spring 2020

NINETEENTH ANNUAL

KALMAN
RESEARCH SYMPOSIUM

Bucknell
UNIVERSITY

KALMAN RESEARCH SYMPOSIUM

INTRODUCTION

SPRING 2020

Welcome to the nineteenth 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 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.*

This symposium showcases the breadth and variety of undergraduate research taking place at Bucknell, as is evidenced by the abstracts of the projects contained herein.

This symposium is named for Ernest Kalman '56 trustee emeritus who died January 16, 2020. Ernie's generosity to his alma mater has taken many forms, one of which was a significant gift in support of undergraduate research. A business and finance major who lived in Bedford Hills, N.Y., and Wellington, Fla., Ernie served on the Bucknell Board of Trustees from 1993 until 2005, when he was named a trustee emeritus. His most permanent legacy at Bucknell is Kalman-Posner Hall, part of the Gateway Residence Center, which was named with classmate Sam Posner '56, P'82, also a Bucknell trustee, in honor of their late fathers. Ernie was also a benefactor of the Albert Einstein College of Medicine and served on their Board of Overseers, helped construct the William Hallenbeck Learning Center serving children with cerebral palsy in Westchester County, N.Y., and supported many Jewish causes including Temple Israel in New Rochelle, N.Y.

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

- Department of Biology
- Bucknell-Geisinger Research Initiative (BGRI) Grant
- Bucknell Institute for Public Policy
- David Burpee Endowment
- Douglas K. Candland Undergraduate Research Fund
- Department of Chemistry
- Culliton Family Fund for Undergraduate Research
- Dean's Fund for Summer Undergraduate Research in STEM
- Department of Electrical & Computer Engineering
- The Emerging Behavioral Scientists Fellowship
- College of Engineering
- Department of Geology & Environmental Geosciences
- Department of Geology & Environmental Geosciences Marchand Fund
- Graduate Summer Research Fellowship
- The Tom Greaves Fund for Research and Curricular Development
- Stephen Glenn Hobar Memorial Research Award
- Diane L. Hymas Undergraduate Research Fund in Engineering
- Drs. Anthony and Joyce D. Kales Undergraduate Research Fund

continued

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

- Kalman Fund for Biomedical Education/Fellows Fund
- Kalman Fund for Undergraduate Research in the Sciences
- Clare Boothe Luce Research Scholarship
- The Katherine Mabis McKenna Environmental Internship Program
- Department of Mechanical Engineering
- Melon Summer Teaching Grant
- National Institutes of Health
- National Science Foundation Grant (NSF)
- (National Science Foundation) NSF Research Experience for Undergraduates at California State University San Marcos
- PA Wild Resource Conservation Program
- The Posse Foundation Scholarship
- PPL Undergraduate Research Fund
- Presidential Fellowship
- Program for Undergraduate Research
- Department of Psychology
- The C. Graydon and Mary E. Rogers Faculty Fellowship
- James L.D. and Rebecca Roser Research Fund
- Helen E. Royer Undergraduate Research Fund
- Schotz Family Interdisciplinary Fund
- Alfred P. Sloan Foundation-Chemistry of Indoor Environments
- Department of Sociology & Anthropology
- Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health
- STEM Scholars
- John P. & Mary Jane Swanson Professorship in Engineering & The Sciences
- Leanne Freas Trout Exploration Travel Grant
- Joann E. Walthour Undergraduate Research Fund

Bhagawat Acharya ’20
Faculty Mentors: Professor Katherine Faull, COMPARATIVE HUMANITIES; Professor Brian King, COMPUTER SCIENCE
Funding Source: Schotz Family Interdisciplinary Fund
Handwritten Text Classification

Atakora Appiah-Padi ’20
Faculty Mentor: Professor Khalil Saucier, AFRICANA STUDIES
A Critical Analysis of the Construct of Humxn: Marx and Spinoza to Fanon and Wynter

Carrie Baeckstrom ’21
Faculty Mentor: Professor Mick Smyer, PSYCHOLOGY
Funding Source: Department of Psychology, The Emerging Behavioral Scientists Fellowship
Graduating Green: Designing a Climate Engagement Tool for College Students

Sarah Bain ’21
Faculty Mentor: Professor Sarah Lower, BIOLOGY
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Using Environmental Factors to Predict the Emergence Patterns of Firefly Species in Pennsylvania

Rob Barlow ’22
Faculty Mentor: Professor Ryan Snyder, CHEMICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Stability and Kinetics of Phase Transformations of Amorphous Dispersions

Robert Barlow ’22
Faculty Mentor: Professor Ryan Snyder, CHEMICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Stability and Kinetics of Phase Transformations of Amorphous Dispersions

Laura Bautista-Borrero ’22
Faculty Mentor: Professor Rachel Landsman, ECONOMICS
Funding Source: Douglas K. Candland Undergraduate Research Fund
Demerit or Demure: Gender Differences in Self-Promotion

Emily Bayuk ’21
Faculty Mentor: Professor Stu Thompson, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: The Helen E. Royer Undergraduate Research Fund
Machine Learning - GPS Anomalies

Orli Bernstein ’21
Faculty Mentor: Professor Anjalee Hutchinson, THEATRE & DANCE
Funding Source: Douglas K. Candland Undergraduate Research Fund
Scenic Design Research for Devised Theatre

Nicholas Bindela ’21
Faculty Mentor: Professor Chris Dancy, COMPUTER SCIENCE
Funding Source: National Science Foundation Grant (NSF)
Building Computational Cognitive Models For Human AI Interaction

Ariel Booker ’21
Faculty Mentor: Professor Vanessa Massaro, GEOGRAPHY
Funding Source: Schotz Family Interdisciplinary Fund
Gender Disparities in Exonerations

Lillian Brice ’20
Faculty Mentors: Professor Michelle Johnson, ANTHROPOLOGY; Professor Edmund Searles, ANTHROPOLOGY
A Melting Pot of Well-Being: An Ethnography of Māori Healing Practices

John Buggeln ’20
Faculty Mentor: Professor Tom Solomon, PHYSICS & ASTRONOMY
Funding Source: Program for Undergraduate Research
Active Mixing of Swimming Bacteria in Hyperbolic Flows

Sara Butler ’21
Faculty Mentor: Professor Hava Turkakin, PHYSICS & ASTRONOMY
Magnetohydrodynamic (MHD) Modeling of Kelvin-Helmholtz Instability and Associated Magnetosonic Wave Emission in Solar Coronal Mass Ejections (CMEs)

Carolyn Campbell ’22
Faculty Mentor: Professor Jasmine Mena, PSYCHOLOGY
Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health
Are the LGBTQ+ Affirming Services Presented on Counseling Center Websites Associated with State Political Friendliness?

Andrew Champlin ’21
Faculty Mentor: Professor Hasan Arslan, CHEMISTRY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences
Macrocycle Synthesis Through Asao-Yamamoto Benzannulation

Clare Cheng ’20
Faculty Mentor: Professor Sanjay Dharmavaram, MATHEMATICS
Funding Source: Dean’s Fund for Summer Undergraduate Research in STEM
Interacting Particles on a Spherical Fluid Shell: A Group Theoretic Study

Weiru Chen ’21
Faculty Mentor: Professor Joshua Cooperman, PHYSICS & ASTRONOMY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences
Homogeneity of Quantum Spacetime

Xueying Chen ’22
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: Department of Chemistry
The Criegee Intermediate as a Reactive Oxygen Species in Thin Film Reactions on a Glass Surface

Benjamin Clegg, Graduate Student
Faculty Mentor: Professor Brian Smith, CHEMISTRY
Funding Source: Graduate Summer Research Fellowship, Department of Chemistry
Design and Application of Modular Functionalized Surfaces for Control of Pharmaceutical Polymorphism

Mateo Conde ’21
Faculty Mentor: Professor Philip Asare, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Program for Undergraduate Research
Exploring the Feasibility and Challenges in Developing a Population of ICU Patient Models from Data

Jennifer Davis ’20
Faculty Mentor: Professor Chris Martine, BIOLOGY
Funding Source: David Burpee Endowment, PA Wild Resource Conservation Program
What lies in the Dark: Cutting open Baptisia australis fruits in search of seed predators

Lauralee Davis, Graduate Student
Faculty Mentor: Professor Anna Baker, PSYCHOLOGY
Funding Source: Graduate Summer Research Fellowship
Problems with Adherence and Social Stigma in Adolescents with Type 1 Diabetes

Swarup Dhar ’22
Faculty Mentors: Professor Darakhshan Mir, COMPUTER SCIENCE; Professor Nathan Ryan, MATHEMATICS
Funding Source: Bucknell Institute for Public Policy
Examining Pennsylvania’s Parole Decision Process for Bias and Fairness: Work in Progress

Theresa Dollar ’22
Faculty Mentor: Professor Mark Spiro, BIOLOGY; Jen Partica, Civic Engagement
Funding Source: Bucknell Institute for Public Policy
An Improved Campus Food Waste Composting System

Ethan Dunne ’21
Faculty Mentor: Professor Chris Dancy, COMPUTER SCIENCE
Funding Source: College of Engineering
Object Detection in Computer Vision for an Autonomous Robot

Olivia Dyer ’22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: The John P. & Mary Jane Swanson Professorship in Engineering & the Sciences
Visual and Mechanical Characterization of the Muscle to Aponeurosis Junction

Kyle Ferguson ’21
Faculty Mentor: Professor Hava Turkakin, PHYSICS & ASTRONOMY
Funding Source: Program for Undergraduate Research
Kelvin-Helmholtz Instability-MHD Wave Emission and Global Transport of Energy in Solar-Terrestrial Environment

Evan Filion ’20
Faculty Mentors: Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES ; Professor Jeffrey Trop, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Kalman Fund for Undergraduate Research in the Sciences
Fluvial sedimentology and architecture of two Latest Devonian outcrops, North-Central Pennsylvania, USA

Kristen Fu ’20
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Determination and Modeling of Biaxial Mechanical Properties of Skeletal Muscle

Gregory Galczynski ’21
Faculty Mentor: Professor Marie Pizzorno, BIOCHEMISTRY/CELL BIOLOGY
Funding Source: Department of Biology
Transmission of Deformed Wing Virus in Honeybees

Mateo Garcia ’20
Faculty Mentors: Professor Joseph Jozwiak, ENVIRONMENTAL STUDIES & SCIENCES, INTERNATIONAL RELATIONS; Professor Manuel Larrabure, INTERNATIONAL RELATIONS
Funding Source: The Posse Foundation Scholarship
Global Goals - An Examination on the Economic and Political Effects of Globalization within Football

Emma Gebauer ’20
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: Department of Chemistry
Identifying Key Ingredients in E-Cigarette Liquids using GC-MS Analysis

Olivia George ’20
Faculty Mentor: Professor Morgan Benowitz-Fredericks, BIOLOGY
Funding Source: Department of Biology
Regulation of Neuropeptide Y Gene Expression in Response to Food Restriction in Rhinoceros Auklet chicks

Keith Grega ’21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: John P. & Mary Jane Swanson Professorship in Engineering & the Sciences
Biaxial Tensile Mechanics of Aponeurosis

Clara Han ’21
Faculty Mentor: Professor Joel Wade, PSYCHOLOGY
Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health
The relationship between parental marriage and children’s future relationship preferences

Olanne Healy ’20
Faculty Mentor: Professor Clare Sammells, SOCIOLOGY & ANTHROPOLOGY
Funding Source: Program for Undergraduate Research
Food Insecurity & Greek Life on College Campuses

Jeff Heim ’21
Faculty Mentor: Professor Robert Stockland, CHEMISTRY
Funding Source: Department of Chemistry, Kalman Fund for Undergraduate Research in the Sciences
Synthesis, Isolation, and Characterization of Heteroarylgold Compounds

