Source: Fund for Undergraduate Research in Biological and Chemical Sciences

Characterization of Garz Protein Function During Dorsal Closure in Drosophila

During development, a single cell transforms into a complex, multicellular organism through integrated processes where cells divide, move, organize, and acquire specialized functions. One important developmental process occurs when cells move and change shape to form tissues and organs. I focus on the Garz protein, which was previously identified as potentially playing a role during the formation of a continuous epidermal layer that consists of skin cells. In Drosophila, the process that forms a continuous epidermal layer is called dorsal closure, which occurs during late embryonic development. At the beginning of dorsal closure, the dorsal or backside of the embryo has an eye-shaped opening in the epidermal layer. During dorsal closure, actin networks composed of dynamic actin filaments and myosin motor proteins induce a series of cell shape changes that allow the epidermal cells to migrate towards the dorsal side and close the dorsal opening. These actin networks are similar to the networks that allow our muscles to contract. To determine if reducing the level of Garz protein produces a defect that leads to embryonic death, I generated garz mutant embryos and found that a subset of these embryos died. I also determined if reducing the level of Garz protein affects the actin networks required for producing forces during dorsal closure. To do this, I examined the actin networks in garz mutant embryos using an immunofluorescent assay and found a range of dorsal closure defects.

Yinuo Jing '23

Faculty Mentor(s): Professor Thiago Serra, Professor Ryan Stauffer, ANALYTICS & OPERATIONS MANAGEMENT
Funding Source: Joann E. Walthour Undergraduate Research Fund

Do the Rich Get Richer even on Blockchains? The Matthew Effect of Smart Contracts on the Ethereum Blockchain

The research is about the Matthew Effect of smart contracts, computer programs that send or receive cryptocurrencies on blockchains. The Matthew effect means concentration of wealth. We investigate whether the early-stage investment is significant for late-stage success for smart contracts. Blockchain, a system that is used to record transactions of cryptocurrencies, offers an exciting opportunity for studying the Matthew Effect. On a blockchain, we have access to records of all the transactions that have ever been performed by any user of the blockchain. To analyze the Matthew Effect, I analyzed historical transaction records on the Ethereum network. Transaction data needed for the research has already been collected and released in previous research (Zheng, Zheng, & Dai, 2020). The released dataset contains more than 4 hundred million transaction details including transaction value, giver, and receiver. Different from previous research that only included transaction amounts, I added the USD value of each transaction. I compared the total USD of each contract at the time when the contract was created and one year later to see the correlation between early-stage investment and late-stage success. I define total USD in the contract as a standard of success because more transactions value means more users and more service fees that contracts gain. The research results show that smart contracts with more early-stage investment became more successful later.

Colton Jiorle '25

Faculty Mentor(s): Professor Nathan Siegel, MECHANICAL ENGINEERING
Funding Source: STEM Scholars

Electroformed Heat Pipe Heat Exchanger

As the necessity to shift towards renewable forms of energy becomes ever more apparent in the wake of the consequences of climate change, one major barrier that has largely yet to be solved is the problem of energy storage. It is technologically possible to meet our energy demands solely with renewables, and likely many times over. However, when energy is generated is a critical factor to meet our necessary load demands each day and when most renewables are active is not controllable. Many different forms of energy storage already exist but with many issues such as cost, scaling, and environmental impact. We are exploring the development of low-cost energy storage mediums, such as salt, sand, or dirt. However, these mediums have very low thermal conductivity and thus it becomes necessary to synthesize different techniques to accomplish a feasible storage method. Principally, we are investigating the combination of a heat pipe and the topology of a bio-inspired heat exchanger. Due to the highly complex geometry of such a device, it becomes necessary to utilize non-traditional manufacturing methods, namely an electroformer. If we can successfully incorporate both of these elements into thermal

energy storage, it would lead to the cheap and economical storage of energy allowing us to justify larger-scale use of renewable energy within our power grid.

Xander Karpowicz '22

Faculty Mentor(s): Professor James Arthur, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Roughness Effects of Seabed on Underwater Vehicle Flow Behavior

Underwater vehicles are designed to move submerged through bodies of water with either human-operated or autonomous control. Even though these vehicles are becoming more common, their design models are incomplete. For example, modern dynamic models do not account for significant flow patterns induced while traveling close to a rough seabed. The purpose of this research is to experimentally characterize the flow patterns surrounding an underwater vehicle while it is in the presence of a rough seabed-like surface. For these tests, particle image velocimetry is used to gather data on the velocities of fluids around the hull of a scaled DARPA submarine fixed to the bottom of a flume. Using this data, the flow patterns around the underwater vehicle hull can be analyzed. It is found that there is a clear increase in mass and momentum flux due to the presence of the seabed roughness. Additionally, there is non-isotropy in the Reynolds' normal stresses. The wake flow is marked by recirculation and muted Reynolds' shear stresses in the presence of the rough boundary. Overall, these results have implications on the kinds of turbulence models suitable for simulation of the flow as well as the types of flow patterns that are expected to result from the presence of a rough seabed-like surface.

Eadaoin Kelly '22

Faculty Mentor(s): Professor Morgan Benowitz-Fredericks, BIOLOGY
Funding Source: Department of Biology

Effects of Researcher Disturbance Levels on 5-Day-Old Black-Legged Kittiwake Chicks

The ability to closely monitor and manipulate marked populations of seabirds is invaluable for ecological research and conservation efforts. A reconfigured radar tower on Middleton Island, Alaska provides accessible semi-artificial nesting sites for black-legged kittiwakes (Rissa tridactyla). However, long-term researcher disturbance may affect seabird physiology, as disturbed and undisturbed birds may not be directly comparable in studies. We tested the effects of researcher disturbance on kittiwake chicks by categorizing disturbance levels as "high", "medium", and "low" based on researcher activities at 3 locations. A subset of the high disturbance birds were supplementally fed (whole fish ad libitum 3x/day). A (N=77) and B (N=77) chicks were measured after being bled in <3min when the A chick was 5 days old. Regurgitation was noted if produced during measurements. Whole-blood glucose and ketones were measured with handheld point-of-care (POC) meters; glucose was further measured with plasma in the lab. Despite being validated in adult kittiwakes, glucose values of the chicks from handheld meters did not show good concordance with lab-measured glucose (R2=0.08). Red blood cells were used for genetic sexing in the lab. Disturbance levels significantly impacted body condition in low and high-unfed A chicks, but there was no significant difference between that of low and high-fed A chicks. Blood metabolites do not reflect body condition or disturbance category. Chicks of the low disturbance area regurgitated significantly more than the chicks of any other disturbance category.

Peyton Kendall '22

Faculty Mentor(s): Professor Kristine Trego, CLASSICS & ANCIENT MEDITERRANEAN STUDIES
Funding Source: Douglas K. Candland Undergraduate Research Fund

Roman Oil Lamps of the Turnure Collection

In 2020, James Turnure, Samuel H. Kress Professor of Art History Emeritus, donated a collection of antiquities to Samek Art Museum at Bucknell University. Among the artifacts donated were seventeen previously unstudied Roman oil lamps, seven of which were selected to serve as the subject of this study. The chief aim of the project was to establish a catalog of the lamps, so as to make them accessible to the archaeological community. To do so, the lamps were individually drawn, described, photographed, and measured. Based on this information, they were then classified according to prevailing typologies, allowing for approximate dating and regional attribution. Following the documentation of the lamps, comparanda, or similar lamps, were identified in a variety of public and private collections. The descriptions, types, and comparanda of the lamps formulated the catalog, thereby creating an archaeologically standardized account of the artifacts. This documentation allows for a greater degree of scholarly access to Samek Art Museum's holdings, thereby introducing the lamps to the known archaeological corpus. The establishment of the catalog led to the curation of an exhibit of the lamps in Bertrand Library, on display currently. Furthermore, it served as the basis for a senior honors thesis, "Molding Diana: A Critical Analysis of a Selection of Lamps from the Turnure Collection," which investigates the modern reception of small finds, the ancient Roman oil lamp industry, and the transmission of iconography throughout the ancient Mediterranean world.

Joelle Kim '23

Faculty Mentor(s): Professor Michael Krout, CHEMISTRY
Funding Source: Harold W. Heine Undergraduate Research Fund in Chemistry, Presidential Fellowship, ACS petroleum research fund

Unsaturated β,β- Disubstituted Carbonyl Synthesis via Negishi Reaction

Unsaturated β,β-disubstituted carbonyls serve an integral role in synthetic chemistry as important substrates for direct addition, conjugate addition, and cycloadditions. Reactions involving these substrates have the potential to generate functionalized β-quaternary carbonyls and other desirable structures that are useful in complex molecule synthesis. Among cross-couplings, Negishi reactions leverage highly chemoselective organozinc nucleophiles. The mild reactivity and ready accessibility of alkyl organozinc facilitated the use of these reagents with β -haloenones in a Csp2 -Csp3 cross-coupling to synthesize β,β-unsaturated disubstituted carbonyls. We observed that various Pd(II) precatalysts with bulky biaryl

phosphine ligands promote an efficient coupling reaction with catalyst loadings at or below 2 mol% and reaction times generally less than 1 hour. Various functional groups are well-tolerated, including cycloenone, cyclopentenone, lactone, etc. providing over 25 reactions products in 55 to 95% yields.

Derek Knight '22

Faculty Mentor(s): Professor Sarah Smith, CHEMISTRY
Funding Source: Fund for Undergraduate Research in Biological and Chemical Sciences

Analysis of Various Peptide Stapling Methods to Inhibit Protein Interactions in Kinetoplastid Parasites

Interactions between proteins that regulate how the protein complex, as a whole, functions are integral to almost every biological function. Many diseases result when normal protein-protein interactions (PPIs) are altered, and the ability to manipulate these PPIs would enable the development of new classes of therapeutic agents. α-helices are a type of protein secondary structure that is commonly found at the interface between two proteins. There is a large body of ongoing research into the development of short protein fragments, or peptides, that can be engineered to fold into an α-helical structure to mimic a natural PPI. In this study, we are testing multiple methods to crosslink a short peptide to induce an α-helical fold, including metal-binding hybrid-coordination motifs, ring-closing metathesis reactions, thioether crosslinks, and lactam bridges. These peptides have been designed to bind to and prevent the function of Ribose-5-phosphate isomerase B (rpiB), a relevant target in the development of new treatments for parasitic diseases. I will present the work that we have completed to synthesize this set of peptides. I am continuing to work to compare the relative stability and secondary structure of each of these cross-linked peptides.

Megan Kopitsky '22

Faculty Mentor(s): Professor Bill Flack, PSYCHOLOGY
Funding Source: Program for Undergraduate Research

Bucknell 2020-2021 Campus Climate Survey Results

The present study analyzed the results of a campus climate survey that was disseminated to a random sample of the student body amid the COVID-19 pandemic during the spring 2021 semester at Bucknell. The survey addressed the prevalence rates of campus sexual assault in addition to investigating campus sexual assault prevention efforts, campus resources, and responses to reports of campus sexual assault. Results demonstrated prevalence rates consistent with established rates from campus climate surveys conducted at Bucknell in previous years. This suggests that the measures taken to mitigate COVID-19 since the start of the pandemic in the spring of 2020, including social distancing and limits on social gatherings, did not lessen the occurrence of campus sexual assault at Bucknell.

Shane Kozick '23

Faculty Mentor(s): Dr. Troiani (ADMI), NEUROSCIENCE
Funding Source: Helen E. Royer Undergraduate Research Fund

Measuring Concordance of Sulcogyral Patterns in Monozygotic and Dizygotic Twin Pairs

The brain's surface is made up of sulci (grooves) and gyri (ridges) that together create the distinct folded (sulcogyral) appearance of the brain. Sulcogyral folding patterns have been identified in the orbitofrontal cortex (OFC) based on the continuity of the medial and lateral orbital sulci (MOS & LOS). Pattern types are named according to their frequency in the neurotypical population, with Type I present in ~50%, Type II in ~30%, Type III in ~15%, and Type IV in ~5%. It has been previously found that populations with schizophrenia have reduced frequency of Type I patterns, but the heritability of the OFC sulcogyral patterns is unknown.

The goal of this project was to explore whether OFC patterns are heritable. We examined whether there is increased concordance of patterns in 172 monozygotic (MZ) twins relative to 304 dizygotic (DZ) twins using structural magnetic resonance imaging data. We also characterized pattern subtypes to explore variance within OFC sulci that is not based on MOS and LOS continuity.