Nellie Heitzman, Graduate Student
Faculty Mentor: Professor Sarah Lower, BIOLOGY
Funding Source: Graduate Summer Research Fellowship
Relationship between sex, life stage, and gut microbial communities in Photuris fireflies

Leah Henk ’21
Faculty Mentor: Professor Deborah

Sills, CIVIL & ENVIRONMENTAL ENGINEERING
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Culturing algae with different sources of inorganic carbon

Gwendolyn Hostetter ’20
Faculty Mentor: Professor Katherine Faull, COMPARATIVE HUMANITIES
Funding Source: Douglas K. Candland Undergraduate Research Fund
No Rest for the Wiccan: Looking at the Salem and Finnmark Witch Trials

April Hurlock ’23
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: STEM Scholars, Alfred P. Sloan Foundation – Chemistry of Indoor Environments
Effect of Self-Oxidation on Deposited Third-Hand Smoke Film Composition

Cecily Hutchison ’20
Faculty Mentor: Professor Roger Rothman, ART & ART HISTORY
Tancredi: A New Image of Nature

Ana Islas ’20
Faculty Mentors: Professor Dabrina Dutcher, CHEMICAL ENGINEERING, CHEMISTRY; Professor Karen Castle, CHEMISTRY
Funding Source: Department of Chemistry
Carbon Monoxide Concentrations in E-Cigarette Effluent

Samuel Jacob ’21
Faculty Mentor: Professor Carl Kirby, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Department of Geology & Environmental Geosciences, The Katherine Mabis McKenna Environmental Internship Program
Chemical and Biological Documentation of Impairment/Non-Impairment due to Acid Deposition in the Headwaters of Swift Run and Bear Run, Central Pennsylvania

Rachel Johnson ’20
Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Department of Geology & Environmental Geosciences
Testing of two models of Precambrian Deformation in the Shylock shear zone near Phoenix, AZ

Peter Kaladius ’21
Faculty Mentor: Professor Peter Jansson, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: PPL Undergraduate Research Fund
On an investigation of inertial reactions’ origins and Mach’s Principle

Xander Karpowicz ’22
Faculty Mentor: Professor Jonathan Torres, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Effects of Print Settings and Post Processing Treatments on 3D Printed ABS for Prosthetics

Taehwan Kim ’20
Faculty Mentor: Professor Brian King, COMPUTER SCIENCE
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Time Series Prediction using Deep Echo State Networks

Emma King ’20
Faculty Mentor: Professor Hélène Martin, LANGUAGES, CULTURES & LINGUISTICS-French
Funding Source: Leanne Freas Trout Exploration Travel Grant
The Regent: Catherine de Medici; Using Cultural Power to Construct a Nation

Sinet Kroch ’22
Faculty Mentor: Professor Jenna Christian, WOMEN’S & GENDER STUDIES
Funding Source: Douglas K. Candland Undergraduate Research Fund
Understanding How Race and Ethnicity Impact Cambodian Immigrants Experience

Tina Krolikowski, Graduate Student
Faculty Mentor: Professor Anna Baker, PSYCHOLOGY
Funding Source: Graduate Summer Research Fellowship
Borderline Traits in Mothers and Their Adolescent Daughters: The Effects of Relationship Quality, Social Cognition, and Emotion Regulation in Non-Clinical Populations

Megan Lafond ’21
Faculty Mentor: Professor Douglas Dexter, EDUCATION
Funding Source: Joann E. Walthour Undergraduate Research Fund
Inhibition and its Impact on Reading Comprehension in Early Childhood Education

Angela Lai ’22
Faculty Mentor: Professor Brian Smith, CHEMISTRY
Funding Source: Drs. Anthony and Joyce D. Kales Undergraduate Research Fund
Additive Control over Acetaminophen Crystallization from Solution

Tracy Li ’21
Faculty Mentor: Professor Peter Jansson, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health
Nutrition-based Therapies on Positive Medical Outcomes in Depression

Gavin Lindsay ’21
Faculty Mentor: Professor Hasan Arslan, CHEMISTRY
Funding Source: Kalman Fund for Undergraduate Research in the Sciences
Synthesis and characterization of a push-pull hydroquinone polymer

Peter Liu ’22
Faculty Mentor: Professor Lucas Waddell, MATHEMATICS
Funding Source: Program for Undergraduate Research
How significant is the initial population when using a genetic algorithm to solve the quadratic assignment problem

Carrie Loomis ’22
Faculty Mentors: Professor Ellen Herman, GEOLOGY & ENVIRONMENTAL GEOSCIENCES; Professor Molly McGuire, CHEMISTRY
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Effect of Iron Precipitates on Dissolved Iron Oxidation

Catherine MacKay ’21
Faculty Mentor: Professor Anjalee Hutchinson, THEATRE & DANCE
Funding Source: Douglas K. Candland Undergraduate Research Fund, Program for Undergraduate Research
UnHeard/UnSpoken -- the creation of a devised theatrical production

Sandra Madanat ’21
Faculty Mentor: Professor Christine Buffinton, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Cardiac Flow Loop for Assessing TAVR Placement In Patient-Specific Anatomy

Soni Madnani ’20
Faculty Mentor: Professor Nina Banks, ECONOMICS
Funding Source: Bucknell Institute for Public Policy Summer Fellowship
Sadie Alexander’s Role on President Truman’s Committee on Civil Rights

John Mahon ’20
Faculty Mentor: Professor Douglas Collins, CHEMISTRY
Funding Source: Department of Chemistry, Stephen Glenn Hobar Memorial Research Award
Long lived Criegee intermediates

Ariana Majer ’20
Faculty Mentor: Professor Mark Haussmann, BIOLOGY
Funding Source: Department of Biology, National Institutes of Health
Abnormal acute stress responses are associated with telomere loss in Japanese quail

Thomas Matsumura ’22
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Program for Undergraduate Research
Measuring Lower Limb Muscle Activity and Kinematics in Variable Toe Pattern Gait

Kayla McCellon, Graduate Student
Faculty Mentor: Professor Bill Flack, PSYCHOLOGY
Funding Source: Program for Undergraduate Research
College Hookup Culture in Relation to Sexual Assault

Cheyenne McKinley ’20
Faculty Mentor: Professor Sarah Lower, BIOLOGY
Funding Source: National Science Foundation Grant (NSF), The C. Graydon and Mary E. Rogers Faculty Fellowship
Evolution of a firefly femme fatale: a Transcriptomic Analysis

Owen Meng ’20
Faculty Mentors: Professor Alan Cheville, ELECTRICAL & COMPUTER ENGINEERING; Professor Le Paliulis, BIOLOGY
Funding Source: Program for Undergraduate Research
Open-Source Micromanipulators

Rashid Mills ’21, Liv Cabrera ’22, Atakora Appiah-Padi ’20, James Jennings ’20
Faculty Mentor: Professor Jaye Austin Williams, AFRICANA STUDIES
Funding Source: Melon Summer Teaching Grant
Revisiting August Wilson in the 21st century: Blackness Qua Queerness

Okkar Min ’20
Faculty Mentor: Professor Brandon Vogel, CHEMICAL ENGINEERING
Funding Source: Dean’s Fund for Summer Undergraduate Research in STEM
Poly(l-lactic acid) nanoparticles produced by impingement jet mixing solvent displacement: Optimization of process parameters for particle size and polydispersity

John Mirsky ’23
Faculty Mentor: Professor Elizabeth Durden, SOCIOLOGY & ANTHROPOLOGY
Funding Source: The Office of the Provost and Department of Sociology
The Effect of Religious Attendance and Prayer on Subjective Health Outcomes

Brody Mistrot ’21
Faculty Mentor: Professor Brian Smith, CHEMISTRY
Funding Source: Department of Chemistry, Kalman Fund for Undergraduate Research in the Sciences
Understanding Covalent Organic Framework Nucleation Through Small Molecule Structural Analogs

Lydia Naughton ’21
Faculty Mentor: Professor Gregory Pask, BIOLOGY
Funding Source: Kalman Fund for Biomedical Education/Fellows Fund
One Big, Smelly Family: Decoding the Odorant Receptors in the Indian Jumping Ant

Elyse Nissley ’21
Faculty Mentor: Professor Jennie Stevenson, NEUROSCIENCE
Funding Source: Joann E. Walthour Undergraduate Research Fund
Effects of a Glucocorticoid Synthesis Inhibitor on Isolation-Induced Anhedonia in Prairie Voles

Ian O’Keefe ’20
Faculty Mentor: Professor Brandon Vogel, CHEMICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Solid-Phase Extractive Polymerization As a New Method for Polyanhydride Synthesis to Limit Oxidation during Polymerization and Improve Purity for Controlled Drug Delivery

Ephraim Oliphant ’22
Faculty Mentor: Professor Ned Ladd, PHYSICS & ASTRONOMY
Funding Source: Program for Undergraduate Research
Alfven Waves and the Sun’s Corona

John Owen ’21, Tyler Luong ’22, Sebastien Bickford ’21
Faculty Mentor: Professor Stewart Thomas, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Enabling the Internet of Vegetables

Jaewon Park ’20
Faculty Mentor: Professor Andrew Sloboda, MECHANICAL ENGINEERING
Funding Source: Diane L. Hymas Undergraduate Research Fund in Engineering
Time Series Data Analysis for Classification of Upper Body Motion in Bench Press Exercises

Zane Patterson ’22
Faculty Mentor: Professor Eric Kennedy, BIOMEDICAL ENGINEERING
Funding Source: Program for Undergraduate Research
Investigating the Distribution of Playground Injury Severities from Public School Surveillance Reports

Minh Anh Phan ’22
Faculty Mentor: Professor Stu Thompson, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Making the ReadySetFit App Kayak-Friendly

Drew Phipps ’20
Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Department of Geology & Environmental Geosciences Marchand Fund, Program for Undergraduate Research
Detrital Geochemistry and Geochronology of the Late Devonian Spechty Kopf Formation: Improved Constraints on Sediment Provenance and Depositional Age

Drew Phipps ’20
Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Department of Geology & Environmental Geosciences Marchand Fund, Program for Undergraduate Research
Detrital Muscovite Geochemistry and Detrital Zircon Geochronology of the Late Devonian Spechty Kopf Formation: Improved Constraints on Sediment Provenance and Depositional Age

Brenna Prevelige ’20
Faculty Mentor: Professor Mark Haussmann, BIOLOGY
Funding Source: Department of Biology, National Institutes of Health
The cost of nutritional restriction and catch-up growth in Leach’s Storm-Petrels (Hydrobates leucorhous)

Ziang Qin ’22
Faculty Mentor: Professor Philip Asare, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Department of Electrical & Computer Engineering
Bucknell Farming Irreation Management Study

Amber Quinlan ’20
Faculty Mentor: Professor Douglas Dexter, EDUCATION
Funding Source: Douglas K. Candland Undergraduate Research Fund, Program for Undergraduate Research
Creating Effective Multicultural Classrooms: How Gen Z can Lead the Way

Gray Reid ’20
Faculty Mentor: Professor Matthew Slater, PHILOSOPHY
Funding Source: Douglas K. Candland Undergraduate Research Fund
Perceptions of Vaccinations

Erin Rigney ’20
Faculty Mentor: Professor Rob Jacob, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Detecting a Susquehanna River Paleochannel along the North Branch near Mifflin Township, Pennsylvania: A multi-method geophysical survey to determine depth to bedrock

Tyler Rome ’20
Faculty Mentor: Professor Andrew Sloboda, MECHANICAL ENGINEERING
Funding Source: Department of Mechanical Engineering
Using Inertial Measurement Units to Classify Bench Press Exercise

Carly Rovner ’20,
Renee Russell, Graduate Student
Faculty Mentor: Professor Peter Judge, PSYCHOLOGY, ANIMAL BEHAVIOR
Funding Source: Graduate Summer Research Fellowship, Department of Psychology
Squirrel monkeys (Saimiri sciureus) demonstrate pronounced individual differences in understanding a puzzle task

Clara Sandu ’20
Faculty Mentor: Professor David Evans, NEUROSCIENCE
Funding Source: Bucknell-Geisinger Research Initiative (BGRI) Grant
A Systematic Review of Misophonia: Definition, Clinical Correlates, Natural History, and Neural Substrates

Karen Santizo ’21
Faculty Mentor: Professor Kat Wakabayashi, CHEMICAL ENGINEERING
Funding Source: The Katherine Mabis McKenna Environmental Internship Program
Fabrication and Characterization of Hemp Fiber Bio-composites

Holden Scharpf ’22
Faculty Mentor: Professor Kenny Mineart, CHEMICAL ENGINEERING
Funding Source: The Helen E. Royer Undergraduate Research Fund
Adhesion and Elastic Modulus in Block Copolymer Gels Measured by Shear Test and Microindentation

Zack Schiffer ’20
Faculty Mentor: Professor Brian Smith, CHEMISTRY
Funding Source: Department of Chemistry
Atmospheric Headspace Control over Polymorphic Crystallization of Acetaminophen

Steven Sedig ’21
Faculty Mentor: Professor Alan Cheville, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Schotz Family Interdisciplinary Fund
Stitching the Gap Between Design and Technology

Ruth Segall ’21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Culliton Family Fund for Undergraduate Research
Collagen Fiber Alignment in Orthopedic Tissue

Claudia Shrefler ’21
Faculty Mentor: Professor Abby Flynt, MATHEMATICS
Funding Source: Clare Boothe Luce Research Scholarship
Redefining Food Access in Rural Counties of Pennsylvania

Benjamin Siciliano ’20
Faculty Mentor: Professor Brian Smith, CHEMISTRY
Funding Source: Department of Chemistry
Lactose-Modulation of Environmental Conditions Controlling Acetaminophen Polymorphism

Maxwell Skirpan ’20
Faculty Mentors: Professor James Baish, BIOMEDICAL ENGINEERING; Professor Christine Buffinton, MECHANICAL ENGINEERING
Funding Source: James L.D. and Rebecca Roser Research Fund
Hemodynamic Analysis Of Blood Flow In Embryonic Hearts Developing Persistent Truncus Arteriosus

Sam Soldatis ’20
Faculty Mentor: Professor Rob Jacob, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Kalman Fund for Undergraduate Research in the Sciences
Delineating Bedrock-Alluvium Interface And Pleistocene Paleochannel of the West Branch Susquehanna River Using the Gravity Method; Montgomery, Pa

Allison Sullivan ’20
Faculty Mentors: Professor Emily Stowe, BIOLOGY; Dr. Betsy Read, California State University San Marcos; Dr. Rosalina Hristova, California State University San Marcos
Funding Source: NSF Research Experience for Undergraduates at California State University San Marcos
Brown Blob Trials from the Benchtop: Extracting and Sequencing RNA from Microcoleus

Mikaela Thomas ’20
Faculty Mentor: Professor Martin Isleem, LANGUAGES, CULTURES & LINGUISTICS-Arabic
Funding Source: Honors Thesis
The Power of Language: An Analysis of Language Use and Attitudes in Morocco

Joseph Titman, Graduate Student
Faculty Mentor: Professor Brandon Vogel, CHEMICAL ENGINEERING
Funding Source: Graduate Summer Research Fellowship
Development of Two Novel Methods for the Synthesis of Polyanhydrides to Prevent Oxidation and Degradation

Hanh Tran ’20
Faculty Mentor: Professor Sarah Lower, BIOLOGY
Funding Source: Department of Biology
Using computational approach to identify candidate odorant receptor genes in the most common firefly species in North America, Photinus pyralis

Anurag Vaidya ’21
Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING
Funding Source: Presidential Fellowship
Development and Implementation of Volumetric Compression Relaxation Testing of Skeletal Muscle

Shelby Valent, Graduate Student
Faculty Mentors: Professor David Rovnyak, CHEMISTRY; Professor Timothy Strein, CHEMISTRY
Funding Source: National Science Foundation Grant (NSF), Bucknell Graduate Summer Research Award
Structural Features of Stepwise Cholate Micelle Formation Using Chemical Shift Perturbations

Aditi Vijayvergia ’21
Faculty Mentor: Professor Amal Kabalan, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Program for Undergraduate Research poster presentation
A Service Robot for Hospital Patients

Chunzhen Wang ’20
Faculty Mentor: Professor Dave Kelley, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: PPL Undergraduate Research Fund
A Circularly Polarized Loop Yagi Array with a Parallel-Plate Driven Element

Yili Wang ’21
Faculty Mentor: Professor Brian King, COMPUTER SCIENCE
Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health
Identify Features of Images with High Interest from Children with Autism

Devin Whalen ’22, Ryan Bailis ’21
Faculty Mentor: Professor Keith Buffinton, MECHANICAL ENGINEERING
Funding Source: Program for Undergraduate Research
The Dynamic Response of FREEs

Abigail Wukitch ’22
Faculty Mentor: Professor Moria Chambers, BIOLOGY
Funding Source: Department of Biology, Presidential Fellowship
The protective effect of chronic infection during secondary infection in Drosophila melanogaster

Matylda Zaklicki ’20
Faculty Mentors: Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES; Professor Jeffrey Trop, GEOLOGY & ENVIRONMENTAL GEOSCIENCES
Funding Source: Program for Undergraduate Research
Sedimentological and Paleoenvironment Analysis of the Late Devonian Catskill Formation, North-Central Pennsylvania, USA

Ruoying (Yvonne) Zhang ’21
Faculty Mentor: Professor Anna Kell, ART & ART HISTORY
Funding Source: Douglas K. Candland Undergraduate Research Fund
Apathy

Nick Zhang ’21
Faculty Mentor: Professor Stu Thompson, ELECTRICAL & COMPUTER ENGINEERING
Funding Source: Culliton Family Fund for Undergraduate Research
Verifing the reliablility and validity of phone GPS data

Erin Zielinski ’22
Faculty Mentor: Professor Kenny Mineart, CHEMICAL ENGINEERING
Funding Source: National Science Foundation Grant (NSF)
Creating Different Sized Reverse Micelles and Comparison of Their Diffusion

Bhagawat Acharya ’20

Faculty Mentors: Professor Katherine Faull, COMPARATIVE HUMANITIES; Professor Brian King, COMPUTER SCIENCE

Funding Source: Schotz Family Interdisciplinary Fund

Handwritten Text Classification

This presentation will present a new handwriting grouping algorithm that has been developed to decrease the Character Error Rate (CER) for a collection of manuscript documents written in various hands and in multiple languages. The Moravian Lives project (moravianlives.org) focuses on tens of thousands of handwritten ego-documents; to facilitate transcription of these, the team has been using Transkribus. Numerous and varying handwriting styles found in the documents present challenges to creating highly accurate HTR models. Human identification of similarities in handwriting is tenuous; automated scribe identification or grouping of handwriting styles could result in much more accurate models. An undergraduate computer science student and professor of computer science and are experimenting with deep learning to author a grouping model, designed to group or sort memoirs by handwriting styles. These groupings should enable the creation of more accurate models in Transkribus, as well as more accurate transcription outputs.

Atakora Appiah-Padi ’20

Faculty Mentor: Professor Khalil Saucier, AFRICANA STUDIES

A Critical Analysis of the Construct of Humxn: Marx and Spinoza to Fanon and Wynter

Since the 19th c. most leftists have considered Karl Marx to be one of the most impactful economic and political theorist from Europe. However, this label doesn’t sufficiently express the work and influence of Karl Marx. A vast majority of his time was spent working on philosophical concepts like alienation - in estranged labour – and self-actualization. This intense meditation on metaphysical issues is a clear sign that Marx was a philosopher to his core. Due to Marx’s philosophical lens – historical materialism - he came to the conclusion of an economic and political system of communism. This study looks to extend this tradition by analyzing other philosophers’ conceptions of the humxn condition. More specifically, an analysis of the work of Sylvia Wynter, Baruch de Spinoza, Frantz Fanon, and Akan and Igbo philosophy to understand how constructions of “humxn” have impacted the understanding of humxn nature. These new modes of Being consequently create new political and economic systems. By understanding that our societal structures are products of our philosophical framing of being, we begin to explore how a new humxn history will require new systems of governance.

Carrie Baeckstrom ’21

Faculty Mentor: Professor Mick Smyer, PSYCHOLOGY

Funding Source: Department of Psychology, The Emerging Behavioral Scientists Fellowship

Graduating Green: Designing a Climate Engagement Tool for College Students

Through the Emerging Behavioral Scientists Fellowship of Bucknell’s psychology department, I collaborated with Dr. Smyer on a project for his Graying Green initiative, which uses workshops and tools to move people from environmental anxiety to earth-friendly action. One of these tools is the “Your Climate Journey” deck of cards, a set of climate actions that individuals can categorize by what they already do, what they would not do, or what they could do, for the purpose of educating people about how they already help the environment and what they can do to increase their positive impact. While Professor Smyer began by focusing on the aging population, my contribution fits into the initiative by adapting these cards for college students. Combining human-centered design and psychology, I conducted a series of interviews with current students to test existing and new material. I used the data and feedback from these interviews to modify the deck to be as engaging and effective as possible, repeating this process multiple times to ultimately produce a prototype. My version has since been edited, printed, and used for several different groups of college students, including BSG Senators, as a part of the “Your Climate Journey” workshops. Once these prototypes have been revised, Dr. Smyer plans to share the tools with members of theAssociation for the Advancement of Sustainability in Higher Education (AASHE).

Sarah Bain ’21

Faculty Mentor: Professor Sarah Lower, BIOLOGY

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Using Environmental Factors to Predict the Emergence Patterns of Firefly Species in Pennsylvania

How do environmental parameters affect the geographic distribution of organisms? The overall goal of this research project attempts to investigate environmental factors (air and soil temperature) influencing species distributions with fireflies as the model organism. Fireflies are a very widely admired organism but are vastly understudied; more and more information is being discovered about this organism everyday so it is a new, interesting, and current area of research. With that being said, there are many aspects of these organism that still need to be researched. Flash patterns and DNA barcoding to identify which firefly species were present at three local field sites (the Bucknell Natural Area, CLIMBucknell Challenge course, and Bald Eagle State Park). That data, in addition to minimum and maximum air temperatures, were used to create a degree-day (mGDD) model. The degree-day model was adapted so it can be used as a predictive model of the various local firefly species found in years to come. Fireflies can be bio-indicators of environmental health, knowing more about how air and soil temperature affects when and where they emerge will begin to illustrate what could happen to firefly populations in relation to the continuation of climate change which is such a pressing issue in the world today.

Rob Barlow ’22

Faculty Mentor: Professor Ryan Snyder, CHEMICAL ENGINEERING

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

Stability and Kinetics of Phase Transformations of Amorphous Dispersions

Many pharmaceuticals are composed of two main components: active pharmaceutical ingredients (API) and excipients. In pills/tablets, an API’s characteristics will greatly influence the potency or bioavailability (the ability of a compound to dissolve in the blood to be used by the body). Moreover, the structure has a major impact on the bioavailability. The excipient can help to control the structure of the API because whether it’s amorphous or crystalline. Generally, amorphous particles are more soluble and crystalline are less soluble. However, crystalline structures tend to be more stable than amorphous structures, and sometimes crystallize over time. The excipient helps prevent or slow this since polymers themselves don’t crystalize, so a homogenous mixture of API and excipient would be expected to have little or no crystallization (Myerson, 2002).

Solutions of various weight percents of dicarboxylic acid to PVP are dissolved in isopropanol. In a Vibrating Orifice Aerosol Generator (VOAG), a solution is fed into the machine where it’s sprayed, allowing individual drops to dry independently creating small particles. Also, the VOAG produces a narrow droplet distribution which allows it to create particles of similar size to eliminate size dependency. Using powder x-ray diffraction (pXRD), samples are monitored to determine if and how long this takes and percent of API crystallization. Standards of known crystallinity are made to compare to the data to determine the percent crystallinity in the sample. This is done using partial least squares regression, peak area, and peak height.