We find no difference in concordance rates between MZ and DZ twin pairs. Results from subtype analysis suggest that variability exists in other sulci that are not captured in overall OFC pattern characterization. This suggests subtyping may be important for future studies to further understand the relationships between pattern types and subtypes. Overall, these results suggest a minimal genetic influence on OFC pattern types, indicating that OFC sulcogyral patterns may capture important variance that is not genetic in origin but is relevant to psychiatric disease risk.

Aki Kuramochi '25

Faculty Mentor(s): Professor G.C. Waldrep, ENGLISH

Stopgap

Poems doting on romanticism probing detail and form to commandeer language towards original and refreshing meanings, saturated with metaphor and food with backdrops in Japan, descriptions of physicality, as well as fault lines underlying relationships. Research in my writing is clasping the hands of memory and imagination. It is a fictive processed product, and that is why it is romantically glazed. I am an obsessive individual, who wants his life to be more beautiful and meaningful than it might be. Richard Hugo talks in The Triggering Town about a place, the titular town, to be familiar with, and these compressed refractions are some of the urges that yank at my consciousness. Adamantly, I believe poetry and its form is visual language as much as it is sonic. Form is details that transport a poem into a scene, and desperation to draw in writing with more richness. Form is not a crutch, but an enhancing frame. I am an attention whore who desires my writing to catch the eye, and I know it. I want to drive through the poems with specificity that imposes my view. Qualia or the subjectivity of human senses is quaint, but I want my poems to be a controlled environment where I'm the sole vessel to look through as a mesmerizing, yet memorably disturbing prism.

Angela Lai ’22

Faculty Mentor(s): Professor Brian Smith, CHEMISTRY
Funding Source: Drs. Anthony and Joyce D. Kales Undergraduate Research Fund

Controlling the Formation and Stability of Metastable Acetaminophen Polymorphs Using Humidity

Control overactive pharmaceutical ingredient (API) crystallization continues to be a major challenge in drug formulation, primarily due to molecular polymorphism, or the ability of a compound to exist in different packing structures within the solid-state. The differences in polymorphic form impact important drug-delivery properties such as solubility, and polymorph selectivity is highly dependent on the crystallization conditions. We examine acetaminophen as an ideal model system, with multiple known polymorphs accessible at atmospheric pressures. Using Differential Scanning Calorimetry (DSC) and Powder X-Ray Diffraction (PXRD), we evaluate how humidity can be used to target specific polymorphs of acetaminophen that have traditionally been difficult to prepare, as well as control the long-term stability of the crystalline forms.

Isabelle Levesque-Du Bose ’23

Faculty Mentor(s): Professor Elizabeth Capaldi, BIOLOGY
Funding Source: Department of Biology

Size Variation and Morphometric Analysis of Freshwater Mussels (Elliptio complanata) in the Susquehanna River Watershed

Freshwater mussels are a vastly understudied group of animals, and as a result, basic life history characteristics are unknown for many species. In some species, gravid females display a deceptive lure made from part of their mantle, but unless the female is displaying the lure, it is difficult to quickly and accurately determine the sex of mussels based on their external morphology. As a result, local mussel populations have hidden sex ratios, making estimates of population growth difficult. Using live Eastern elliptio mussels (Elliptio complanata) from the Susquehanna River and the Buffalo Creek, we sought to determine if there is a predictive relationship between sex and shape. Samples of gonadal fluid were extracted from the visceral mass to determine the sex of each individual. These data were then connected to three measurements of the corresponding shell: length, width, and depth (girth). No sexual dimorphism was present using these simple measurements. However, in a subset of the population sampled, further morphometric analyses of shape from digitized photographs of the animals revealed differences between the sexes, displaying a level of dimorphism previously unknown in this species. Determining the sex of live individuals has important implications for future studies of mussel biology, including answering questions related to mussel reproduction, demography, and population distribution.

Bangyan Li ’22

Faculty Mentor(s): Professor Robert Nickel, Professor Michael (Stu) Thompson, Professor Janet VanLone, EDUCATION, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Department of Electrical & Computer Engineering

ProPANE Notetaking Assistive Technology

The Propane project is a collaborative research project between Electrical & Computer Engineering and Education at Bucknell University. Our goal is to develop an assistive technology that will support note-taking for college students with learning disabilities (LD) and English Language Learners (ELLs) in the lecture-based classroom to improve their content learning and academic performance. While research has shown that effective note-taking leads to better performance and content mastery, students with LD and ELLs may struggle with this task in lecture-based classrooms. The purpose of the project is to reduce students’ cognitive load and free students’ working memory space to absorb lecture content.

Our approach is to create a smartphone application that will be used by the student to capture the lecture. The student will submit a video of the lecture and the application will use various image processing techniques and segmentation algorithms to extract the key information from the lecture. The extracted information is returned to the student for them to further review and or annotate. The extraction of the targeted information is a unique aspect of this project and presents major technical challenges but can potentially support effective and efficient note-taking. By allowing the student to focus on the lecture and not note-taking, it allows them to engage in other ways and use their working memory space on activities and discussion.

Tianzhu Liu ’22

Faculty Mentor(s): Professor Lucas Waddell, MATHEMATICS
Funding Source: Program for Undergraduate Research

An LP-based Characterizations of Solvable Cases of the Quadratic Assignment Problem

The quadratic assignment problem (QAP) is perhaps the most widely studied nonlinear combinatorial optimization problem. It has many applications in various fields, yet has proven to be extremely difficult to solve. This difficulty has motivated researchers to identify special objective function structures that permit an optimal solution to be found in an efficient manner. Previous work has shown that certain such structures can be explained in terms of the continuous relaxation of a mixed 0-1 linear reformulation of the problem known as the level-1 reformulation-linearization-technique (RLT) form. Specifically, the objective function structures were shown to ensure that a binary optimal extreme point solution exists to the continuous relaxation. This paper extends that work by considering known solvable cases in which the objective function coefficients have special chess-board and graded structures and similarly characterizing them in terms of the level-1 RLT form. As part of this characterization, we develop a new relaxed version of the level-1 RLT form, the structure of which can be readily exploited to study the special instances under consideration.

Murphy (Xiaoxuan) Liu '22

Faculty Mentor(s): Professor Karlo Malaga, BIOMEDICAL ENGINEERING
Funding Source: Dean's Fund for Summer Undergraduate Research in STEM

Effect of Patient-Specific Anisotropic Brain Conductivity on Volume of Tissue Activation in Deep Brain Stimulation for Parkinson's Disease

Deep brain stimulation (DBS) involves surgically implanting electrodes into brain areas exhibiting pathological neural activity and then stimulating those areas with continuous pulses of electricity. DBS is an established therapy for neurological movement disorders, such as Parkinson's disease (PD) and essential tremors. Computational models of DBS can be used to estimate the neural response to stimulation, termed the volume of tissue activation (VTA). A certain level of model complexity is required to obtain accurate VTA predictions, namely the electrical properties of the surrounding brain tissue. In this study, the effect of anisotropic tissue conductivity on the VTA was evaluated in a patient-specific manner. Forty PD patients who received bilateral subthalamic nucleus (STN) DBS (72 implantations) were included. For each implantation, individualized tissue activation models incorporating their anisotropic tissue conductivity (derived from diffusion tensor imaging) were built. Simulations were run at each electrode (4 per implantation) to account for local changes in tissue conductivity. For comparison, simpler models assuming a homogeneous and isotropic tissue conductivity were also built. The VTA was characterized based on size and shape using various metrics: volume, spread in the x-y-z directions, and sphericity. Overall, incorporating anisotropic tissue conductivity resulted in significantly larger and less spherical VTAs. VTA size and shape were affected to varying degrees across patients and depending on stimulation location relative to the STN. Findings from this study suggest that anisotropic tissue conductivity should not be neglected in patient-specific DBS modeling to accurately characterize the VTA.

Victoria Loffredo '22

Faculty Mentor(s): Professor Janet VanLone, EDUCATION
Funding Source: Helen E. Royer Undergraduate Research Fund

A Year Like No Other: Leading and Learning Through a Pandemic

Over two years ago the COVID-19 pandemic forced school closures and opened a new world of virtual learning. Since March 2020, school leaders have faced numerous challenges as they attempted to educate all students while keeping communities safe. School shutdowns forced districts to turn to virtual learning, and then the task of deciding how to reopen. School leaders were at the forefront of every district's response. K-12 schools make a critical contribution to a functioning society, and often bear the responsibility of resolving societal struggles, which we saw throughout the pandemic. The purpose of this ongoing qualitative study is to explore school leaders' perspectives and decision-making processes throughout the pandemic. School leaders understand what is needed to begin the recovery process as we move beyond the pandemic. It is important for policymakers, educators, and communities to understand how school leaders navigated the decision-making process regarding school reopening and foresee challenges moving forward. With help from my mentor, Professor Janet VanLone from the Education Department, I worked this summer to collect data by conducting semi-structured interviews with superintendents across the Northeast. After conducting the interviews, I worked to transcribe and begin coding the data. Through the coding process, my preliminary results showed that common themes included how school leaders looked towards federal and state governments to provide guidance but instead received nothing and the community nature/culture of the area of the school district.

Ellie Lowe '23

Faculty Mentor(s): Professor Brian Smith, CHEMISTRY
Funding Source: Program for Undergraduate Research

Selective Melt Crystallization of the Elusive Form III Polymorph of Acetaminophen

Polymorphism is the inherent possibility for a molecule to crystallize into multiple different structures in the solid-state. The preparation of one polymorph over another is practically useful in pharmaceutical development, as key properties like compressibility and solubility can vary with the structural form. Many conditions can affect polymorph formation such as temperature, additives, and atmosphere. Acetaminophen, the active ingredient in Tylenol, is one example of a polymorphic compound. Here we use acetaminophen as a model system to better understand the sensitivity of polymorph selection and interconversion to environmental conditions. Using Differential Scanning Calorimetry (DSC) and Powder X-Ray Diffraction (PXRD) we show that polymorphs of acetaminophen often characterized in the literature as 'elusive' can be reproducibly crystallized through melt recrystallization when the atmospheric headspace is controlled at various stages.

Makenna Luzenski '23

Faculty Mentor(s): Professor Chris Boyatzis, PSYCHOLOGY
Funding Source: Psychology Undergraduate Research

Hand Sanitizer Use and COVID-19: A Naturalistic Observation of Hand-washing Habits in College Students

The COVID-19 pandemic struck colleges across the nation, leading schools to take many risk-mitigation steps to protect student/staff health, including installation of hand sanitizers across campus when schools reopened in fall 2020 for instruction. We examined students' use of school-installed hand sanitizers in campus buildings to learn if that risk-mitigation strategy helped limit the transmission of COVID-19 on campuses. During that semester, we conducted unobtrusive naturalistic observations of 1680 private-university students as they walked past hand sanitizers in high-traffic buildings (library, dorms, classroom buildings). In an overwhelming 96% of observations, students did not use hand sanitizers. Our data suggest that public-use hand sanitizers in campus buildings were not an effective use of that money. However, it is possible that personal hand sanitizers were effective.

Silja M. Hilton '22

Faculty Mentor(s): Professor Ashli Baker, Professor Jean Peterson, CLASSICS & ANCIENT MEDITERRANEAN STUDIES, ENGLISH
Funding Source: Douglas K. Candland Undergraduate Research Fund

On Cleopatra VII: From Horace and Shakespeare to Self-Representation

This research project explores and analyzes Horace's Ode 1.37 and Shakespeare's Antony and Cleopatra in context of their poetic and theatrical narratives, word choice, and grammatical structures in an effort to form a clearer image of Cleopatra VII. While each work is placed within its historical settings, I do not pursue their historical 'truths.' Rather, I draw from the authors' literary conceptions about the Ruler, from Horace's impotens ("a woman lacking in self-control") to the fierce agency in deciding death ("deliberata morte ferocior"), to Shakespeare's 'othering' of Cleopatra as tawny, gypsy, and whore, to his portrayals of her as Goddess and Isis. Ultimately, both Horace and Shakespeare fashion Cleopatra according to ancient Roman and Early Modern ideological opposing constructs, such as male versus female, native versus foreign, sexually pure versus sexually indulgent, and more. In an attempt at both challenging and fusing Horace and Shakespeare's literary narratives with an ancient Egyptian archeological framework, I return to Cleopatra's representations on coinage as well as inscriptions, while contemplating her own perspectives as possibilities for the historical reimagination of a woman and woman in power. By looking at her self-representations, we discover a Queen identifying as wholly Egyptian, male and female, queen and king, ruler, regent, Pharaoh, goddess, daughter, sister, and mother. To amplify her silenced voice, we must reimagine her narrative by returning to the primary sources she left behind. Only then can a just representation of Cleopatra be formed.