Robert Barlow ’22

Faculty Mentor: Professor Ryan Snyder, CHEMICAL ENGINEERING

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

Stability and Kinetics of Phase Transformations of Amorphous Dispersions

Many pharmaceuticals are composed of two main components: active pharmaceutical ingredients (API) and excipients. APIs are the active ingredients, while excipients are the inactive ingredients. Specifically, in pills/tablets, an API’s characteristics will greatly influence the potency or bioavailability (the ability of a compound to dissolve in the blood to be used by the body). The more bioavailable a drug is, the less is required to achieve a desired effect. Moreover, the structure has a major impact on the bioavailability. The excipient can help to control the structure of the API because whether it is amorphous, crystalline, or some intermediate can influence solubility. Generally, amorphous particles are more soluble and crystalline particles are less soluble. However, crystalline structures tend to be more stable than amorphous structures, and, consequentially, sometimes crystallize fully or partially over time. The polymer excipient helps prevent or slow down this since polymers themselves do not crystallize, so a homogeneous mixture of API and excipient would be expected to have little or no crystallization (Myerson, 2002).

The Vibrating Orifice Aerosol Generator (VOAG) helps form amorphous dispersions. These dispersions comprise of a polymer excipient, polyvinylpyrrolidone (PVP), and a model API (a dicarboxylic acid). These are chosen since PVP is a common excipient in many pharmaceuticals and dicarboxylic acids resemble many APIs.

Solutions of various weight percents of dicarboxylic acid to PVP are dissolved in isopropanol (IPA). The VOAG works similarly to a spray dryer (commonly used in the pharmaceutical manufacturing): a solution is fed into the machine where it is sprayed, allowing individual drops to dry independently creating small particles. One main difference between the VOAG and spray dryer is that the spray dryer operates at higher temperatures, whereas the VOAG uses ambient temperatures with lower flow rates and improved droplet dispersion to allow for drying. Also, the VOAG produces a narrow droplet distribution which allows the VOAG to create particles of similar size to eliminate size dependency. We form amorphous particles and analyze their dynamic stability. Using powder x-ray diffraction (pXRD), samples are monitored regularly to determine if the particles begin to crystallize, how long this takes, and percent of API crystallization. Standards of known crystallinity are made to compare to the data to determine the percent crystallinity in the sample. This is done using partial least squares regression, peak area, and peak height.

Laura Bautista-Borrero '22

Faculty Mentor: Professor Rachel Landsman, ECONOMICS

Funding Source: Douglas K. Candland Undergraduate Research Fund

Demerit or Demure: Gender Differences in Self-Promotion

This study seeks to gain a deeper understanding of factors that contribute to the gender gap in labor market outcomes. Existing research found gender differences in the propensity to self-promote on LinkedIn profiles (Altenberger et al., 2017) and in more abstract experimental environments (Exley & Kessler, 2019). This study uses a carefully designed incentivized survey experiment to do the following: (i) Identify whether gender differences in self-promotion are justified by differential treatment of self-promotion by male vs female job applicants; and (ii) Identify whether the use of direct questions rather than open ended questions can close the gender gap in self-promotion. Across treatments, we vary the type of "job application" questions answered by participants facing a potential hiring situation. We also vary whether the gender of participants assigned to the role of "job applicant" is visible or not. While still in data collection stages, we plan to analyze the degree of self-promotion across treatments by gender. We also intend to analyze, controlling for degree of self-promotion, whether men and women are treated differently for comparable applications across treatments.

Emily Bayuk '21

Faculty Mentor: Professor Stu Thompson, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: The Helen E. Royer Undergraduate Research Fund

Machine Learning - GPS Anomalies

To provide the Bucknell Field Hockey team with more accurate player statistics, this research attempted to mathematically define GPS anomalies (incorrect GPS data points) and determine why they occur by using Machine Learning.

Machine Learning can be defined when computers learn how to get better at a task without being given explicit instructions; machines make predictions after finding patterns in large amounts of data. It is the reason computers can identify the same person's face in different pictures, Netflix can recommend movies and tv shows based on those you've watched and liked, and Spotify can suggest new songs according to what you usually listen to.

After exploring Machine Learning through podcasts, online classes, videos, and a book Hands-on Machine Learning with Scikit-Learn & TensorFlow, as well as interviewing professors about the subject, I determined Machine Learning is not the best way to gain a better understanding of GPS anomalies. In fact, it is extremely possible no solution exists to correct GPS anomalies.

Orli Bernstein '21

Faculty Mentor: Professor Anjalee Hutchinson, THEATRE & DANCE

Funding Source: Douglas K. Candland Undergraduate Research Fund

Scenic Design Research for Devised Theatre

This summer I worked with Professor Anjalee Hutchinson, the head of the theatre department, in order to prepare resources for our devising class and main-stage show this coming fall. I focused on image research, finding images related to our central themes of anxiety, loneliness, and miscommunication. These topics will inspire and shape our creative process in the fall, when we will create a new performance. The images I found, pictures of the other work I did, and the work of my fellow researcher Catherine MacKay are showcased on a website we populated this summer. This website will be a resource for the students creating the show in fall. In addition to image research, one of my responsibilities this summer was to design a set on which our show will be created. My goal for this set was to make it open-ended and to avoid assigning our show, which has yet to be created, a premature setting. In order to design the set I worked hands on, experimenting, while building a model; there are many pictures on the website, I have included a link below. I also learned the computer program Vectorworks in order to draft blueprints for the set. http://bucknelldevisingfall2019.scholar.bucknell.edu/

Nicholas Bindela '21

Faculty Mentor: Professor Chris Dancy, COMPUTER SCIENCE

Funding Source: National Science Foundation Grant (NSF)

Building Computational Cognitive Models For Human AI Interaction

My research is centered around Microsoft's "Project Malmo" and their "Collaborative AI Challenge", which was a competition that had contestants aim to develop and train AI to work with humans to accomplish a common goal. My research aims to develop cognitive agents that can effectively simulate human cognition when interacting with the AI agents from the Project Malmo competition. Project Malmo uses the Minecraft client to build the environments in which the AI simulations run. Our research team uses Python to program the environments where the AI and human/cognitive agents will interact. The Python environments behave as a mediator between the Minecraft client and the software we use to program our cognitive agents. My portion of the research project is aimed at developing the cognitive agents to interact with the AI. We use the Adaptive Control of Thought-Rational (ACT-R) cognitive architectural model as a basis for creating our cognitive agents. ACT-R is a psychological theory that allows us to break down human actions and behaviors into discrete operations so we can effectively simulate human cognition. The ACT-R model has a software available online that we use to program our models so they can interact with the AI solutions. I work on creating the cognitive models using the ACT-R software, which is programmed using Common-Lisp. I also work on building the Python environments, sending observations made by the ACT-R agent to Python and making sure the information is properly received in Python.

Ariel Booker ’21

Faculty Mentor: Professor Vanessa Massaro, GEOGRAPHY

Funding Source: Schotz Family Interdisciplinary Fund

Gender Disparities in Exonerations

Wrongful convictions are a gross miscarriage of justice and leave innocent people in prison for countless years. Wrongful convictions undermine the integrity and legitimacy of the legal system. Wrongful convictions can be traced as far back as the Salem Witch trials and there is a great deal of scholarship on the issue. However, as much as we currently know about wrongful convictions little is known about the gender disparities that exist between the wrongful convictions of men and women. Since 1989, there have been 2,471 individuals exonerated and only 217 of those are women. There is a lack of literature about women who have been falsely convicted. In my project, I attempt to fill the gap in women’s wrongful convictions and statistics surrounding these cases. My research will provide information regarding existing scholarship and statistics that are specific to female exonerees. Within my project, I examine information about every exoneree in the United States since 1989 through the University of California Irvine and the University of Michigan’s collaborated National Registry of Exonerations. I also looked at scholarly articles about wrongful convictions, the causes of wrongful convictions, and women’s incarceration rates. By addressing the widespread misunderstanding of wrongful convictions and their prominence in the U.S. criminal justice system, I hope to bring further attention to the subject. And additionally, by focusing on the gender divide in wrongful convictions it creates a valuable avenue of much-needed research on the topic.

Lillian Brice ’20

Faculty Mentors: Professor Michelle Johnson, ANTHROPOLOGY; Professor Edmund Searles, ANTHROPOLOGY

A Melting Pot of Well-Being: An Ethnography of Māori Healing Practices

Drawing on contemporary anthropological approaches used by scholars of well-being, including Michael Jackson and Paul Stoller, I explore how indigenous healers in New Zealand blend “traditional” and “modern” elements to establish a creative and inclusive system. Specifically, I explore the use of herbal treatments, ritual chanting, and ceremonies that encapsulate Māori cultural values. I also examine the impact of biomedicine and New-Age wellness approaches on indigenous healing practices. I argue that Māori healing moves beyond the binary of “tradition” and “modern” as healers merge past and present and combine foreign and native. My research is based on published scholarly literature, participant-observation I conducted during my semester abroad in Dunedin, New Zealand in Spring 2019, and semi-structured recorded interviews with tohunga (indigenous Māori healers). During my five-month stay, I spoke with tohunga, experienced indigenous ceremonies and karakia (ritual chanting) first-hand (no comma) and attended the Christchurch Healing Expo where I shadowed a Māori healer during a mirimiri (sacred ritual massage). My honors thesis addresses the historical and cultural origins of Māori healing practices, how these practices integrate with contemporary society, as well as how the indigenous population perceives health. Furthermore, it demonstrates that it is impossible to fully separate Māori healing from other wellness systems because “indigenous” healing has always incorporated healing practices from other cultures. My research contributes to the anthropological study of wellness by reevaluating the meaning of “indigenous” healing and its connection to identity and well-being in contemporary New Zealand.

John Buggeln ’20

Faculty Mentor: Professor Tom Solomon, PHYSICS & ASTRONOMY

Funding Source: Program for Undergraduate Research

Active Mixing of Swimming Bacteria in Hyperbolic Flows

We present experiments on the effects of imposed, laminar fluid flows on the motion of active (self-propelled) tracers. The active tracers are bacillus subtilis bacteria, including a wild-type strain and two variations, one with the GFP mutation and one with a smooth-swimming mutation for which the microbe doesn't tumble. The imposed flows are simple hyperbolic flows and vortex chain flows. We test theories that predict "swimming invariant manifolds" (SwIMs) that act as one-way barriers that impede the motion of active tracers in the flow (swimming bacteria). For the hyperbolic flows, we investigate the structure of the barriers as a function of the imposed flow magnitude, and have supporting evidence for the existence of SwIMs.

Sara Butler '21

Faculty Mentor: Professor Hava Turkakin, PHYSICS & ASTRONOMY

Magnetohydrodynamic (MHD) Modeling of Kelvin-Helmholtz Instability and Associated Magnetosonic Wave Emission in Solar Coronal Mass Ejections (CMEs)

Interrupted telegraphy systems, regional power outages, and damaged satellites demonstrate a few of the consequences to earth technology by mechanisms that can be analyzed and prevented. The impact of solar wind on the earth and other objects in interplanetary space is relatively understudied, yet has far-reaching applications. Previous related studies have observed through close study of shear flow regions in the Solar-terrestrial environment, that Kelvin-Helmholtz Instability (KHI) and Magnetohydrodynamics (MHD) wave emissions along these boundaries may be a method by which energy is transported from flow. In order to gain a deeper understanding of the non-linear dynamics that distribute energy throughout the Solar Corona, we expand upon these previous studies to investigate the nonlinear evolution of KHI and MHD waves along the boundaries of coronal mass ejections (CMEs), large eruptions of the corona that have a significant effect on satellites, earth's power grids, and humans in space. We utilize different criteria for measuring efficiency, including 2-D/3-D magnetohydrodynamic modeling software. We also discuss in detail the implementation of this software in our analysis about the nature of MHD instabilities in astrophysical plasmas throughout the universe.