Casey Mack and Macy Albaitis '22

Faculty Mentor(s): Professor Regina Gazes, ANIMAL BEHAVIOR
Funding Source: Department of Biology

Conditioned Territory Defense in Madagascar Hissing Cockroaches (G. portentosa)

In male blue gourami fish (Trichogaster trichopterus), signaled presentation of a male rival produces an aggressive conditioned response (Hollis, 1984). We replicated Hollis's (1984) study in a species that also shows territorial aggression: Madagascar hissing cockroaches (MHC; Gromphadorhina portentosa). During training, four adult male MHCs were designated as "CS+" animals and received a light (NS) followed by visual access to a rival male (US). Simultaneously, another group of four adult male MHCs designated as "CS-" animals received the light (NS) and visual access to a rival male (US) at random intervals, such that the light was not predictive of the appearance of the male. During testing, each CS+ animal was paired with a CS- animal, the light was presented, and the animals were given direct physical access to each other. CS+ animals won all of these test fights, indicating conditioned territorial aggression in MHCs. Follow-up experiments revealed that signaled presentation of a rival male may produce an aggressive conditioned response in male MHCs. These results suggest an important ecological role for classical conditioning in MHCs.

Davis MacKelcan '22

Faculty Mentor(s): Professor Brantley Gasaway, RELIGIOUS STUDIES
Funding Source: Douglas K. Candland Undergraduate Research Fund

Reactions of Religious Leaders to Covid-19

I researched the response of central PA churches to the novel coronavirus. My main curiosity in this study was whether the popular media opinions on conservative Christians and their apparent resistance to the coronavirus were as pervasive as some were suggesting. My method of inquiry was threefold. I first virtually surveyed local pastors, sending out over 170 surveys and receiving a total of 43. I asked a variety of questions concerning the pandemic, their congregations, and the last year and a half as a whole. I then offered the opportunity for survey participants to partake in zoom interviews. I was able to conduct 12 interviews where I asked general questions and was able to get more context when compared to the survey questions. What I learned in my research was that even in one of the more conservative areas of the US the vast majority of people both believed in and altered their behavior as a result of Covid-19. The people the news often pointed to create controversy exist but they are exceptions and not the rule. I think this is an important thing to understand because when we are presented with someone who is very much out of the norm and told this is a common belief it spreads confusion, panic, and hatred for many people that simply aren't deserving of it.

AKM Sadman (Abir) Mahmud '24

Faculty Mentor(s): Professor Katharina Vollmayr-Lee, PHYSICS & ASTRONOMY
Funding Source: National Science Foundation Grant (NSF)

Influence of Pins on The Jamming Transition of a Sheared Athermal System

We use molecular dynamics simulations to study a two-dimensional athermal, a bidisperse system with purely repulsive harmonic interactions. Via top and bottom walls consisting of frozen particles, we shear the system. Energy is dissipated via interactions $\vec{F}^{\rm D} = - b (\hat{r}_{ij} \cdot \vec{v}_{ij}) \ hat{r}_ij$. The system furthermore has non-moving "pins". The size ratio of pins:small: large is 0.004:1:1.4 and pins are located on a square lattice. We show preliminary results for pressure and shear stress as a function of packing fraction. We find that in agreement with previous work on the non-sheared system, the jamming transition decreases with an increasing number of pins.

Marta Majewski '22

Faculty Mentor(s): Professor Kevin Myers,PSYCHOLOGY
Funding Source: Helen E. Royer Undergraduate Research Fund

Psychological, Cognitive, and Physiological Effects of Food Insecurity

Many people live with chronic food insecurity, characterized by unreliable, unpredictable food access. Paradoxically, food insecurity promotes obesity, although causal links are not understood. As food insecurity is embedded in a complex web of socioeconomic variables, we propose an animal model on laboratory rats that can pinpoint basic bio-psychological impacts of chronic uncertainty. The feeding model entails long-term maintenance on a feeding schedule with four daily feeding

times (9:00 am, 1:00 pm, 5:00 pm, and 9:00 pm) with either highly predictable (SEC group) or constantly unpredictable (INSEC group) amounts delivered at each mealtime. We studied psychological and cognitive effects using the elevated plus-maze, object- and place-recognition memory tests, and an ELISA test of stress hormones. While no cognitive differences were observed between SEC and INSEC in the memory tests, differences in anxiety were seen in the elevated plus-maze. Then, a physiological effect of food insecurity on stress was measured via an ELISA, finding INSEC rats had higher levels of corticosterone than SEC rats. We propose this to be a potentially useful animal model for controlled studies of the chronic uncertainty inherent in food insecurity.

Claire Marino '23

Faculty Mentor(s): Christopher Martine, BIOLOGY
Funding Source: Department of Biology, David Burpee Endowment

Using Comparative Morphology to Describe a New Bush Tomato Species from the Australian Monsoon Tropics

Estimates suggest that over 70% of the Australian flora and fauna have yet to be described. Numerous new plant species are still being described each year from across the continent. Here, we investigate one such potential new species currently known to field botanists as Solanum sp. 'Deaf Adder', which is named for its only known location in the remote Deaf Adder Gorge within Kakadu National Park, a biodiversity hotspot. It is currently designated as a localized variant of Solanum asymmetriphyllum and is a close relative to Solanum sejunctum. However, based on the numerous morphological differences between these three plants and their geographical separation within the national park, it is more than likely that 'Deaf Adder' is a distinct and separate species. More than 30 morphological characters were measured using either manual methods or ImageJ on a greenhouse-grown female 'Deaf Adder' specimen, including leaf length, stem prickle density, and seed count, and then used to document the differences among 'Deaf Adder', S. asymmetriphyllum, and S. sejunctum. Data analyses are continuing to be compared across the three taxa, including PCA, ANOVA, and post-hoc testing. Preliminary data suggest that there is clear separation among the three taxa and strong evidence to support that Solanum sp.'Deaf Adder' is a distinct species. The new species is one of only a few bush tomatoes endemic to Kakadu National Park. It is one of three Solanum species occurring here that exhibits functional dioecy, a sexual system in which morphologically bisexual flowers produce non-functional inapeturate pollen.

Thomas Matsumura '22

Faculty Mentor(s): Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Program for Undergraduate Research, Bucknell-Geisinger Research Initiative

Measuring Lower Limb Muscle Activity and Kinematics in Variable Foot Strike Gaits

Anterior knee pain affects roughly 23% of adults and 29% of adolescents, and many cases go untreated. Prior research has aimed to identify underlying causes of knee pain, and while exact causes can be unknown for individuals, differences in muscle activity, gait patterns, morphology, and loading are key contributors. To better understand links between muscle activity and kinematics, we aimed to measure changes in surface electromyography of knee extensor muscles and others as a result of different gait patterns. A total of twenty subjects underwent surface electromyography measurements in the Bucknell motion analysis biomechanics lab and with the use of non-invasive surface EMG sensors that measure muscle activation. Specific activities and gait patterns include normal walking, toe-in/toe-out walking, heel-strike/toe strike, and normal running. Sensors were placed on the subject's vastus medialis and lateralis, quadriceps, hamstring, and medial/lateral gastrocnemius. Following data collection, data processing included rectification, high/low pass filters, root mean square and moving envelope calculations, and normalization to maximum voluntary contraction EMG. Statistically significant patterns were identified in EMG profiles both intra-subject and between subjects, with the vastus medius and vastus lateralis showing the most variation in activation, and toe-in/toe-out walking showing the greatest activation. In several subjects, the activation profile of both the Rectus femoris/hamstrings and gas med/gas lat were not statistically different from themselves but were different than the vas med/vas lat ratio. The next step is to discuss clinical relevancy and how our data can inform pain prevention.

Caroline Mayk, Emma Dougherty, Catherine Zara, Madison Lance, Aries Contreras & Jasmine Mena '22, '23

Faculty Mentor(s): Professor Jasmine Mena, PSYCHOLOGY
Funding Source: Funding Source: Psychology Undergraduate Research

Cultural Humility and Genetic Counselors' Training and Professional Experiences

Genetic counselors are healthcare professionals who work with individuals and families to give them insight into how their genetic information impacts their health and the health of their family members. Culturally responsive genetic counseling is associated with positive patient experiences such as less worry about their health issue and greater knowledge about relevant health concerns. Yet, prior research indicates that most genetic counselors are White, have a limited understanding of the importance of cultural responsiveness, and are exposed to limited linguistic and cultural competence training. Increasing health equity in genetic counseling services will require a better understanding of how training experiences relate to social justice orientation and cultural humility in service delivery, which is the focus of this study. Data collection is in process. After completing informed consent, participants will complete a 15-20 minute Qualtrics Survey. The study measures include: demographic characteristics (age, gender, race & level of education), Social Justice Scale, Cultural Humility, Multicultural Environment, Qualities of Engaged Counselors Assessment, and Social Desirability Scale-Form C. We hypothesize that multicultural training experiences and environments will be positively associated with cultural humility and social justice orientation. Although data collection is still in the progress, we would hope to see a strong, positive correlation between the genetic counselors who have had multicultural training incorporated into their coursework and graduate school program and their ability to counsel patients who are of a

different background than their own. We hope our results may increase diversity, equity, inclusion, and social justice training in the genetic counseling graduate school curriculum.

Shannon McCollum '22

Faculty Mentor(s): Professor Mark Haussmann, BIOLOGY
Funding Source: Kalman Fund for Biomedical Research Fellows

Prenatal Glucocorticoid Exposure Affects How Adults Respond to Stressors Later in Life

A sudden increase in glucocorticoid hormones (CORT) allows vertebrates to mount a physiological response to stressors, however, there may be long-term consequences to CORT exposure such as oxidative stress. This study examines the effect of prenatal CORT exposure on the development of the stress endocrine axis, and stress responses later in life. Developing birds, like mammals, are exposed to maternal stress hormones in ovo or utero, respectively. We injected quail eggs with a physiological dose of CORT to mimic prenatal exposure. Later in life as adults, we found that the prenatal CORT birds could not turn off their stress response as quickly as the control birds. This result suggests that birds exposed to prenatal CORT may be exposed to higher cumulative levels of stress hormones throughout life as their negative feedback system, or ability to turn off a physiological response to a stressor is altered. Our lab has shown that chronic exposure to elevated CORT levels results in accelerated aging, suggesting these prenatally exposed birds may age more quickly.

Bree McCullough '22 and Eliza Ray '24

Faculty Mentor(s): Professor Edwin Ladd, PHYSICS & ASTRONOMY
Funding Source: Presidential Fellowship

Unveiling the Structure of the Universe for Non-Science Students

Our research focuses on creating and testing the effectiveness of an introductory astronomy lab activity designed for undergraduate non-science majors. To explore the Hubble Law, the expansion of the universe, and large-scale structures, this lab implements the WorldWide Telescope, an interactive multi-perspective visualization tool, analysis of real astronomical data, and tactile models. We conducted a focus group to test the implementation of this new curriculum and compared the results with a previous study done on an earlier version of the lab. We hope to fully develop and publish a fun and interesting laboratory experience that can be accessed without economic or social barriers to advanced technological materials.

John Mirsky '23

Faculty Mentor(s): Professor David Rojas, LATIN AMERICAN STUDIES
Funding Source: Douglas K. Candland Undergraduate Research Fund, The Tom Greaves Fund for Research and Curricular Development, Presidential Fellowship, Program for Undergraduate Research

Multiculturalism in Crisis: 60 Years of Housing Illness in a PA Mushroom Town

Advancing recent literature that critically examines multicultural efforts to generate socio-economic inclusion, this article studies how, in a small yet affluent Pennsylvania town, multicultural festivals are part of a social milieu in which Latinx people face continuing erasure and exploitation—manifested in precarious health and housing conditions Using ethnographic and qualitative methods (including 60 interviews—24 with non-Latinx white and Latinx NGO staff members and 36 with Latinx agricultural workers), I show that, although multicultural festivals in the town aim to give a voice and recognize minority communities, they have been part of a social milieu in which Latinx peoples have been actively silenced and overlooked over the last half-century, resulting in heightened rates of key health issues related to substandard and dangerous housing (including diabetes, obesity, and coronavirus). From a semiotic theoretical approach, the disconnect between increasing performative-visibility and the ongoing marginalization of Latinx individuals can be explained by multicultural festivals functioning as and relying upon floating signifiers. My findings shed light on the nuanced cultural ways that the structural social and material suffering of minoritized populations is overlooked through the invocation of purportedly emancipatory acts of dubious efficacy. I finish by elaborating broader relevances and making a case for possible hope.

Ned Mitrovich '24

Faculty Mentor(s): Professor Jonathan Torres, MECHANICAL ENGINEERING
Funding Source: Emerging Scholar

Design Limitations of 3-Axis and 5-Axis Additive Manufacturing

Background: Additive manufacturing (AM) is a huge asset to rapid prototyping, and it is now the subject of increasing pressure to be utilized for end-product manufacturing as well. Although traditional 3-axis AM can exceed the design freedoms of alternative manufacturing methods, it is still limited in the complex geometries it can create without wasting excessive material on support structures, leading to resistance from industry to adapt. 5-axis additive manufacturing has emerged as a solution, by reducing support waste and increasing design freedom. With greater design freedom comes even greater design complexity, and this investigation aims to develop an approach for understanding the limitations that accompany 5-axis AM.

Methods: Limitations were to be evaluated through the development of a benchmark part. This comprehensive part is meant to house numerous features that allow for a multitude of dimensional and positional metrics to be evaluated.

Results/Conclusions: It was determined that the best method for post-processing the benchmark part would be to print the model in stages. A core centered around the center of the model would be printed first, at such a size that no cut features would intersect the core. This was done with intention, as the sides of the model would be printed next, and material would be extruded around those cutout features. The sides of the model all are to be printed synchronously one layer at a time. In other words, an entire layer of filament would be put down on the rounded face, then an entire layer on one of the flat faces, etc.

Natalie Moreno ’22

Faculty Mentor(s): Professor Emily Stowe, BIOLOGY
Funding Source: Kalman Fund for Biomedical Research Fellows

Identification of Novel Microorganisms and Nitrogen Fixing Organisms in Central Pennsylvania

In this project, we sought to identify novel organisms from various locations throughout the Bucknell Natural Area. Bacteria were isolated on minimal media (lacking ammonia and nitrate) supplemented with a small amount of yeast extract and sucrose or mannitol. After repeated quadrant streaking, two novel microorganisms were isolated. PCR amplification of the 16S rRNA gene followed by sequencing of the PCR product indicates that one is of the Pantoea genus and the other of the Paenibacillus genus. Once the organisms were isolated, metabolic analyses were conducted using the BIOLOG GenIII plates. We will present the metabolic analysis as well as the results of annotating the genomes of these two organisms. In the second part of this experiment, the community characteristics of the soil samples were assessed using BIOLOG Ecoplates and community DNA was used to assess nitrogen-fixing capability by PCR amplification using the nifK and nifH genes.

Nolan Morrison ’22

Faculty Mentor(s): Professor Brandon Vogel, CHEMICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Factors That Inuence Successful Ettmp-PEGDA Thiol-Ene Hydrogel Synthesis

Ethoxylated trimethylolpropane tri-3-mercaptopropionate (ETTMP) and poly(ethylene glycol) diacrylate (PEGDA)-based hydrogels are promising candidates for injectable, localized drug delivery due to the potential for non-swelling behavior and controllable drug release properties. However, we nd that existing literature synthesis methods suffer from slow gelation times or a lack of reproducible procedures. In this work, we present a repeatable synthesis procedure, along with a sensitivity analysis of the major variables that impact successful synthesis. Our methods allow the hydrogels to be reliably synthesized in a polymer concentration range of 15 to 90 wt.%, resulting in gelation times between 2 min and 1 h with equilibrium moduli between 3.5 and 190 kPa. Furthermore, base-catalyzed conjugate Michael curing led to 16.35 min and 1.67 min gelation times for buffer pH values of 6.5 and 8, respectively. Additionally, we show that ETTMP purification directly controls the concentration of mercaptopropionic acid that inhibits the Michael addition. Lastly, we nd that a stoichiometric mixture of ETTMP and PEGDA freezes at -23.6 oC and can be stored at -20 oC for 2 months without crosslinking, as opposed to 2 days at room temperature, making storage and shipment of mixtures possible.

Jayne Marie Muoio, Julia McNally, Aanya Chopra, Ashley Boccio ’22

Faculty Mentor(s): Professor Mark Haussmann, BIOLOGY
Funding Source: Department of Biology

The Effects of Alcohol on Male Siamese Fighting Fish Aggression and Metabolic Rate

Ethanol consumption depresses the central nervous system and may lead to sedation, impaired memory, and uninhibited behavior. Alcohol congeners, which are chemical byproducts of the distillation process, have been found to have effects on aggressive demonstrations in Betta fish. Male Siamese fighting fish, Betta splendens, are well-known for their displays of aggression towards one another, most commonly exhibiting behaviors such as gill flaring and striking. We investigated how the rate of consumption of tequila, with high-congener content, versus ethanol, with low-congener content, would affect aggressive behavior and metabolic rate. To study this, four treatment groups and one control group were used. The two binge groups (ethanol and tequila) were exposed to a high concentration of alcohol to total solution volume in experimental tanks for 1 hour. The two prolonged groups (ethanol and tequila) were exposed to a lower concentration of alcohol to total solution volume for 4 hours. After the alcohol exposure period, aggressive behaviors were measured and oxygen consumption data was gathered to calculate the metabolic rate at rest and while fighting. Males in the prolonged tequila group had a significantly higher average gill flaring frequency than all other groups. Males in the prolonged tequila group had the highest average strike frequency followed by binge tequila. The prolonged tequila group also had the overall highest oxygen consumption at rest and during the fighting. The higher congener alcohol given in prolonged, lower concentration groups increased aggressive behavior and metabolic rate, whereas binge exposure decreased behaviors and metabolic rate for both alcohol types.

Abdullah Nabi ’23

Faculty Mentor(s): Professor José Madero Muñoz, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Observation of Free Falling Water-Alcohol Droplets During Combustion

The existing sources of fuels are finite and non-renewable so, the development of alternative fuels is essential to avert a world crisis. Substituting the traditional fossil fuels with fuels obtained from bio-sources is desirable since it can lead to carbon-neutral or even carbon-negative processes. One promising renewable fuel is bio-ethanol. However, bio-ethanol is heavily diluted in water before processing. Normally, the water content in the water-based broth reaches more than 90 percent of the total weight during the fermentation step so, the de-watering process is energy-intensive and expensive. By using alcohol-water mixtures instead of the fuel, the de-watering process could be eliminated, decreasing around 20-30% of the total production cost of these biofuels. The research deals with the combustion of multi-component droplets, specifically ethanol and water mixtures using a single droplet generator. The experiments mainly rely on the generation of a stream of droplets with controlled size, spacing, and velocity by using the ink-jet printing technique and axially injecting them into a high-temperature

chamber. The combustion of the droplets was proven to follow the d squared law of combustion. The droplet combustion characteristics in terms of the burning rate, droplet diameter, and liquid mass transfer mechanism will be studied as the research continues.

Nguyen Nguyen ’23

Faculty Mentor(s): Professor Alex Kelly,
COMPUTER SCIENCE
Funding Source: Program for Undergraduate Research

Understanding Bilingualism with the Multi-modal Δ-RNN Model

Current language models are unable to reproduce the relationship between languages in the minds of bilingual speakers. Code-switching, a linguistic behavior where bilingual speakers alternate between languages, can be used to evaluate language models’ ability to understand relationships between languages in a human-like manner. However, trained only on language data, current models do not code-switch. To replicate the code-switching behavior, we train the multi-modal Δ-RNN model of Ororbia et al. jointly on the MS-COCO-ES image captions dataset. Each image in the dataset is linked to five human-annotated English captions and five machine-translated Spanish captions for a total of 200,000 captions. We pair each caption with the image, and randomly shuffle the dataset to reduce noise. At the end of our project, we have prepared the dataset and set up the base bilingual multi-modal Δ-RNN model. Our next step consists of testing the model layer’s cosine similarity to two monolingual multi-modal Δ-RNN models and evaluating the model’s performance. The analysis will allow further evaluation of the usefulness of the multi-modal models in simulating the language understanding and acquisition processes of bilingual speakers.

Trang Q Nguyen ’22

Faculty Mentor(s): Professor Karen McGrath,
ACCOUNTING & FINANCIAL MANAGEMENT

The COVID-19 Impact on Corporate Financial Fragility in the Vietnamese Manufacturing Industry

In the past decades, under the government’s export-led growth strategies, the Vietnamese manufacturing sector has established a deep tie with the international market and become the main growth generator for the whole Vietnamese economy. However, during the pandemic when the global economy contracted at -4.4 percent, demand slumped worldwide, and myriads of corporations faced bankruptcy, this existing growth model and the manufacturing sector’s reliance on the volatile external market induced significant risks to this sector from both the demand and supply sides. Using firm-level data on 43 manufacturing exporting companies from the Vietstock database and national-level data on the development of COVID-19 and the magnitude of fiscal policies enacted by IMF and World bank, this paper attempts to investigate the impact of the COVID-19 situation on significant trading partners and in Vietnam on bankruptcy risks of manufacturing companies. Using a fixed-effect regression model, I found that the COVID-19 pandemic introduced great revenue volatility but did not undermine the solvency levels of Vietnamese manufacturers. Further examination of firm-level financial ratios elucidates that a decade of high growth has built up the necessary firm-level financial resilience that allows these manufacturers to withstand massive macroeconomic shocks. This result suggests that effective implementation of trade policies from the government and active corporate financial management are key to sustaining the growth of this sector in the aftermath of the pandemic.

Ephraim Oliphant ’22

Faculty Mentor(s): Professor Ibrahim Sulai,
PHYSICS & ASTRONOMY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Noise Characterization in the Axion Search

Axions are theoretical new particles that may help solve large unanswered questions in physics ranging from the nature of dark matter to the Strong-CP problem. The Global Network of Optical Magnetometers (GNOME) is a collaboration searching for evidence of Axion and Axion-like particles by searching for the predicted interaction between the new particles and atomic spins. Magnetometers are highly sensitive instruments traditionally used to measure the magnetic field’s effect on atomic spins, but after drastically reducing the local magnetic field they become an ideal tool to detect the effects of the Axion. We are contributing data from a magnetometer in Lewisburg, and are examining noise characteristics of the data across time and frequency. Gaussianity is one such characteristic, which when estimated can help us to better understand the significance of possible detections and nondetections. We developed a tool to quantify this parameter for GNOME’s magnetometers.

Anthony Orlando ’24

Faculty Mentor(s): Professor Kenneth Mineart,
CHEMICAL ENGINEERING
Funding Source: Chemical Engineering Department – Undergraduate Research

Temperature Dependence of Diffusion in Mineral Oil Based Polymer Gels

One application of polymer gels is for use as transdermal drug patches where the temperature of the gels would vary slightly depending on which part of the body the patch is applied to and the climate that the patient is living in. Therefore, it is important to consider the temperature dependence of diffusion of solutes through these gels. Additionally, studying diffusion allows for the determination of the activation energy of the diffusive process for a specific gel composition. Diffusion testing in temperature-controlled environments was conducted to find the diffusion coefficients of the gels at different temperatures. This testing determined the relationship between temperature and diffusion coefficient. Since diffusion coefficient is a temperature-dependent property, it can be hypothesized that the relationship between these variables follows the Arrhenius Equation D(T)=D_0 e^((-E_a)/RT) where D(T) is diffusion versus temperature (T), R is the universal gas constant and Ea is the activation energy required to initiate the diffusion. Based on the results of this investigation, the change in diffusion coefficient as temperature changes for 20% SEBS polymer mineral oil-based gels is very strongly correlated to the above Arrhenius Equation. Additionally, the activation energy of the diffusion process for these gels was found to be 39.9 kJ/mol. This represents the minimum energy required to begin the process of diffusion of molecules out of this type of gel. Future projects

can be conducted on polymer gels with different polymer concentrations or polymer species to determine the effect of these factors on the temperature dependence of diffusivity.

Alexa Patel '22

Faculty Mentor(s): Professor Moria Chambers, BIOLOGY
Funding Source: Department of Biology

Bacteria vs. Hydrogel: Will P. aeruginosa, E. coli, or E. faecalis Survive?