Carolyn Campbell '22

Faculty Mentor: Professor Jasmine Mena, PSYCHOLOGY

Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health

Are the LGBTQ+ Affirming Services Presented on Counseling Center Websites Associated with State Political Friendliness?

LGBTQ+ college students experience unique barriers to accessing mental health services due to the societal marginalization of their identities. Examples of barriers include: fear of being outed, lack of counselor knowledge, and a lack of communication from their institutions about resources. In order to alleviate these barriers to accessing affirming services, counseling center websites (CCWs) are ideal for marketing since they are convenient and anonymous. However, recent research indicated that only 49% of CCWs provided any LGBTQ+ information. State-level political friendliness has also been associated with wellbeing and distress among LGBTQ+ individuals, which may be related to CCWs. This study defined state political friendliness based on the following policies: religious exemption, employment nondiscrimination, and hate crimes laws. With this context in mind, the present study sought to (1) conduct a content analysis of CCWs to determine the frequency of LGBTQ+ affirming information and (2) analyze the association between frequency of affirming information and LGBTQ+ political friendliness at the state level. A national sample of 221 schools was generated to represent both the proportion of qualified schools per state and the national proportion of public versus private schools. Results showed statistically significant relationships between each political friendliness variable and at least one of the variables examined from the CCWs. These results will be used to recommend structural changes at colleges and universities and state level policies to ensure this population is informed of and provided with affirming mental health care.

Andrew Champlin '21

Faculty Mentor: Professor Hasan Arslan, CHEMISTRY

Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Macrocycle Synthesis Through Asao-Yamamoto Benzannulation

Macrocycles are molecules that contain large ring structures with unique qualities compared to their linear counterparts. Some macrocycles, such as cyclodextrin, form host-guest complexes with various compounds like volatile hydrocarbons in which the guest compound gets trapped inside the molecular cavity of the host macrocycle. Such macrocycles have applications in various fields from water purification, chiral separations, drug delivery and the fragrance industry. Despite the many uses of macrocycles, they remain difficult to synthesize as most known techniques are applicable to a small set of compounds and/or require unique reaction conditions such as temperature and concentration. In our work, we attempt to synthesize macrocycles and develop a blueprint for future synthesis of similar compounds through a reaction called a Cu(OTf)2-catalyzed Asao-Yamamoto Benzannulation. Multiple macrocycles with various sizes will be presented using this new methodology, allowing us to explore host-guest complexation of these macrocycles. Preliminary geometry optimization of the proposed macrocycle shows a rectangular-shaped ring structure being the most stable conformation; therefore, it is expected to show good affinity towards planar guest molecules. Current efforts are focused on alternative routes to the precursor compounds that make the building blocks of the macrocycles, allowing for increased yield and modularity of the final macrocycles. Our novel approach to synthesizing macrocycles using Asao-Yamamoto benzannulation will provide further insight into the conditions required for the synthesis of future macrocycles.

Clare Cheng ’20

Faculty Mentor: Professor Sanjay Dharmavaram, MATHEMATICS

Funding Source: Dean’s Fund for Summer Undergraduate Research in STEM

Interacting Particles on a Spherical Fluid Shell: A Group Theoretic Study

Many biological structures can be modeled as a system of interacting particles moving on a two-dimensional elastic membrane, for instance, protein clusters on cell-membranes and capsids of immature enveloped viruses. In this work, we present a model for such systems. We adopt the combination of the Helfrich model and the Lennard-Jones model as our energy representation of the particle-membrane system. The nonlinearity of the model gives rise to a complex competition of equilibrium states of the energy with symmetric features. We implement group-theoretic techniques to examine symmetric states and develop an automated computer program that systematically catalogs the symmetric equilibrium configurations for varying numbers of particles and model parameters.

Weiru Chen ’21

Faculty Mentor: Professor Joshua Cooperman, PHYSICS & ASTRONOMY

Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Homogeneity of Quantum Spacetime

The goal of this research is to study how homogeneous quantum spacetime is on different length scales. Given a quantum spacetime, we want to study whether every point in this spacetime shares the same properties at the same length scale. We numerically simulate the quantum spacetime predicted by a particular quantum theory of gravity called causal dynamical triangulations, which uses higher dimensional triangles as the building blocks to construct this spacetime. We investigate five properties that we can measure on different length scales. Among these measurements, our spectral homogeneity measure yields the most positive results. Our Ricci curvature homogeneity measure seems to be promising but, due to its computational complexity, we still lack desirable data. The other three homogeneity measures turn out not to give well-defined results. Based on what we have learned so far, our spectral homogeneity measure indicates that quantum spacetime is homogeneous on sufficiently large scales and inhomogeneous on small scales.

Xueying Chen ’22

Faculty Mentor: Professor Douglas Collins, CHEMISTRY

Funding Source: Department of Chemistry

The Criegee Intermediate as a Reactive Oxygen Species in Thin Film Reactions on a Glass Surface

The indoor environment is where people are exposed to most of the time and where various chemicals can deposit on large surface areas. Ozone, an air pollutant that can be introduced from outdoors, can react with organic compounds deposited on indoor surfaces to create the high energy Criegee Intermediates (CI). The CI reacts rapidly with certain chemicals to form highly oxygenated species, some of which can then further degrade into hazardous chemicals. Our current study focuses on the reactions of oleic acid and 4-methylcatechol mixtures with gaseous ozone. While prior studies have probed ozone reactions with single components, the present study emphasizes the impact of mixtures on oxidation products and chain oxidation. The reactions are performed by depositing the mixed solution of oleic acid and 4-methylcatechol on the outside surface of glass capillaries, which are then exposed to approximately 100 ppb ozone a gas flow reactor for 1 hour. The decay of oleic acid and 4-methylcatechol, along with the formation of key products, are monitored with direct analysis of mass spectrometry. Our studies show that both 4-methylcatechol and oleic acid form CI-based intermediates that compete to form a wide distribution of products. In the end, we aim to deepen the scientific understanding of atmospheric chemistry as chemical complexity is increased in laboratory studies toward the real complexity of the environment.

Benjamin Clegg, Graduate Student

Faculty Mentor: Professor Brian Smith, CHEMISTRY

Funding Source: Graduate Summer Research Fellowship, Department of Chemistry

Design and Application of Modular Functionalized Surfaces for Control of Pharmaceutical Polymorphism

In current pharmaceutical development, small molecule crystallization is critical for production of viable drug therapies; however, extensive control over this process is currently limited due to the stochastic nature of nucleation onset and the wide number of factors that drive nucleation and polymorphism. Heterogeneous surfaces are known to accelerate crystal nucleation versus bulk homogeneous conditions; however, control over structure at the interface is often difficult. Here we present a platform for modifying glass surface structure using a covalently-attached functionalization approach. These groups noticeably alter surface hydrophilicity, which is controllable through functional group exchange. Moreover, using a reversible chemical bridge, the surface species can be readily exchanged post-synthesis. When applied to melt recrystallization of model system acetaminophen, functional group identity affects nucleation onset in the amorphous solid. Here we report the development of a modular functionalized surface library and its potential for exploring nucleation onset control.

Mateo Conde ’21

Faculty Mentor: Professor Philip Asare, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: Program for Undergraduate Research

Exploring the Feasibility and Challenges in Developing a Population of ICU Patient Models from Data

There has been recent interest in developing systems to control existing medical devices, such as infusion pumps, by using patient data collected from the vitals monitor and a decision-making algorithm to make automatic interventions. These systems, which we call Closed-Loop Assistants or CLAs, are designed to augment the clinician’s abilities by monitoring patient health and intervening when necessary, with the goal of reducing the complexity of medical care. The aforementioned systems need a way to be validated. However, there does not exist models that account for patient differences, limiting their abilities to inform and validate such systems in a greater population. Our goal is to use existing generic models and data from real patients to develop a population of patient models, where patient physiologies differ from each other. We used Pulse as our generic model and data from MIT’s eICU database. Our approach is to start with Pulse as the generic patient model and try to create patients in Pulse who respond to inputs similar to the way the patients in the MIT database respond. We have been able to find the parameters in this case for simple simulation scenarios, but struggle with more complicated scenarios. This is due to the optimization algorithm converging when model produces similar results for different parameters. Future work involves exploring the parameter space and difference between the model and the actual patient data to inform our optimization techniques.

Jennifer Davis ’20

Faculty Mentor: Professor Chris Martine, BIOLOGY

Funding Source: David Burpee Endowment, PA Wild Resource Conservation Program

What lies in the Dark: Cutting open Baptisia australis fruits in search of seed predators

Baptisia australis var. australis (L.) R. Br. (Fabaceae) is a rhizomatic perennial wildflower found in riparian, forest-edge, and prairie habitats throughout central and eastern North America. In Pennsylvania, it is classified as state-threatened due to habitat loss. Previous research in other areas of North America has found seed predation to be significantly damaging to Baptisia australis reproductive success, particularly due to lepidopteran and weevil larvae. No seed predation data has been collected for the Allegheny River metapopulation (consisting of the only extant populations in Pennsylvania), therefore our work examining seed predation in the region is novel. Fruits were gathered from six populations along the Allegheny River and preserved in ethanol. They were examined for holes, measured, and dissected. Mature and immature seeds were counted, and any abnormalities inside, such as frass or larvae, were documented. Data obtained from dissecting fruits will help determine the level of seed predation that is currently occurring in Allegheny River populations of B. australis var. australis, as well as variation in average fruit length, seed count, and seed size. Our current findings suggest that lepidopteran seed predation is present in Pennsylvania, a previously unknown concern for this rare plant. This research serves two main purposes: to collect qualitative and quantitative data on threats to B. australis var. australis populations in Pennsylvania, and to contribute to future conservation of the species. Understanding the extent of seed predation in the Allegheny River drainage will aid in reassessing the conservation status of B. australis var. australis.

Lauralee Davis, Graduate Student

Faculty Mentor: Professor Anna Baker, PSYCHOLOGY

Funding Source: Graduate Summer Research Fellowship

Problems with Adherence and Social Stigma in Adolescents with Type 1 Diabetes

For adolescents with Type 1 Diabetes the clinical importance of both adherence to disease management and social support from family and friends is apparent. Adolescence is ultimately defined by the critical transition from childhood and dependence on family, to a newfound independence and increased value and importance in peers (Robinson, 2008). However, the role that family support or peer support plays on adherence to diabetes management or stigma is still unclear. This study aims to determine differences between the type of support provided by family compared to peers, to examine how possible differences in the type of support impact adherence, to examine how stigma and anxiety may impact adherence, and to examine the types of barriers adolescents with Type 1 Diabetes experience and how these barriers may impact adherence. Approximately 300 adolescents between the ages of 14 and 18 years old with Type 1 Diabetes are completing a survey with nine different measures assessing adherence, social stigma, anxiety, sleep, and social support. Recruitment is taking place through the T1D Exchange Network in conjunction with social media platforms and Qualtrics. At the time of this submission, data collection is still ongoing. The final results and discussion points will be presented at the Kalman Research Symposium.

Swarup Dhar ’22

Faculty Mentors: Professor Darakhshan Mir, COMPUTER SCIENCE; Professor Nathan Ryan, MATHEMATICS

Funding Source: Bucknell Institute for Public Policy

Examining Pennsylvania’s Parole Decision Process for Bias and Fairness: Work in Progress

For a criminal justice system, it is imperative that decision-making processes exercise fairness. Using data acquired from the Pennsylvania Department of Corrections (PADOC) on inmates over the last 30 years, this research seeks to examine Pennsylvania’s parole decision process for quantitative and qualitative notions of bias and fairness. During the Summer, and most of the fall semester, I worked to gain domain knowledge in the field; analyzed statistics about the demographic data; cleaned and processed the data; and worked to gain a general understanding of the types of data at our disposal. This poster will present my work in progress. In particular, it will examine the data for any racial disparities in the rates of the disciplinary tickets received while in prison.