The goal of experimentation was to analyze the antimicrobial properties of solvent-loaded hydrogels. The gels were synthesized, by the Vogel lab, with the intent that they could be used to coat stents or artificial organs to improve compatibility in the human body. Hydrogels were loaded with one of the following solvents: 1) water (H2O), 2) propylene glycol (PG), 3) 1,2-hexanediol (1,2-HD), 4) propylene glycol + 1,2-hexanediol (PG+1,2-HD), 5) propylene glycol + 1,2-decanediol (PG+1,2-DD), or 6) 1,2-hexanediol +1,2-decanediol (1,2-HD+1,2-DD). The Zone of Inhibition assay was used to observe and quantitatively measure how the hydrogels inhibit microbial growth. The solvent-loaded gels were able to inhibit the growth of all three bacterial species used: Pseudomonas aeruginosa, Escherichia coli, and Enterococcus faecalis. Inhibition of E. faecalis was less in comparison to the counterpart diameters measured for P. aeruginosa and E. coli for the same solvent-loaded gels. The Percent Kill assay was used to quantify the amount of colony-forming units (CFUs) the loaded gels killed. The assay showed that most wells with solvent-loaded hydrogels had greater percent kill than control media wells. The biofilm assay was used to measure the extent of antimicrobial properties of the loaded gels. Unfortunately, the gels retained the crystal violet dye which diminished the ability to measure the extent of inhibition. Further testing with other pathogens should be performed to provide more insight on the clinical application of these solvent-loadedd hydrogels.

Lindsay Perrin '23

Faculty Mentor(s): Professor Richard Crago, CIVIL & ENVIRONMENTAL ENGINEERING
Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Using LiDAR and Stream Power Indices to Predict Hotspots for Sediment Erosion

The goal of this research was to investigate erosion patterns within watersheds, using two streams near Bucknell's campus as the testing sites. Being able to predict erosion is very useful, as it can help with the study of water quality and pollution prevention. The aim was to accurately predict where erosion is most likely to occur, so that mitigation efforts can be made more effective.

The research was comprised of two parts; field measurements and work done with ArcGIS from digital elevation models based on LiDAR data taken in 2006 and 2017. With the data incorporated into ArcGIS, different relationships were examined among variables like the elevation difference, the standard deviation of the elevation difference, the stream power index, and the average elevation difference over the contributing area. A strong relationship between the stream power index and the standard deviation of the elevation differences was found. As the stream power index increases, so does the standard deviation. This is due to sediment transport, as high sediment loads within a stream reach would be expected to imply substantial movement of sediment from one position in the reach to another. This investigation provides support for the stream power index as an indicator of sediment transport along small flow paths. By examining stream power indices in vulnerable areas, we can better pinpoint where extra attention is needed to manage erosion. We know that the places with large stream power indices are prone to higher levels of run-off, and therefore higher levels of pollution.

*Katie Phillips '22

Faculty Mentor(s): Professor Aaron Mitchel, PSYCHOLOGY
Funding Source: Helen E. Royer Undergraduate Research Fund

Analgesic Effects of Mindfulness Meditation

Mindfulness meditation focuses on being aware of the present moment and prior research suggests it can modify the perception of pain. When used as a coping strategy, mindfulness meditation has been shown to increase pain tolerance and threshold. However, most mindfulness techniques focus on a single sense at a time. In other domains, multisensory input enhances perceptual processing, and adding a multisensory component to standard mindfulness meditation might increase the analgesic effects. The present study examined the effects of an added multisensory component to mindfulness meditation on pain perception during a cold pressor test. Three groups, a control group, a mindfulness meditation group, and a multisensory mindfulness meditation group, completed a baseline cold pressor test and a second cold pressor test where pain threshold, tolerance, and intensity were measured. Between the first and second tests, the mindfulness groups were given instructions to practice mindfulness meditation. We hypothesized that while a standard mindfulness technique would increase the duration for acute pain threshold and tolerance, and added multisensory component would show a longer duration for pain tolerance and threshold than a standard mindfulness technique and the control groups. Preliminary results have not supported this hypothesis; thus, we consider alternative explanations for our results.

Nick Pirone '23

Faculty Mentor(s): Professor Eric Kennedy, BIOMEDICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Development of Guidelines for Playground Surfacing Based on Field Testing

Many different playground surfaces are used in the United States for fall-related injury protection. These surfaces are categorized as unitary or loose-fill and there is a strong interest in quantifying their performance to ensure they are meeting head-injury safety standard ASTM F1292, which dictates a compliant head injury criteria (HIC) metric of less than 1000. Analysis for this study was performed from a randomized sample of 103 public playgrounds across the United States, which was collected by the National Program of Playground Safety on behalf of the United States Consumer Product Safety Commission (CPSC). Field testing data included analysis of safety surfacing, including fall height, depth of the surface material,

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and resulting head injury criteria (HIC) score to interpret performance trends in ASTM-compliant HIC scores.

The results indicate for all materials that as the fall height increases, the surfacing's performance decreases. A similar trend applies for surface depth—as the surface depth decreases, the surfacing's consistency decreases. While all the surfaces display similar overall trends, there are a few differences as well. Some surface materials appear to reach a fall height at which performance decreases regardless of surfacing depth. Other surfaces demonstrate a linear relationship between fall height and surface depth. Preliminary data tables showing the relative performance of surface depth to specific fall height ranges were developed for each surface material. From these preliminary data tables, recommendation tables were created as a cost-efficient alternative to using an impact testing device.

Sam Pring and Jay KC '23

Faculty Mentor(s): Professor Mark Spiro, BIOLOGY
Funding Source: Manning Intern Botanical Science, The Bucknell Farm

Effect of Tillage Radish on Mycorrhizal Density in a Regenerative Agriculture System

Traditional agriculture has become dependent on industrial methods, using heavy machines, fossil fuels, and synthetic chemicals. However, due to the harm of these methods, a growing movement of regenerative agriculture is emerging. This approach takes advantage of the natural tendencies of organisms in the ecosystem to grow abundant nutritious crops, without the negative effects. The Bucknell Farm follows such a practice, with two main principles being no-till, and the usage of cover crops. Manual tilling industrial farms loosen the soil to prep for the planting season but this has been shown to induce soil erosion. Cover crops are used to build organic matter, and to retain water in the fields. By planting non-harvested crops during the off-season, these plants help prevent nutrient and water losses. A common cover crop used is the tillage radish, which grows long roots that loosen the soil allowing subsequent crops to develop deeper root systems while using less energy. However, as a member of the Brassicaceae, tillage radish releases chemicals, isothiocyanates, that are known to inhibit the growth of mycorrhizae fungi. These fungi are beneficial in farms, helping crops with water absorption and nutrient collection. Our research looks into whether the tillage radish affects mycorrhizal propagule count in the subsequent growing season. Using the Most Probable Number method (MPN) we investigate if the tillage radish reduces the mycorrhizae populations and if this reduction can be detrimental to the subsequent crop seen by reduced nutrient content.

Qian Qian Mei '22

Faculty Mentor(s): Professor Eddy Lopez, ART & ART HISTORY
Funding Source: Douglas K. Candland Undergraduate Research Fund

Printing Awareness: Endangered Species and A Piece of the Bigger Picture

In the history of Earth, the planet has gone through five mass extinctions, where at least 60% of the species were wiped out within a million years. Some scientists have stated that the earth is currently going through its sixth mass extinction. Currently, there are over 15,000 endangered species and over 11,000 that are vulnerable due to different anthropogenic disturbances such as habitat loss or pollution. Many studies have shown the effects of these disturbances on animal populations and the resulting implications in the rapid decline of species' population numbers. Printing Awareness: Endangered Species and A Piece of the Bigger Picture is a printmaking project that incorporates 24 linoleum blocks to depict the endangered species - reptiles, birds, mammals, mussels - in the state of Pennsylvania. Each block can be a standalone piece, but when all the blocks are placed together, they form the map of the state, highlighting the many endangered species in Pennsylvania. This work is inspired by artists Sue Coe, Asher Jay, Mark Cawood, Banksy, Andy Warhol, and their works advocating for animals, as well as Chuck Close's gridded portraits. Many people, including artists, have spoken out about the detrimental effects of human activity on the environment. My printmaking project aims to raise awareness for the numerous endangered species in Pennsylvania and to give them a spotlight and voice. As humans, we play a role in their endangerment, however, we can also play a role in their conservation.

Harrison Quinn '23

Evaluating Dutch Acceptance

The Netherlands has a legacy of tolerance. Unique for its time, this tolerance earned the small country economic and social advantages over ideologically and religiously-torn larger powers. But since the Eighty Years' War concluded with Dutch independence, tolerance has become less exclusive. The United States has heralded tolerance as a new global status quo, and it remains a base value of modern liberal democracy. But, in the early twenty-first century, the rise of populism in the Netherlands as a response to unprecedented social change cast doubt onto the virtue of tolerance in the Western world.

Many accept that to 'live and let live' is no longer enough to counter intolerance and now seek a culture of acceptance. Multiculturalism, a product of tolerance, has been disowned in favor of integration, a product of acceptance, following political murders enacted by immigrants and the subsequent rise of populism. But in the Netherlands, the divide between tolerance and acceptance is often blurred, leading to vague social objectives. This paper will distinguish acceptance from tolerance and demonstrate that the latter is unsatisfactory in stemming the populist rise that the Netherlands faces. This paper will review Dutch progress on social acceptance from the perspective of both native and recent immigrant groups in the Netherlands. This will be accomplished using survey data on beliefs regarding integration. Using these opinions and recent historical trends, this paper will determine if the Netherlands is still leading the world in progress.

Nicole Reddig '22

Faculty Mentor(s): Professor Janet VanLone, EDUCATION
Funding Source: Presidential Fellowship, Joann E. Walthour Undergraduate Research Fund

Supporting Teacher Retention Through a Trauma-Informed Lens

This poster explores the relationship between trauma-informed practices and teacher burnout and retention. Trauma-informed practices recognize the traumas that students may bring into the classroom and their influence on students' behavior, social and emotional health, and ability to learn. By utilizing trauma-informed practices, teachers can help children who have experienced trauma build resiliency and overcome their experiences. While teachers play an important role in the support system of these students, they are also at risk for experiencing secondary trauma and burnout. For the past decade, schools across the United States have seen high levels of burnout and turnover amongst their educators. This poster discusses two studies of trauma-informed practices in education: (1) A systematic review finding that few states require pre-service teachers to be trained in trauma-informed practices and, (2) a mixed-methods study of the effect of a grant program in Pennsylvania funding trauma-informed practices on teacher burnout and turnover. The results indicate that teachers in Pennsylvania are experiencing burnout, particularly emotional exhaustion, but that there were no differences in burnout levels or intended turnover between teachers who taught in schools with the grant for trauma-informed practices and those that did not. Implications for further policy are discussed, including suggestions for implementing tiered whole-school models of trauma-informed practices to support both students who have experienced trauma and the teachers that work with them.

Grace Risinger '23

Faculty Mentor(s): Professor Daniel Alvord, SOCIOLOGY & ANTHROPOLOGY
Funding Source: James L.D. and Rebecca Roser Research Fund

City Flags and the Politics of Urban Revitalization

City leaders and other local economic development actors attempt to leverage place-based culture and identities to draw in visitors and investors, promote growth strategies, and generally give their city an edge in regional economic competition (Florida 2003; Gotham 2007; Greenberg 2000; Hannigan 2003; Lloyd and Clark 2001; Zukin 1995). However, the main goal of urban branding is to forge an "urban imaginary," meaning a coherent place-based identity that influences the impression that visitors have of the city (Gotham 2007; Greenberg 2000). Flags can be part of this impression. Flags, particularly for nation-states, are effective place-based symbols, meant to capture and evoke the identity of a place or group of people. And since 2016 hundreds of cities across America have redesigned their city flags. This project uses this recent trend in city flag redesigns to investigate the politics related to forging an "urban imaginary." While urban imaginaries may seem coherent to consumers, they are instead "plural, conflicting, contested, and power-laden" (Gotham 2007:828). This project builds on this understanding of urban imaginaries by focusing on how the process of urban branding, specifically city flag redesigns, is potentially contested.

Ricky Rodriguez '23

Faculty Mentor(s): Professor Chet'la Sebree, ENGLISH
Funding Source: California Healthcare Undergraduate Research

Poetry and Power: The Role of Creative Writing in Healing and Uplifting Marginalized Communities in America

The need for a more intentional and genuine approach to art has never been more important – especially within marginalized communities. Writing – specifically – allows for people to express their emotions, connect with others, and tell their stories.

Poetry – in essence – is all the aforementioned on paper. In combination with rhythm, structure, and undeniable prose, poetry amplifies all voices that are willing to be heard. Marginalized communities have used poetry as a way to identify who they are, where they belong, and emphasize the revolutionary nature of their existence.

By collecting poems from a myriad of artists with marginalized identities, writing about my own experience(s) as a queer/non-binary/first-generation/low-income college student, interviewing other poets, and reflecting on why poetry means so much to me and my communities, we have been able to center poetry and its power in a way most people have never experienced.

Working in collaboration with Professor Chet'la Sebree, we have created a digital 'zine' that aims to make the (written) arts more accessible to all readers. Considering the distaste many people have for reading/writing, we decided to create an 'academic zine' that aims to reach a much wider audience that feels - more often than not – ostracized by academia.

By incorporating an artistic component to this academic zine, not only will more people be willing to read and share our work - it will further deconstruct the false notion that "good poetry/art" is only created in academic spaces.

Tatiana Roman '22

Faculty Mentor(s): Professor Ramona Fruja, Professor David Rojas, EDUCATION, LATIN AMERICAN STUDIES
Funding Source: Douglas K. Candland Undergraduate Research Fund

Transforming Systemic Inequity: Listening and Learning from Teachers of Color During COVID-19

For the 2022 Kalman Research Symposium, I will present a research project that I have carried out in New York City from May 2021 to January 2022 where I have been examining how education institutions have responded to the COVID-19 pandemic. My goal with the PUR Grant was to elucidate the fundamental role that education institutions played in sustaining the racialized systems of exclusion that shape US society and economy, and how schools can be used to alleviate systemic exclusion.

In this oral presentation, I will show that the COVID-19 pandemic has brought to light that schools were not prepared to address the needs of marginalized students and how marginalized teachers are a key resource for school institutions in New York City. However, this work increased the workload of marginalized teachers who had to advance the pedagogical

and emotional labor of aiding students all while experiencing their troubles with the COVID-19 pandemic. Although Black and Latinx teachers' experience allows them to help marginalized students, it also makes them vulnerable to exploitation by schools who put on their shoulders the responsibility to help students in need.

Dominique Schaefer, Alexis Tierney, Marta Majewski '22

Faculty Mentor(s): Professor Kevin Myers, NEUROSCIENCE, PSYCHOLOGY
Funding Source: Psychology Undergraduate Research

Novel Animal Model of Food Insecurity

Easy access to food is commonly thought to promote obesity in the modern environment. However, people coping with food insecurity have limited, unpredictable food access yet are also prone to obesity. Causal factors linking food insecurity and obesity are not understood. In this study, we describe an animal model to investigate the biopsychological impacts of the chronic unpredictability inherent in food insecurity. Female rats were maintained on a 'secure' schedule of highly predictable 4x/day feedings of uniform size, or an 'insecure' schedule delivering the same total food over time but constantly unpredictable regarding how much, if any, food would arrive at each scheduled feeding. Subgroups of secure and insecure rats were fed ordinary chow or high-fat/high-sugar (HFHS) chow to identify separate and combined effects of insecurity and diet quality. Insecure chow-fed rats were hyperactive and consumed more when provided a palatable liquid diet. Insecure HFHS-fed rats additionally had higher progressive ratio breakpoints for sucrose, increased meal size, and subsequently gained more weight during ad libitum HFHS access. Insecurity appeared to maintain heightened attraction to palatable foods that had habituated in rats with secure access to HFHS diet. In a second experiment, rats on the insecure schedule with ordinary chow subsequently gained more weight when provided ad libitum chow, showing that prior insecurity per se promoted weight gain even in the absence of HFHS food. We propose this to be a useful animal model for mechanistic research on biopsychological impacts of insecurity, demonstrating that chronic food uncertainty is a factor promoting obesity.

Owen Schiele '22

Faculty Mentor(s): Professor James Arthur, MECHANICAL ENGINEERING
Funding Source: Program for Undergraduate Research

Turbulent Flow Over a Backward-Facing Step with a Porous Insert

In many engineering applications such as engine flows and combustion, a step like expansion called a backward-facing step is used. When the flow moves over the backward-facing step, a separated flow is formed and a recirculation region occurs directly next to the step. A large pressure drop also occurs over the backward-facing step which can be detrimental to the flow. The goal of these experiments is then to try and improve the heat transfer over the backward-facing step by the use of a porous floor insert. This floor insert is experimented with to reduce the reattachment length and allow for better heat transfer. Particle image velocimetry is used with water and hollow glass spheres to track the velocity distribution of the flow upstream from the step, at the step, and downstream from the step at a Reynolds number of 5040. This data was then run through the software DaVis which allowed for the movement of the flow to be analyzed. Trips were added to the flow entrance to ensure that the flow stayed turbulent in nature. Through experimentation, four discoveries were made. It was concluded that the presence of porous inserts reduces reattachment lengths by over 90% depending on its location. The inserts also lead to retardation of the streamwise mean flow. Also, inserts result in a significant increment in streamwise and wall-normal turbulence and Reynolds stress, and redevelopment is deteriorated by the inserts.

Katelynne Schmidt '22

Faculty Mentor(s): Professor Amanda Wooden, ENVIRONMENTAL STUDIES & SCIENCES
Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Honoring Indigenous Conceptualizations of Nature to Dismantle Colonial Extraction in North America: Learning together with Diné (Navajo people)

As our world faces immense pressure to shift towards a renewable-energy-based economy, it is imperative that countries and nations reconstruct the ways they engage in resource extraction. This reconstruction must address how Western/colonial conceptualizations of nature and power have enabled gross over-extraction, grave ecological degradation, and overtly-racist mistreatment of Indigenous communities to occur. By listening, honoring, and "standing with" the Diné and Navajo Nation, this exploration acknowledges some of the historical (and active) implications of colonial/resource extraction specific to this community; this project also focuses on the current, renewable solar-energy initiatives led by the Navajo Nation to demonstrate how Indigenous, decolonial understandings of nature, history, and cultural knowledge can inspire "just" ways of living. This research is centered on three guiding questions: (1) How has colonialism and extractivism — resource extraction without regard for social, cultural, or environmental factors — disproportionately and negatively impacted the Navajo people; (2) How is the Navajo Nation engaging in a "just" renewable-energy transition?; (3) How does listening, honoring, and standing with the Diné and Navajo Nation inspire possibilities for the future? The research methods consisted mainly of literary, organizational, and news content analysis, introductory language study, critical analysis of scholarly and peer-reviewed academic journals as well as videos and artwork guided by Indigenous and feminist methodologies. The results of this project identified the various social, cultural, political, and economic barriers that restrict renewable energy development on Navajo land and critically analyzed the variation in representation across different groups within the Navajo Nation.

Emily Scholfield ’22

Faculty Mentor(s): Professor Matthew Slater, Professor Katherine Ward, PHILOSOPHY
Funding Source: Presidential Fellowship, Program for Undergraduate Research

Earning Public Trust: An Interdisciplinary Analysis of Black American’s Trust Relationship with Medicine

The COVID-19 pandemic has revealed glaring inequities in healthcare quality and access in the United States, as well as patterns of distrust in the medical community. This project seeks to develop an understanding of the impacts of the history of medical malpractice against Black Americans on the modern-day trust relationship between this community and medicine. Methods include a historical and bioethical analysis of incidents of medical malpractice disproportionately impacting Black Americans, a philosophical analysis of the nature of trust and what it would mean for the medical community to earn the trust of patients whose communities have been wronged, an empirical assessment of the current state of trust through a survey. I argue that the medical community must work to earn a sustainable relationship of trust with Black Americans, rather than assuming an entitlement to that trust. The popularized historical narrative in the United States glosses over and buries instances of racialized medical malpractice, and this creates a sense of eroded trust when Black Americans are constantly told a history which contradicts their lived experience or the experiences of their families and communities. For the sake of depth, this project focuses on Black Americans, but the conceptual underpinnings are likely relevant to other communities whose histories have been buried, particularly Indigenous populations. Healthcare is a necessity, so building a future in which medical professionals truly earn their patients’ trust through an understanding of their experiences and histories is vital to human welfare and public health.

Madison Scopano ’22

Faculty Mentor(s): Professor Judith Grisel, NEUROSCIENCE, PSYCHOLOGY
Funding Source: Program for Undergraduate Research

Influence of Maternal Separation on Stress and Alcohol Reward: Contributions of β-Endorphin

Adverse childhood experiences affect over half of the population and are associated with chronic health problems, mental illness, and substance misuse in adulthood. The opioid peptide β-endorphin regulates the stress response and has been implicated in the risk for excessive alcohol consumption. Clinical research has demonstrated that initial sensitivity to the rewarding effects of alcohol is associated with stress sensitivity and predicts the risk of developing an alcohol use disorder. Here, we explored the influence of β-endorphin on changes induced by maternal separation in open field activity, [and initial rewarding effects of alcohol], using control C57BL/6J and β-endorphin deficient B6.129S2-Pomc tm1Low /J; KO mice. Maternal separation (MS) occurred for three hours each day from postnatal days (PND) 5-18. MS and control subjects were tested as adolescents (PND-26 to 32) or adults (PND-58 to 72). Anxiety was assessed using an open field assay, [followed by a single-exposure conditioned-place preference paradigm to measure alcohol reward]. In general, the effects of MS were more evident in adults than in adolescents, and dependent upon β-endorphin. There was no effect of MS on open field activity in adolescent mice of either strain, but locomotor activity (both distance and speed) in the open field was increased in adult MS subjects of both strains. MS increased anxiety-like behavior in adults with normal β-endorphin as measured by time spent in the center of the open field, but not in β-endorphin deficient mice. However, adult β-endorphin deficient mice that had undergone MS had fewer anxiety-like behaviors in the Plus Maze as adults than their unseparated counterparts. Taken together, these results suggest that the effects of MS are age and β-endorphin dependent.

Kartikeya Sharma ’22

Faculty Mentor(s): Professor Brian King, COMPUTER SCIENCE
Funding Source: Program for Undergraduate Research

Trajectory Gaze Path Analysis and Isolating Areas of Interest in Eye-Tracking Data for Autism Spectrum Disorder Studies

According to the CDC, about 1 in 59 children have autism spectrum disorder or ASD, representing a significant percentage of the population. Unfortunately, this condition often remains undiagnosed until later in childhood, which, in turn, delays many clinical treatments that could improve social functioning outcomes.

Researchers have identified abnormal visual attention as a hallmark symptom of ASD. With this finding, ASD researchers commonly deploy eye-tracking systems in their experiments. A typical experimental setup assesses how participants look at objects encapsulated within one static image or a stimulus. Eye-tracking systems collect real-time gaze data over a short, fixed time period. ASD experts have found that children without ASD generally focus more on objects associated with socializing, such as people or food items, than on inanimate objects. In contrast, children with ASD tend to focus on both categories of images with no preference. Heat maps, currently used in the clinical setting, forgo clinically crucial information about how children cognitively prioritize stimuli over time.

To better understand the cognitive process for prioritization of stimuli between children with and without ASD, clinical researchers need novel methods that yield visuals that show how participants prioritize stimuli over time. My work under the guidance of Dr. Brian King is developing multiple novel algorithms intersecting between the computer science fields of data mining and machine learning, including density-based clustering, object detection, and image classification. Further, we make these data visualization algorithms accessible to end-users through an interactive graphical user interface (GUI) encapsulated within a software toolkit.

Miranda Shearer ’23

Faculty Mentor(s): Professor Regina Gazes, ANIMAL BEHAVIOR
Funding Source: Provost’s Office

Social Eavesdropping in Madagascar Hissing Cockroaches (Gromphadorhina portentosa)

Social eavesdropping is when individuals gather information about others by observing social interactions. Insects such as paper wasps learn about the relative dominance status of two other wasps by observing fights. Madagascar hissing

cockroaches (MHCs) similarly live in social groups with dominance hierarchies among males and may therefore share this cognitive ability. In the present study, we tested for social eavesdropping in MHCs. Two 120-minutes observation periods were performed to determine how long aggressive interactions between males last. The results showed that the males' agonistic behaviors lasted an average of 90 minutes, followed by a lack of activity. These findings will lay the groundwork for future studies in which 90-minute trials will be used to observe male agonistic interactions. The next step of this study is to determine whether MHCs are capable of using social eavesdropping to modify their behavior. Before training, 16 males will be randomly assigned as either fighters or observers. During training, two subjects will observe a 90-minute interaction between other males. The observers will then be paired with a fighter they observed and one they did not, and the agonistic behaviors of each will be recorded.

Lily Shorney '22

Faculty Mentor(s): Professor Bill Flack, PSYCHOLOGY
Funding Source: Program for Undergraduate Research

Bucknell 2020-2021 Campus Climate Survey Results

The present study analyzed the results of a campus climate survey that was disseminated to a random sample of the student body amid the COVID-19 pandemic during the spring 2021 semester at Bucknell. The survey addressed the prevalence rates of campus sexual assault in addition to investigating campus sexual assault prevention efforts, campus resources, and responses to reports of campus sexual assault. Results demonstrated prevalence rates consistent with established rates from campus climate surveys conducted at Bucknell in previous years. This suggests that the measures taken to mitigate COVID-19 since the start of the pandemic in the spring of 2020, including social distancing and limits on social gatherings, did not lessen the occurrence of campus sexual assault at Bucknell.