Theresa Dollar ’22

Faculty Mentor: Professor Mark Spiro, BIOLOGY; Jen Partica, Civic Engagement

Funding Source: Bucknell Institute for Public Policy

An Improved Campus Food Waste Composting System

Food waste disposal is a problem at higher education institutions all over the country, including Bucknell University. Most of Bucknell’s food waste is transported to the Lycoming landfill, including an estimated 2 cubic yards of vegetable waste from the Bostwick kitchen daily. This amplifies our carbon and methane footprints and in effect contributes to climate change. Our campus has the potential to decrease our school’s environmental impact by redirecting food waste headed to the landfill to a compost system. Furthermore, finished compost is a valuable resource for the new campus farm.

In this project, I assessed the current composting system at Bucknell to identify ways in which it can be improved. I communicated with facilities and dining while researching techniques at comparable institutions. In addition, I made visits to our site, the Rodale Institute, and the Lycoming Landfill. I also used a CHN analyzer to examine the current state of our compost. This research led to four potential recommendations for the campus’s composting.

Ethan Dunne ’21

Faculty Mentor: Professor Chris Dancy, COMPUTER SCIENCE

Funding Source: College of Engineering

Object Detection in Computer Vision for an Autonomous Robot

This project is centered on creating an autonomous robot agent that can navigate the halls of Dana Engineering. The robot makes use of the cognitive architecture model called ACT-R to define the basic and irreducible cognitive and perceptual operations that enable the human mind. My project is a sub-project on the topic of developing the vision capabilities for this robot. The robot, named Spike, needs to be capable of detecting objects and reacting based on the state of the environment. Spike’s mind is run on an NVIDIA Jetson TX2 because of its high computing power, which is necessary for things like object detection in live video feed. Ultimately, the goal of this project is to be able to detect objects in a camera feed and relay those objects in a format that can be read by the ACT-R model. Spike will use a Stereo Labs ZED camera for vision and a TensorFlow

Object Detection API to determine what it is seeing. When finished, this subsystem should be able to provide all of the environmental information that Spike needs to make decisions.

Olivia Dyer ’22

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING

Funding Source: The John P. & Mary Jane Swanson Professorship in Engineering & the Sciences

Visual and Mechanical Characterization of the Muscle to Aponeurosis Junction

Aponeurosis is a tendinous sheath-like tissue found in many muscle-tendon units, and the muscle-aponeurosis junction is poorly understood. We want to determine the structure of the transition from muscle to aponeurosis and how it may be similar or different from the myotendinous junction. Imaging and visually characterizing the muscle-aponeurosis junction using SEM imaging of tissue samples will show how the tendon and muscle fibers interact with one another in the transition zone. Characterizing the stiffness of aponeurosis to muscle transition with a material testing system will help provide information as to how the structural properties of the aponeurosis differ along the length of the tissue. Evaluating these characteristics will help us better understand how damages to the tissues occur, how those damages can be repaired and rehabilitated, and how to properly develop computer models of the musculoskeletal system. Sample images using the SEM have been taken to develop a general understanding of aponeurosis morphology.

Kyle Ferguson ’21

Faculty Mentor: Professor Hava Turkakin, PHYSICS & ASTRONOMY

Funding Source: Program for Undergraduate Research

Kelvin-Helmholtz Instability-MHD Wave Emission and Global Transport of Energy in Solar-Terrestrial Environment

Solar wind and its interactions with the planetary magnetic fields is the controlling mechanism for the interplanetary space and solar-terrestrial environment. Dynamics that distribute energy throughout interplanetary space within two different regions is an important area of research, which helps predict the impact of solar wind on the Earth and other objects in the interplanetary space. In this study, we investigate the possibility of KHI and wave emission as a means of energy transport out of several shear flow regions in solar-terrestrial environment, namely Coronal Mass Ejections (CMEs) and Supra-Arcade Downflows (SADs) in the solar corona and Bursty Bulk Flows (BBFs) in the Earth’s magnetosphere. Through the use of 2D magnetohydrodynamic (MHD) modeling with FLASH code, our results suggest the emission of propagating MHD waves during linear phases of Kelvin-Helmholtz instability growth, which was proposed not to be possible in the past studies. KHI and MHD wave emission was found to be possible along all three shear flow boundaries investigated. We suggest that these waves may be a means of energy transport out of CMEs and SADs and may contribute to the unknown reason of solar coronal heating in the solar corona and the generation of substorms in the Earth’s magnetosphere via wave-particle interactions. Furthermore, they may contribute to the sudden stopping of SADs and BBFs via transportation of flow kinetic energy out of these regions.

Evan Filion ’20

Faculty Mentors: Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES ; Professor Jeffrey Trop, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Fluvial sedimentology and architecture of two Latest Devonian outcrops, North-Central Pennsylvania, USA

Thick successions of river deposits accumulated in the north-central Pennsylvania region of the Appalachian foreland basin during Late Devonian and Early Mississippian time (~380-345 Ma). The properties and morphologies of these paleorivers are not well characterized. Tectonic, climatic, and eustatic controls on river dynamics and basin infilling also remain unclear. This study assesses the sedimentology, facies architecture, paleochannel depths, and grain size through a 133 m thick section of fluvial strata at two outcrops mapped as Huntley Mountain Formation near Blossburg, Pennsylvania. Field-based lithofacies observations, high-resolution panoramic photography, terrestrial lidar scanning, and laser particle size analysis were used to build a stratigraphic column, map fluvial architecture, and estimate river paleoslope. Channel facies primarily consist of cross- and horizontally-stratified fine- to medium-grained sandstones with bar surfaces and scours. Proximal floodplain facies consist of thinly-bedded gray crevasse splay sandstones and massive levee siltstones and are more abundant upsection. Distal floodplain facies chiefly consist of red relict-bedded and fissile mudstone paleosols (with rootlets, slickensides, caliche nodules) and are more abundant downsection. Paleochannel depths (0.6-3.5 m, median = 1.6 m) and bar deposit grain sizes (median diameters 99-221 µm) increase significantly upsection. Estimated river paleoslopes (2.47x10-5 - 4.22x10-4) do not change significantly over the studied interval. Increasing channel depth and grain size and decreasing distal floodplain preservation without a significant paleoslope change is consistent with the hypotheses of: 1) increasing channel discharge, associated with global cooling and a wetter climate at the end of the Devonian, and/or 2) decreasing basin accommodation to sedimentation ratio.

Kristen Fu ’20

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING

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

Determination and Modeling of Biaxial Mechanical Properties of Skeletal Muscle

The goal of the research project is to determine and model the biaxial mechanical properties of skeletal muscle. Uniaxial tensile testing of excised muscle samples is commonly used to evaluate passive muscle stiffness. However, passive muscle is very anisotropic and nonlinear, while traditional engineering materials have isotropic and linear properties. It is observed that force is transmitted laterally in skeletal muscle which suggests muscle is subject to a biaxial stress state in vivo. Biaxial stress-relaxation tensile testing and modeling of passive skeletal muscle will help to more accurately model the mechanical properties of passive skeletal muscle.

During the summer, we developed a test procedure to prepare cruciform-shaped muscle samples of uniform thickness and stretch those samples using a newly acquired biaxial materials testing system. The samples are speckled and 2D digital image correlation is used to identify an appropriate region of interest and track tissue strain. This is critical in planar biaxial tension testing as the test results are highly dependent on sample shape and boundary condition assumptions.

The testing data were then analyzed and used to develop a finite element model with anisotropic nonlinear material properties resulting from the arrangement of fibers in certain directions. Muscle fibers were defined as a transversely isotropic Mooney-Rivlin material. FEBio was used to create the finite element models with different primary orientation of the fibers. The mechanical properties of model are modified using parametric studies to better fit the material properties collected from experiment.

Gregory Galczynski ’21

Faculty Mentor: Professor Marie Pizzorno, BIOCHEMISTRY/CELL BIOLOGY

Funding Source: Department of Biology

Transmission of Deformed Wing Virus in Honeybees

One of the largest contributors to the decline of honey bees in North America was the introduction of the parasitic mite, Varroa destructor, and its ability to vector many of the positive-sense RNA viruses that infect honey bees. One such positive-sense RNA virus from the Iflaviridae family is Deformed wing virus (DWV). Infection with DWV during pupation inhibits the development of the adult wings, causing the emerging adults to have crumpled wings, bloated abdomens, and die shortly after eclosion. The virus can also be transmitted via oral secretions from adult nurse bees feeding larvae and to other adults via trophallaxis. In order to determine the effect that differential modes of transmission of DWV have on viral loads in the brain, DWV was directly injected into the hemolymph in the abdomen. After incubation at various time points the heads were dissected and RNA was isolated following a phenol chloroform extraction. Levels of DWV were quantified using qRT-PCR and a standard curve of known quantities of DWV in the plasmid pL427. Absolute quantification was used to analyze the results. Relative quantification using the rp49 housekeeping gene was used to normalize the data set. Bees injected in the hemolymph with DWV were found to have DWV present in the head, indicating the injections replicated the natural mode of infection via Varroa destructor mites. Future experiments will follow this up with altering the age and diets of the bees prior to infection via injections.

Mateo Garcia ’20

Faculty Mentors: Professor Joseph Jozwiak, ENVIRONMENTAL STUDIES & SCIENCES, INTERNATIONAL RELATIONS; Professor Manuel Larrabure, INTERNATIONAL RELATIONS

Funding Source: The Posse Foundation Scholarship

Global Goals - An Examination on the Economic and Political Effects of Globalization within Football

Football, commonly known as soccer in the United States, is highly regarded as a symbol of how the globalized world functions in this day and age. For good and for bad, it has reinforced a situation in which politics and capitalism within the sport are inescapable, and has therefore shaped the sport to the way it is today. The extreme commercialization of football in the 1990s, with its massive investment in televising, has led to a larger global brand and huge marginal profits for clubs. However, with this commercialization there has been more emphasis placed on exploitation, destruction in traditional values, and the influxes of “foreign invasions”. By using Argentina and England as case studies, we observe the symbolic pressures that the ruling class place onto the international working class. The ruling class in this analysis refers to the developed countries and the executives that come from these nations that directly and indirectly impact the under-developed countries’ clubs, players and society as a whole. In turn, this represents the worst aspects of contemporary globalization with its pivotal shifts in culture, common manipulation of international transfers of labor and capital, and the corruptive practices that are allowed by larger international bodies. In conclusion, from this investigation we can comprehend how football functions, but also how it is a lens into how the international community utilizes, and is utilized by, globalization.

Emma Gebauer ’20

Faculty Mentor: Professor Douglas Collins, CHEMISTRY

Funding Source: Department of Chemistry

Identifying Key Ingredients in E-Cigarette Liquids using GC-MS Analysis

Electronic cigarette (‘vape’) usage has rapidly increased over the last decade with teens and young adults comprising a significant amount of the market. In order to make products attractive to users, vape liquid manufacturers have created products with a variety of flavors, such as strawberry, vanilla, and peppermint. While food-grade chemicals are often used, these compounds may have health risks when inhaled. Recent studies have also been aimed at identifying a connection between carbon monoxide (CO) production of vapes and the use of flavored liquid. Consequently, this study aims to identify flavoring components that could lead to CO production during the vaporization process. Passive headspace solid-phase microextraction (SPME) using polydimethylsiloxane (PDMS) and polydimethylsilonane/divinylbenze (PDMS-DVB) fibers have allowed for selective sampling of flavoring components, (e.g., menthol, piperonal, 1,5,9-cyclododecatriene 1,5,9-trimethyl), preservatives (e.g., β-vatirenene and butylated hydroxytoluene) in vanilla and flavorless vape liquids. Chemical analysis was performed using gas-chromatography coupled to mass spectrometry (GC-MS). Though SPME allows for better separation of these compounds, the data are harder to quantify. To address this, direct liquid injection coupled to GC-MS was utilized for straightforward quantification of select compounds with higher abundances, such as menthol. Continued studies will be aimed at quantifying menthol concentration across flavors and its relationship to CO production, as well as quantifying other flavoring compounds that may play important roles in vape chemistry or chemical exposure.