Nishant Shrestha '23

Faculty Mentor(s): Professor Carl Shu-Ming Lin, MATHEMATICAL ECONOMICS
Funding Source: Culliton Family Fund for Undergraduate Research

The Muslim Ban and its Effect on the Crime Rate in the USA

The research conducted was econometrics research on the effect of Executive order 13769, famously known as the Muslim ban, on the crime rate of the United States. More specifically, a time fixed effects regression was utilized to analyze the data collected which consisted of crime and demographic data between the years 2008 and 2019. A panel data analysis was performed and results showed that the Muslim Ban had no significant effect across various spectrums of crime in the United States.

Hannah Sieg '24

Faculty Mentor(s): Professor Thiago Serra, ANALYTICS & OPERATIONS MANAGEMENT
Funding Source: Helen E. Royer Undergraduate Research Fund

Fairness and Machine Learning

Models that help forecast outcomes are likely to benefit from more and better data. However, with too much data, computers cannot process the information in a timely manner. Researchers have sought ways to prune models, reducing the computational burden without sacrificing too much accuracy. Unexpectedly, some of the pruning techniques introduce biases into predictive models. Underrepresented groups may be hindered by the predictions of the compressed models. This summer project focuses on ways to measure the (un)fairness of models and suggest avenues for correction.

Davin Sim '22

Faculty Mentor(s): Professor Donna Ebenstein, BIOMEDICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund

Chemical and Nanomechanical Analysis of Cat and Rat Whiskers

Cats, as predators, use their whiskers for hunting, while rats, as scavengers and prey, use their whiskers to navigate efficiently. Rat whiskers are more flexible than cat whiskers and differ from cat whiskers in both their external (e.g., length, diameter, tapering) and internal structure. This study aims to investigate how the chemical and nanomechanical structure of animal whiskers (cat and rat) affect their functions. As sample preparation, whiskers from both species were embedded in an epoxy resin and polished to reveal transverse sections. Chemical analysis was performed using μRaman spectroscopy, which provides a "chemical fingerprint" of the protein that makes up each whisker. Mechanical analysis was performed using nanoindentation, where a small tip is pressed into a sample to measure local modulus or stiffness. The Raman spectra demonstrate that rat and cat whiskers are both composed of proteins similar to pure keratin. The spectral peaks of disulfide bonds (S-S, 500 cm-1) are more prominent in the cat than rat whiskers, suggesting increased crosslinking in cat whisker keratin, and increased keratin crosslinking is typically associated with increased stiffness. Nanoindentation results support this chemical analysis, as the cat whiskers have a higher mean modulus than the rat whiskers (5.9±0.3 GPa vs. 5.0±0.3 GPa). This study revealed that the increased flexibility of rat whiskers is due not only to having thinner, more tapered whiskers than cats but also due to differences in the chemical composition and mechanical properties. These results will contribute to future designs of biomimetic whiskers for sensing robots.

Crystal Dawn Snyder, Graduate Student

Faculty Mentor(s): Professor Jasmine Mena, PSYCHOLOGY
Funding Source: Graduate Program

Students' Attitudes Towards Family Work Benefits When Professors Act as a Third Party Influence

During the COVID-19 pandemic, mothers lost hours of paid work to care for children when compared to fathers. While these patterns were exacerbated during the pandemic, prior research shows that women are more likely to struggle to gain paid work due to the traditional views of women being the caretaker and men being the breadwinners. Traditional gender attitudes may be partly responsible for the gender gap in the workplace. Third parties may influence decision makers' choices to enhance supportive attitudes towards family work benefits. The current study will use an experimental design to understand if cues about a professor's support on family work benefits may influence college students' decisions when choosing a community organization for an internship. The expectation is that participants in the experimental condition will be more likely to select an internship with a community organization that provides family work benefits (hypothesis 1), the relationship between condition and internship selection will be moderated by participant gender (hypothesis 2), and participant egalitarianism and family benefits attitudes will predict internship selection and will be moderated by gender (hypothesis 3). The expectation is also that women will be more likely to select an internship that provides family work benefits compared to men and women will report higher egalitarian and family work benefits attitudes. Participants will be undergraduates recruited from the PSYC 100 subject pool. If students, future decision-makers, develop more supportive attitudes towards family work benefits it may help to eliminate the gender gap in the workforce.

Abigail Strayer '22

Faculty Mentor(s): Professor Claire Campbell, HISTORY
Funding Source: The Katherine Mabis McKenna Environmental Internship Program

A Tale of Three Cities

Milton, Sunbury, and Lewisburg… why these towns? For one, all three are on the Susquehanna, all three are towns that have a history of being formerly industrial with coal and lumber, all three have water that flows through the town, whether it is visible or not. A lot of my project consisted of looking at Sanborn maps of these three cities and seeing what modern infrastructure has replaced these industrial spaces, and what has happened to the water.

Victor Svistunov '22

Faculty Mentor(s): Professor Moria Chambers, Professor Sarah Lower, BIOLOGY
Funding Source: Department of Biology, National Science Foundation Grant (NSF), Program for Undergraduate Research

What's That Smell? Expression of Odorant Receptors in Lucidota atra, the Black Firefly

Studying signal evolution at a gene will provide insight into how diversity arises. Fireflies are a good system to study signal evolution because they rely on relatively simple mating signals and have repeatedly gained and lost adult bioluminescence throughout time. While nocturnal lighted species use bioluminescence for mating, unlighted species likely use pheromones/odorants to find their counterparts. If so, unlighted species are expected to have more functional odorant receptor (OR) genes that facilitate mate finding. However, the OR gene repertoires of most unlighted species are unknown. Therefore, to investigate this hypothesis, I took a transcriptomic approach in one unlighted-adult species, Lucidota atra, for which there is behavioral evidence of pheromone use. I assembled and compared transcriptomes derived from the antenna and the back legs of wild-caught males and females. Using bioinformatic techniques, I identified a total of 64 ORs and an ORco coreceptor gene in L.atra. Phylogenetic analysis revealed that a specific group of ORs diversified in L.atra as compared to other beetles. Differential expression analysis showed that ORs are more functional/expressed in the antenna. While some ORs showed sex-biased expression, only LatrOR45 was significantly upregulated in females, a potential indication that it is a candidate mating or oviposition OR. This study gives a foundation for future mechanistic studies in firefly olfaction to identify novel pheromones. In the future, comparing L. atra OR repertoire to that of a closely related lighted species could revolutionize our understanding of signal evolution at a gene level.

Caroline Tattersfield '22

Faculty Mentor(s): Professor Anjalee Hutchinson, THEATRE & DANCE
Funding Source: Program for Undergraduate Research

Marketing Black Theatre in Non-Urban, Predominantly White Communities

Historically American theatre has fiercely promoted white theatre-makers at the expense of Black artists. American theatre has made a long-term investment in sustaining the portrayal of whiteness by granting privileges and favor towards White playwrights. Historically, Black theatre has not been equally represented on the American theatre landscape due to being described by White American scholars as "sub-par, reactionary, and anti-intellectual" because it hasn't always been universally "recognized as a site of theorization" (Johnson). From the Black perspective, Black theatre is seen as a supporting force that sustains Black culture. As Stuart Hall asserts, Black theatre emphasizes that "it is only through how we present and imagine ourselves that we know how we are constituted and who we are" (Hall). This project was designed to identify the marketing strategies that professional and university theatres in predominantly White, non-urban areas used to promote productions of plays written by Black playwrights. I seek to uncover the marketing methods theatres used to; promote messages of racial injustice towards Black people and prepare White audience members to be in a space that criticizes their historical role in perpetuating racism in America. This research is relevant to the Bucknell Department of Theatre and Dance because Black theatre that contains subjects of racism that criticize White audiences has yet to be studied in depth in a scholarly context.

Chin Ting Kong ’22

Faculty Mentor(s): Professor Andrew Sloboda, MECHANICAL ENGINEERING
Funding Source: Program for Undergraduate Research

Using Chaotic Interrogation and Attractor Deformation to Determine Damage Location and Extent

One promising approach for detecting damage in non-linear systems is to use chaotic interrogation: a system is excited by a chaotic signal and the resulting response is used to infer the damaged state. In this work, a new method based on boundary transformation vectors (BTVs) is explored as a way of simultaneously ascertaining both damage level and location.

The process works as follows: (1) The system is excited by a chaotic signal. (2) The system response is recorded at some location. (3) The peaks of the system response are sampled and combined to create a picture of the chaotic signal known as a Poincare section. (4) By comparing the boundaries of Poincare sections for different damage states using BTVs, the damage level and location can be inferred.

Three different systems were explored: a 5-body mass-spring-damper model, a simulated cantilever beam, and a physical cantilever beam. To excite these systems, a chaotic Brusselator signal was chosen. Displacements were used as output signals in the simulated systems; for the physical beam, acceleration was used.

Results from the simulated systems demonstrate that chaotic interrogation and BTV analysis can be used to ascertain system damage in stiffness or damping and, in some cases, location because Poincare boundary changes to scale with the level of damage. For the physical beam, damage extent was discernible for particular combinations of damage and observer locations. However, indications of damage location were inconsistent.

Overall, these results demonstrate that the BTV method has promise and can be improved with further research.

Tung Tran ’23

Faculty Mentor(s): Professor Joshua Stough, COMPUTER SCIENCE
Funding Source: Program for Undergraduate Research

Bayesian Optimization of Echocardiography Segmentation

Bayesian Optimization (BO) is widely known as a strong hyperparameter optimization technique in high-parameter machine learning problems. Echocardiography is a ubiquitous modality for evaluating heart structure and function in cardiology. In previous work, BO was demonstrated to be effective at optimizing the architectural and training-related hyperparameters of a published deep fully convolutional neural network model for multi-structure segmentation in echocardiography. Following this success, this work further attempts to realize the potential of the mentioned frame-by-frame model and an additionally published temporal-coherent echocardiography video segmentation model. As a result, we obtained a more efficient frame-by-frame model. We also found our optimized video segmentation model performs worse than its published model. For the frame-by-frame model, we report mean Dice overlap of 0.95, 0.97, and 0.94 for left ventricular endocardium, left atrium, and left ventricular epicardium. The newly optimized model saw improvement in derived clinical index ejection fraction (2.6% vs. 3.7), and tighter limits of agreement, which were already within inter-rater variability for non-contrast echo. The number of weights used also reduced from ~40M to 9 - 18M, thus increasing the efficiency of the newly optimized model. For the video segmentation model, we report deteriorated results with worse mean Dice on apical 2-chamber view for all three substructures; and no significant improvement found on apical 4-chamber view. In the derived clinical index ejection fraction, no significant difference is observed.

Benjamin Travis ’22

Faculty Mentor(s): Professor Mark Haussmann, BIOLOGY
Funding Source: Program for Undergraduate Research

A Novel Method for Assessing Oxidative Damage Susceptibility

Oxidative stress is defined by a cellular imbalance between reactive oxygen species (ROS) and ROS neutralizing mechanisms. This phenomena can result in the damaging of macromolecules across the cell and is linked to aging and the pathogenesis of numerous non-communicable diseases (e.g. cancer, cardiovascular disease, neuropathology, and more). In this project, I aim to develop a novel assay for holistically assessing genomic susceptibility to oxidative stress by measuring baseline levels of DNA oxidative damage, antioxidant efficacy, and damage repair activity. This is performed using the nucleated red blood cells of Japanese Quail, a hydrogen peroxide challenge, and a repair incubation. Oxidative damage is measured using liquid chromatography to isolate 8-oxo-dGuo (an oxidized mutant of the guanine nucleobase) for quantification by LC-MS/MS. In the future, this novel methodology will be applied to studies investigating the correlation between oxidative damage and life span, and how oxidative stress susceptibility can be modulated in relation to parental effects.

Madden Tuffy ’22

Faculty Mentor(s): Professor Moria Chambers, Professor Sarah Lower, BIOLOGY
Funding Source: Kalman Fund for Biomedical Research Fellows

Understanding Larval Immunity: Rearing the Common Eastern Firefly Photinus Pyralis in the Lab

While best known for its light production to find a mate, the common eastern firefly, Photinus pyralis, with its unique life cycle also presents an opportunity to study how organisms regulate immunity during different life stages. P. pyralis remain in the larval stage for up to two years in the soil, surviving in a microbe-rich environment until adulthood. In contrast, P. pyralis adults only live for two weeks and are primarily focused on finding a mate. Therefore, we hypothesize that the degree to which a firefly invests in immunity depends on the life stage. To study the immune system of firefly larvae, we need to be able to grow larvae in a laboratory setting. While this has been successfully done before by caring for larvae singly in containers, this is incredibly time intensive. We paired female adult P. pyralis with multiple males to allow them to choose male mating partners. Nine mothers successfully laid eggs that

hatched into larvae. These larvae were reared individually in sealed containers for the first two weeks post-hatching and were then transferred to eco-shoeboxes containing detritivores and fungivores. While it is challenging to monitor firefly larvae throughout development, we were able to find multiple larvae living two months after hatching. However, we were unable to sustain larvae for longer periods in the eco-shoeboxes, limiting our ability to study their immune system. We propose an alternative rearing method where egg-laying and larval rearing are confined to one location to reduce larvae mortality.

Xinran (Joyy) Wan '22

Faculty Mentor(s): Professor Sanjay Dharmavaram, MATHEMATICS

Funding Source: Helen E. Royer Undergraduate Research Fund

Point Location on a Triangulated Surface in 3D Space

In membrane biophysics, the problems concerning endo- and exo-cytosis and virus budding involve understanding the systems of cell membranes with protein particles embedded. A simple model for such a system would be a membrane with interacting particles that carry charges and exert attractive or repulsive forces on each other. The interacting particles represent proteins on the cell membrane. One of the models is called the Finite Element Method, which triangulates the surface to do a good approximation. An important step in the Finite Element Method involves finding the location of a point in 3D space efficiently, and hence the research question of this project is about finding an algorithm to locate a point on a triangulated surface in 3D space. The method of inquiry includes literature reading, writing scripts in Python/Matlab/C++, and discussions between the mentor and other professionals. Referred literature includes existing algorithms in 2D space and the ray-triangle intersection algorithm in 3D space is implemented. The method was tested on a triangulated spherical surface, then an intermediate step called Binning Triangles was implemented which makes the process of locating points faster by eliminating unnecessary searches. Then the project is geared towards working on general surfaces in 3D space. Due to some issues with the paper being referred to, the goal of solving the problem for a general surface in 3D hasn't been fully reached. However, solutions for the basic cases such as spherical surface and Gaussian surface are developed and potential future directions exist.

Meaghan Yant '22

Faculty Mentor(s): Professor Elif Miskioglu, CHEMICAL ENGINEERING

Funding Source: James L.D. and Rebecca Roser Research Fund

A Pilot Study on Feasibility of a Kinesthetic Intervention for Developing Expertise in Construction Hazard Identification

Active learning is a teaching technique known to be more effective than traditional methods, such as lectures. A relatively new area of active learning called kinesthetic learning refers to learning through movement or the use of props and has significant potential as a pedagogical technique for challenging concepts. In this pilot study, we investigate the use of a kinesthetic intervention to promote students' development of expertise in construction site hazard identification. Roughly 1000 U.S. construction workers perish annually, underscoring the ongoing threat posed by these hazards. At the undergraduate level, hazard identification is challenging to teach due to limited access to construction sites. Our kinesthetic intervention is a 3-D printed model that supplements a hazards lecture. The goal of this pilot study was to prepare the intervention for classroom implementation. We evaluated the intervention via two methods: (1) think-aloud interviews and (2) a small sample size intervention vs. control test. During the intervention vs. control test, participants were asked to complete a post-lecture hazard recognition survey. Results showed the need for minor adjustments to increase the stability of the model and highlighted unclear wording in the survey. This pilot has informed a full-scale classroom intervention versus control study being conducted at a large public institution. This will provide a sufficient sample size to assess whether this kinesthetic intervention is effective in developing students' expertise in construction site hazard identification and can serve as a proof-of-concept for translation into other disciplines.

Kyle Young '24

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Funding Source: James L.D. and Rebecca Roser Research Fund

Development of a Musculoskeletal Model of the Patellofemoral Joint

Patellofemoral pain affects nearly 25% of the general population and is particularly prevalent in athletes and military personnel. It remains unclear as to why some people experience patellofemoral pain and others do not, however, joint mechanics certainly play an integral role in pain development and disease progression. The mechanics of the patellofemoral joint are driven by multiple factors such as kinematics (the way people move and walk), morphology (the person-specific shape of the musculoskeletal tissues), and the loads that act about the surrounding area of the joint (muscle forces and activation patterns). Broadly, the research aims to develop a computational tool that will help to investigate the contributions of these factors to anterior knee mechanics and thus joint pain long term. A musculoskeletal model of the patellofemoral joint will be developed in OpenSim - an open-source musculoskeletal modeling software - based on the OpenKnee data set, which is freely available. First, segmented MRI scans are used to generate the following geometries: the distal femur, distal femoral cartilage, the patella, patellar cartilage, the proximal tibia, and tendon and ligament insertion/attachment sites. These geometries are then smoothed and refined and imported into OpenSim, an open-source musculoskeletal modeling software, with cartilage as contact geometries. Femoral and tibial kinematics will be defined along with knee extensor muscle forces, thus enabling the simulation of patellofemoral joint contact. Long-term goals include studying the effects of different loading cases, different patellofemoral joint morphologies, and different kinematics on joint contact pressure.

Spencer Zack ’23

Faculty Mentor(s): Professor Katsuyuki Wakabayashi, CHEMICAL ENGINEERING

Funding Source: James L.D. and Rebecca Roser Research Fund

Mechanochemical Modification of Crosslinked Low-Density Polyethylene: Effect of Solid-State Shear Pulverization (SSSP) on Crosslinks, Branches, and Chain Lengths

Crosslinked low-density polyethylene (XLLDPE) is widely used in several specialty plastics industries. However, the permanent chemical crosslinks cause high melt viscosity and poor processability, preventing the material from being reused and recycled effectively. This study investigates solid-state shear pulverization (SSSP) as a continuous, commercially viable mechanochemical processing technique to initiate the decrosslinking of XLLDPE for mechanical recycling. Post-industrial XLLDPE scrap material was processed using SSSP with a range of pulverization conditions, which were correlated with universal processing covariants of specific mechanical energy and particle size distribution. The physical properties of SSSP-processed materials were compared to as-received XLLDPE and uncrosslinked low-density polyethylene. While gel content tests confirm a gradual decrease in crosslinking density with a more energy-intensive SSSP process, melt rheology and dynamic mechanical analysis characterization revealed additional chain architecture modifications such as branching and chain scission. Based on differential scanning calorimetry and thermogravimetric analysis, the SSSP-processed XLLDPE retained their thermal stability and crystallinity; tensile testing results showed improved stiffness, strength, and toughness. Tunable SSSP can transform XLLDPE into a decrosslinked, branched, and melt-processable recycled polyethylene.

Jackie Zak ’24

Faculty Mentor(s): Professor Karlo Malaga, BIOMEDICAL ENGINEERING

Funding Source: James L.D. and Rebecca Roser Research Fund

Deep Brain Stimulation of the Subthalamic Nucleus and its Effect on Gait in Parkinson Disease

Deep brain stimulation (DBS) is a surgical procedure where electrodes are implanted in the brain to modulate specific regions with electricity. This stimulation can alleviate gait disturbances in Parkinson’s disease (PD). DBS modeling can be used to estimate the spatial extent of stimulation, enabling individualized treatment. Although the standard DBS target for PD is the subthalamic nucleus (STN), a generalized approach may not be optimal for every patient due to the diversity of their symptoms. Better outcomes may be obtained by stimulating regions around the STN. Forty PD patients who received bilateral STN DBS were included in this study. For each patient, the location of therapeutic stimulation was calculated using tissue activation models built from individualized imaging data and stimulation settings. The volume of tissue activation (VTA) was used to quantify STN and external (non-STN) activation in the lateral-medial, anterior-posterior, and dorsal-ventral directions. The relationship between STN/external activation and symptom improvement (gait, freezing of gait, postural stability, and total gait) was evaluated. A similar analysis was performed for electrode location (the distance between the active contact and STN centroid). A significant positive relationship between anterior STN activation and total gait improvement was found ($p < 0.01$). No significant relationships were found for the external activation and electrode location analyses. Results suggest that more anterior STN stimulation may be preferable for patients whose primary symptoms are gait disturbances. Furthermore, VTAs may provide more information about stimulation location than active contacts and highlight the importance of patient- and symptom-specific targeting.

Anqi Zang ’23

Faculty Mentor(s): Professor Sarah Lower, BIOLOGY

Funding Source: Department of Biology

Using Bioinformatics to Identify Putative ORs in the Photinus Pyralis Transcriptome

Animals use diverse signals to find mates. Some signals are simple and are emitted in a single mode, for example, visual or acoustic. When we think about fireflies, we usually think of an image that shines like stars at night. Fireflies, which fall under the Lampyridae family of insects in the Coleoptera order of beetles, produce a chemical reaction inside their bodies that allows them to light up and they mainly use this ability to find a mate. However, contrary to popular belief, not all firefly species are bioluminescent as adults. The unlighted-adult fireflies are day-active, and females may attract males over long and short distances by pheromones. Pheromones are detected by the firefly’s odorant receptors (ORs), which are heteromultimeric ion channels consisting of an evolutionarily conserved odorant co-receptor (Orco) and a variable non-Orco. Together, they form an OR complex that facilitates odorant-binding and signal transduction. Previous work in the lab using a conservative homology-based approach found 27 ORs, including Orco, in Photinus pyralis, which is a lighted firefly with the most continuous genome assembly. However, ORs can be very divergent and thus, missed when searching using conservative parameters. This project sought to develop a more expansive search strategy for ORs using both homology and structure-based predictions. Using this strategy, we identified over 100 putative ORs in the P. pyralis genome. The results of this study will provide a basis for future studies on the expression and evolution of ORs in fireflies.

Ziheng Zeng ’23

Faculty Mentor(s): Professor Dabrina Dutcher, CHEMICAL ENGINEERING, CHEMISTRY

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

On the Development and Setup of a Hygroscopic Tandem Differential Mobility Analyzer for Aerosol Studies

Atmospheric particles take up water when exposed to increasing relative humidity, and this behavior is described and quantified by the hygroscopic growth parameter (K). Hygroscopic tandem differential mobility analyzers (HTDMA) can be used to measure the physicochemical properties of aerosol particles and study phenomena that lead to size changes in submicron aerosol particles. It measures how aerosol particles of different initial dry sizes grow or shrink when exposed to changing relative humidity, due to water uptake or rearrangement. Rather than purchasing a commercial

HTDMA, we designed a new HTDMA system using two existing Differential Mobility Analyzers (DMAs) and an existing Condensation Particle Counter. A humidification system for the sample and second DMA was designed and tested at a variety of initial conditions. The HTDMA design was tested running through pure ammonium sulfate, a well-characterized salt that can be used to calibrate these systems. New HTDMA software was also developed to analyze the data on hygroscopicity. Instead of using a manually selected mode, the new software will autodetect peaks and it fits a log-normal distribution producing a more reliable average particle size.

Diamanda Zizis '23
Faculty Mentor(s): Professor Christopher Martine, BIOLOGY
Funding Source: David Burpee Endowment, Wayne Manning Internship Fund, Botanical Society of America Undergraduate Student Research Grant

Heading for a Breakdown: Assessing Evolution through the Hybridization of Two Sexual Systems

Hybridization is an important evolutionary pathway that has contributed to the world's vast biodiversity. In plants, hybridization is known to be an important mechanism for speciation, phenotypic divergence, and changes in reproductive systems. Solanum species present an ideal system to investigate how hybridization between two different sexual systems impacts the reproductive and phenotypic biology of the hybrid progeny. Hybrids were acquired from crosses between Australian species Solanum dioicum (dioecious) and S. ultraspinosum (andromonoecious). The only successful hybrids from the original crosses were those derived from S. diocium as the pollen donor and S. ultraspinosum as the pollen recipient. Due to strong maternal effects, all the F1 hybrids resembled S. ultraspinosum, so all F1 plants were andromonoecious. To assess phenotypic differences between the hybrids and their parents, I collected morphometric data and used ImageJ software. A series of statistical analyses were done using R. A principal component analysis confirmed that the hybrids were distinct from both parents, but were most similar to S. ultraspinosum. The F2 hybrids appear to demonstrate variability in inflorescence architecture, which may be suggestive of a change in the sexual system, although further analysis is needed. In attempts to create an F3 hybrid generation, nearly all of our crosses have failed—suggesting that a hybrid breakdown is occurring. To determine where the breakdown is occurring, I will be employing a technique using fluorescent microscopy. Overall, my study will promote a better understanding of hybridization—a driving force of plant speciation—which has broad impacts on the long-term viability of plant species.

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