Olivia George ’20

Faculty Mentor: Professor Morgan Benowitz-Fredericks, BIOLOGY

Funding Source: Department of Biology

Regulation of Neuropeptide Y Gene Expression in Response to Food Restriction in Rhinoceros Auklet chicks

Nest-bound seabirds are vulnerable to neonatal food restriction due to extended nestling periods that rely on variable food availability in the marine ecosystem. Rhinoceros Auklet (Cerorhinca monocerata) chicks use adrenocortical suppression and morphological allocation to cope with energy deprivation. Physiological and behavioral responses to variation in food intake can be promoted through up- or down regulation of genes in the arcuate nucleus of the hypothalamus, a region in the brain that regulates energy balance. Multiple genes have been identified that exert significant effects on energy homeostasis in birds including neuropeptide Y (NPY), found in the brain and known to be a potent regulator of food intake. To determine how food restriction affects NPY gene expression in Rhinoceros Auklet chicks, we analyzed RNA from brain samples from a food-restriction experiment conducted on captive chicks. After confirming the integrity of the RNA, which remained high after 18 years, we used primers developed for chickens to verify the expression of NPY. We hypothesized that the NPY gene helps regulate physiological and behavioral responses in seabirds during food restriction, predicting that experimentally food-restricted seabirds would exhibit higher NPY gene expression. Using real-time quantitative PCR, we quantified the differences in NPY gene expression between food-restricted and unrestricted seabirds. The results will help us understand how wild birds respond to unfavorable environmental conditions. The opportunity to study molecular regulation of responses to important ecological pressures in seabirds is rare, and nothing is known thus far regarding NPY gene expression in response to food restriction.

Keith Grega ’21

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING

Funding Source: John P. & Mary Jane Swanson Professorship in Engineering & the Sciences

Biaxial Tensile Mechanics of Aponeurosis

Aponeuroses are stiff sheath-like components that act as a transition from muscle to tendon, which then attaches to bone. The mechanical behavior of the aponeurosis is thus of great interest due to its role in force transmission in the body. The aponeurosis spreads over a portion of the muscle belly, therefore it can be inferred that the the aponeurosis experiences a biaxial load. The goal of this work was to perform planar biaxial tensile testing to evaluate aponeurosis tissue mechanical response under a multi-axial load. Biaxial loading was performed on porcine cruciform samples with a custom ADMET planar biaxial materials testing system. Force-displacement data were converted to stress-stretch data in both the longitudinal (along fiber) and transverse (cross fiber) directions. Aponeurosis was stiffer in the longitudinal direction compared to the transverse direction, and stretched more in the transverse direction compared to longitudinal. The average modulus in the longitudinal direction was ~50 MPa in comparison to the transverse modulus of ~2.5 MPa, and there was approximately twice the stretch in the transverse direction. This work presents a new set of physiologically relevant biaxial stress-stretch data of aponeurosis tissue that can be used to inform our understanding of how aponeurosis functions in muscle-tendon units. This work can be applied to FEA and musculoskeletal models to explore clinical applications of connected skeletal muscle systems for treatment modalities such as post-surgery prediction of muscle function and the comparison between weak or diseased muscle to healthy muscle.

Clara Han ’21

Faculty Mentor: Professor Joel Wade, PSYCHOLOGY

Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health

The relationship between parental marriage and children’s future relationship preferences

The study used Qualtrics of Survey Software. It is a demographic questionnaire from Wade, Auer, and Roth (2009). Participants were asked about their age, nationality, gender, sexual orientation and current relationship status. Once participants received the survey through a Qualtrics URL, they were directed to the first portion of the experiment. Participants were first presented with informed consent. Upon reading and signing it, participants were asked to complete the survey, which prompted them to think about the households they grew up in. They had chosen between “first-marriage family”, “post-divorced single family”, “stepfamily”, and “other”. Participants rated whether they think their parents are in love or not on a scale from 1 to 7. This question was for participants who answered “first-marriage family” or “stepfamily” previously. For the participants who answered “post-divorced single family”, they were asked if they think the whole family is happier after their parents were separated.

Olanne Healy ’20

Faculty Mentor: Professor Clare Sammells, SOCIOLOGY & ANTHROPOLOGY

Funding Source: Program for Undergraduate Research

Food Insecurity & Greek Life on College Campuses

The study examines the intersection between food insecurity and Greek life at US colleges. Methods include quantitative results from a survey and qualitative data collected through individual interviews.

Jeff Heim ’21

Faculty Mentor: Professor Robert Stockland, CHEMISTRY

Funding Source: Department of Chemistry, Kalman Fund for Undergraduate Research in the Sciences

Synthesis, Isolation, and Characterization of Heteroarylgold Compounds

Luminescence is an interesting chemical phenomenon that is witnessed throughout the animal kingdom and occurs when electrons that were excited to a higher energy level fall back to their ground state, emitting a photon in the visible light spectrum. A large amount of time and funding from the chemical community has been devoted to understanding this process and harnessing its potential. However, luminescence is uncommon in organometallic compounds. Heteroarylgold compounds are a promising class of organometallic chemicals that show luminescent activity. A better understanding of these compounds could result in the creation of novel chemical detectors and biological tracers that can be useful in a wide range of fields. Several different heteroarylgold compounds have been synthesized in order to investigate their luminescent characteristics. Currently, four of these compounds have been purified and their structures characterized. Each of these compounds demonstrates luminescence when exposed to 365 nm light.

Nellie Heitzman, Graduate Student

Faculty Mentor: Professor Sarah Lower, BIOLOGY

Funding Source: Graduate Summer Research Fellowship

Relationship between sex, life stage, and gut microbial communities in Photuris fireflies

Insect microbial communities have been studied as a contributing factor to aspects of insect life including insect immunity, metabolic, and vectoring efficiency. The relationships between microbial communities and factors, such as distinct sex differences and larval-adult disparities, remain unknown in many insect species. Through investigating with the non-model Photuris fireflies, we allow for distinct behaviors and influencing factors between sexes and life stages of the same species. We hypothesize that there will be a significant difference in relative bacterial abundance between male and female Photuris, because males are not predatory as adults and, therefore, are expected to present with fewer bacteria involved with diet and predatory behaviors. We further hypothesize that there will be a similar trend in the analysis of life stages, as there is a notable shift between the diet of predatory larvae and non-predatory adult males. In this experiment, we analyzed the gut microbiome of Photuris fireflies using Illumina 16S rRNA sequencing to answer two questions- 1) How do environmental factors affect the microbiome and 2) How do life stages affect the microbiome? Through the use of metagenomic analyses, we generated tables of relative abundance by bacterial operational taxonomic units (OTUs) and analyzed the table relationships with ANOVAs to develop principal component analyses (PCA) based on the relative abundance of bacterial genera in Photuris gut microbiomes. Our results can inform studies in firefly conservation, insect-microbiome evolution and wider studies investigating the relationship between gut microbiomes and behavioral variation.

Leah Henk ’21

Faculty Mentor: Professor Deborah Sills, CIVIL & ENVIRONMENTAL ENGINEERING

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Culturing algae with different sources of inorganic carbon

The cultivation of algae for fuel and feed offers alternatives to fossil fuel and conventional animal feed such as soy meal. A research project found, the cultivation of algae is promising for reducing greenhouse gas emissions and energy costs. What’s more, algae are some of the quickest growing photosynthetic organisms, and their cultivation produces large amounts of biomass: ideal for biofuel synthesizing. In addition, algae can grow in most mediums such as sewage or sea water. The goal of this project was to measure the effects of total inorganic carbon ($\sum CO^2$) concentration (delivered as “house air” and solid HCO_3) on the growth rate for Chlorella. This was carried out by growing Chlorella algae in reactors in the Bucknell Environmental Engineering and Studies Laboratory. Both Bold Basal Medium and a modified version which included sodium bicarbonate were used to provide the algae with nutrition. “House air” was used in both experiments and each was run for approximately seven days.

The tests that were conducted are as follows: pH; carbon; nitrogen; and hydrogen percentages; optical density; nitrate; reactive phosphorus; total suspended solids; volatile suspended solids; and total inorganic carbon. The optical density test concludes that the algae grows faster with a partial amount of CO_2 and HCO_3 than with just a partial amount of CO_2. The nitrate and phosphorus tests conclude that this method uses less nitrogen and accumulates more reactive phosphorus. However, TSS and VSS seem to tell a different story of less solids in the bicarbonate grown algae reactors.

Gwendolyn Hostetter ’20

Faculty Mentor: Professor Katherine Faull, COMPARATIVE HUMANITIES

Funding Source: Douglas K. Candland Undergraduate Research Fund

No Rest for the Wiccan: Looking at the Salem and Finnmark Witch Trials

During Summer 2019, I researched the witch trials of Salem, Massachusetts (1692-1693). I looked at each court document relating to witchcraft during this time, including testimonies, depositions, interrogations, warrants, and indictments. I created a timeline and created a general breakdown of the data. I found that ~23.33% of Salem residents were accused, and ~14.29% of the accused were executed. ~68.57% of the accused were women. ~68.42% of those killed were women. ~17.14% of the accused, were hanged, pressed to death, or died in prison. ~97.86% of the accused were Caucasian. One of the main accusers, Elizabeth Hubbard, made the most reports against the villagers of Salem. She made statements against 29 individuals; 14 of them were indicted, 10 were executed, and 1 died in prison.

I am now using this data in my departmental thesis, in which I am comparing the Salem trials to the Finnmark witch trials of seventeenth century Norway. I am looking at similarities in how many individuals were accused, the genders and ages of those accused, beliefs surrounding Satan and witchcraft, and how many were executed. I will use this data to create an interactive digital map.

April Hurlock ’23

Faculty Mentor: Professor Douglas Collins, CHEMISTRY

Funding Source: STEM Scholars, Alfred P. Sloan Foundation – Chemistry of Indoor Environments

Effect of Self-Oxidation on Deposited Third-Hand Smoke Film Composition

While the implications of first-hand and second-hand tobacco smoke have been thoroughly studied, much less is known about the effects of so-called ‘third-hand smoke’ (THS) on the environment and human health. THS is a collection of chemicals from cigarette smoke that settle and adhere to indoor surfaces such as walls, flooring, furniture, and clothing. As these chemicals stay on surfaces for long periods of time, prior studies have shown that reactions occur between chemicals within the deposited THS film, with previously deposited materials, and with the surface itself. In this study, the former two categories of reactions were monitored. Primarily, cigarette smoke was collected in vials and incubated under artificial lighting for various periods of time, which revealed changes in the chemical composition and the rates at which these changes were occurring. Secondarily, cigarette smoke was collected in vials that were pre-coated in antioxidants such as Tris(2-carboxyethyl)phosphine (TCEP) to monitor oxidative processes that affect the composition of THS chemicals. Future studies look to include a variety of deposited films, different reactive surfaces, and other environmental factors in order to obtain a better understanding of what goes on after the cigarette goes out.

Cecily Hutchison ’20

Faculty Mentor: Professor Roger Rothman, ART & ART HISTORY

Tancredi: A New Image of Nature

Tancredi Parmeggiani, born in 1927, gained notability with the help of his patron, Peggy Guggenheim. With an early affinity for drawing, there was no question that Tancredi (as he came to be known) would turn art into his career. Largely due to his early death in 1964 at the age of 37, Tancredi’s work has, for the most part, been forgotten, especially among Anglophone critics and historians. An important moment in his career took place in 1952 when, at the age of 25, he signed the fifth “Spatialist Manifesto,” deeming him a member of Lucio Fontana’s Spatialist Movement. The Post-War Italian movement, Spatialism, aimed to fuse art with science by producing modern visions of space. Throughout the 1950s Fontana and Tancredi developed unique forms of Spatialist art. Whereas Fontana’s art mainly characterized the silence and depth in space, Tancredi’s art portrayed nature as the principal expression of space. Drawing on various Italian language sources (as well as a few in English), my essay examines the ways in which Tancredi’s “natural” Spatialism developed out of his responses to the works of Piet Mondrian and Jackson Pollock. In closing, this essay suggests that Tancredi’s form of Spatialism is equally as evocative of the movement as its founder’s, Lucio Fontana, and deserves recognition in the scholarly discourse surrounding Italian Post-War art.

Ana Islas ’20

Faculty Mentors: Professor Dabrina Dutcher, CHEMICAL ENGINEERING, CHEMISTRY; Professor Karen Castle, CHEMISTRY

Funding Source: Department of Chemistry

Carbon Monoxide Concentrations in E-Cigarette Effluent

E-cigarettes have become vastly popular among current and new smokers. They have been marketed as a healthier alternative to traditional cigarettes. There are many models that allow consumers to customize different aspects in the vaping process, such as flavors and nicotine concentration in e-liquid and, in some models, the power/temperature setting used to vaporize the e-liquid. These have a lesser known health hazard from the presence of carbon monoxide (CO) in the e-cigarette effluent. This project utilizes diode laser spectroscopy to quantify the CO concentration present in the effluent among various power settings and flavoring agents. The preliminary tests show that higher power settings yield higher CO concentrations and there are some variations among flavors which need to be further explored. The observed CO production under these vaping conditions along with an understanding of the chemical reactions that occur during the vaporization process could inform the public as well as regulators about the possible health effects of e-cigarettes.

Samuel Jacob ’21

Faculty Mentor: Professor Carl Kirby, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Department of Geology & Environmental Geosciences, The Katherine Mabis McKenna Environmental Internship Program

Chemical and Biological Documentation of Impairment/Non-Impairment due to Acid Deposition in the Headwaters of Swift Run and Bear Run, Central Pennsylvania

Nearby headwater streams have been negatively impacted by acid deposition. Swift Run, near Troxelville, PA, and Bear Run, near Woodward, PA, were examined. The Tuscarora Formation in Central Pennsylvania often is unable to provide sufficient alkalinity to headwater streams resulting in a drop in pH. This research aims to further examine the relationship between stream chemistry and ecology and the underlying bedrock geology beneath these streams through the measurements of pH, alkalinity, aqueous aluminum content, and fish counts. Due to the low ionic strength and alkalinity of these waters, great care was taken in order to ensure that the data collected were accurate.

At both Swift Run and Bear Run, the overall trend for both pH and alkalinity is an increase downstream. Swift Run watershed pH values ranged from 4.77 to 6.70 during the first round of sampling and 4.66 to 6.98 on a later date. Bear Run pH values are between 4.86 to 6.72. Two rounds of alkalinity sampling at Swift Run exhibit ranges from -1.7 to 3.3 and -1.8 to 4.9 mg/L as CaCO3, respectively, and Bear Run alkalinity values are between -1.0 to 3.1 mg/L as CaCO3. The highest observed aluminum values at Swift Run and Bear Run are 101 and 104 μg/L, respectively, less than the 200 μg/L lethal limit for brook trout. Fish sampling in 100-meter sections of Swift Run resulted in at least 12 strikes in each stretch of stream, except for the most acidified section of Swift Run, which had only 3 strikes.

Rachel Johnson ’20

Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Department of Geology & Environmental Geosciences

Testing of two models of Precambrian Deformation in the Shylock shear zone near Phoenix, AZ

This study focused on testing two models about the timing of Precambrian deformation across the Shylock shear zone near Phoenix, AZ using U/Pb geochronology of apatite. Model 1) the region cooled slowly, from 1700 million years ago (mya) to 1400 mya after experiencing one heating event or, Model 2) the region experienced two heating events, the first in the range of 1700 mya and the second in the range of 1400 mya. We took rock samples from four locations across a transect of the shear zone. Using LA-ICP-MS U/Pb geochronology, we dated zircon and apatite from granites on either side of the shear zone and apatite from schists within the shear zone.

If apatite ages across the shear zone are identical, it supports Model 1 in that only a single event occurred, and the apatite ages across the shear zone represent that event. However, apatite ages across the shear zone are not identical. Samples taken from granites on either side of the shear zone date at 1797±160Ma and 1748±64Ma. The zircons from those same granites date at 1690.3±9.4Ma and 1745±8Ma, respectively. Samples taken from schists within the shear zone have ages of 1498±36Ma and 1415±260Ma. Since the granite zircons and apatites have similar ages within uncertainty, it indicates the granites crystallized and cooled relatively quickly. The apatites in the schist record an age 200-350 Ma later, which means the schist experienced a heating event that is not recorded by the apatite in the granite.

Peter Kaladius ’21

Faculty Mentor: Professor Peter Jansson, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: PPL Undergraduate Research Fund

On an investigation of inertial reactions’ origins and Mach’s Principle

Inertia is hypothesized to be a force, with an unknown source, that acts on every mass in this universe. Many explanations were theorized in the twentieth century to suggest possible origins of inertia; one of the most successful theories is Mach’s Principle. Mach proposed that every piece of matter in the universe acts on any object that has changed the speed or the direction of its motion. The most recent research (conducted over summer 2018 and 2019) investigates a theory derived from Mach’s Principle stating that local celestial mass alignments may give rise to special electromagnetic interactions in the batteries that lead to a statistically significant voltage drainage. The device used for experimentation is a spherical frame with eight arms going from top to bottom, each arm carrying 6 batteries. The batteries run two motors that rotate a heavy Aluminum cylinder at high speeds, hypothetically creating an inertial field (or a Machian field) that affects batteries. This research raises the probability of validating Mach’s Principle by obtaining abnormal voltage drainage patterns on the arms that point to the significant celestial mass alignments where the claimed interaction is expected to be magnified.

Xander Karpowicz ’22

Faculty Mentor: Professor Jonathan Torres, MECHANICAL ENGINEERING

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

Effects of Print Settings and Post Processing Treatments on 3D Printed ABS for Prosthetics

This research aims to test the influence of print settings and post processing treatments (i.e. heat treatment, resin coating, and electroplating) on the material properties of 3D printed ABS plastic samples in order to create stronger parts for use in printed prosthetics. Prosthetic joints and limbs undergo a variety of stresses and strains, primarily at the joints and intersections of fingers, knees, ankles, wrists, and elbows. More often than not, these forces cause the piece at the joint to bend and could potentially cause them to break. Due to the nature of the layered manufacturing process of 3D printing, the strength of these components often depends on the parameters used to produce them. Therefore, it is important to understand how to create stronger 3D printed parts so that volunteer outreach groups such as eNable and home-printers alike can increase the accessibility to these solutions while optimizing the strength and durability of 3D printed prosthetics. Currently, procedures for applying heat treatment, resin coating, and acetone-vapor smoothing have been optimized and tested. The final result of the first portion of this research indicates that resin coating with a resin removal process before curing produces the strongest parts but at the cost of being heavier.

Taehwan Kim ’20

Faculty Mentor: Professor Brian King, COMPUTER SCIENCE

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Time Series Prediction using Deep Echo State Networks

Artificial neural networks have been used for time series modeling and forecasting in many domains. However, they are often limited in their handling of nonlinear and chaotic data. More recently, reservoir-based recurrent neural net systems, most notably Echo State Networks

(ESN), have made substantial improvements for time series modeling. Their shallow nature lend themselves to an efficient training method, but have limitations on non-stationary, non-linear chaotic time series, particularly large, multidimensional time series, such as atmospheric data.

In this research, we propose a novel approach for forecasting time series data based on additive decomposition (AD) applied to a deep echo state network. We compare the performance of our method, AD-DeepESN, on popular neural net architectures used for time series prediction. Stationary and non-stationary data sets are used to evaluate the performance of the methods. Our results are compelling, demonstrating that AD-DeepESN has superior performance, particularly on the most challenging time series that exhibit non-stationarity and chaotic behavior compared to existing methods.

Emma King ’20

Faculty Mentor: Professor Hélène Martin, LANGUAGES, CULTURES & LINGUISTICS-French

Funding Source: Leanne Freas Trout Exploration Travel Grant

The Regent: Catherine de Medici; Using Cultural Power to Construct a Nation

In the 16th century, France established itself as a global cultural leader. Under the original Renaissance king, François I, the foundations of the Renaissance were constructed. Long after his reign in the late 15th into the early 16th century, the final Renaissance king, Louis XIV, fixed France’s place in history as a leading cultural power. However, the question remains: who ruled during the century between these two great kings that allowed for this connection? This thesis argues that Catherine de Medici, the queen and regent of France from 1547 until 1589, was the great king which continued the legacy of François I and set the stage for the cultural legend, Louis XIV. This thesis follows the three cultural branches at the center of the Renaissance in Europe –gastronomy, visual arts, and architecture—and explores Catherine de Medici’s integral role as the female king who advanced the French culture through these channels. Through the lens of the theories of Niccolò Machiavelli, Benôit Bréville, William Monter, and Joseph Nye, Catherine de Medici’s dominant role in the development of the French culture reveals the essential part played by female kings in the fabrication of European cultural history.

Sinet Kroch ’22

Faculty Mentor: Professor Jenna Christian, WOMEN’S & GENDER STUDIES

Funding Source: Douglas K. Candland Undergraduate Research Fund

Understanding How Race and Ethnicity Impact Cambodian Immigrants Experience

Research suggests that adjustment to the U.S. has not been easy for Cambodians. Approximately 195,000 Cambodians fled to the United States between 1975 and 1990 (Cambodian Genocide Project 2010). They were primarily poor, limited in formal education, from rural areas, non-professional, and mostly female, single-parent families with young children. As of 2015, Cambodian Americans live with higher rates of poverty, lower median annual household and personal income, and lower post-high school educational attainment compared to other Asian communities. Cambodian immigrants struggle with access to safe communities, as well as affordable health care and food access. While there is a small body of research that focuses on inequalities that Cambodians face in the U.S., there remains a lack of research on Cambodian experience broadly, and specifically the role of race in their lives. As described by Ngai (2004, xxiii), immigrant assimilation is much more complicated than cultural difference; we need to understand the role of “structures of racial subordination.”

This research examines how race and ethnicity shape the experience of Cambodian immigrants as they transitioned to life in U.S. communities. Specifically, the study aims to understand how being Cambodian—through language, culture, and race—affects their experience at school, in the workplace, and in their communities and homes. What is the role of race and ethnicity in shaping educational access and workplace experiences for Cambodians? And, has racism or other forms of inequality shaped their experiences making a new home for themselves and their families in the U.S.?

Tina Krolikowski, Graduate Student

Faculty Mentor: Professor Anna Baker, PSYCHOLOGY

Funding Source: Graduate Summer Research Fellowship

Borderline Traits in Mothers and Their Adolescent Daughters: The Effects of Relationship Quality, Social Cognition, and Emotion Regulation in Non-Clinical Populations

Borderline personality disorder (BPD) is categorized by impairing emotional dysregulation, unstable perceptions of the self, frequent mood changes, self-harm, and fear of rejection or abandonment (British Psychological Society, 2009). Traits oftentimes become prominent during adolescence and are diagnosed more frequently in females (British Psychological Society, 2009). Researchers have evaluated impairments in social cognition in individuals with BPD (Preißler, Dziobek, Ritter, Heekeren, & Roepke, 2010). In addition, negative communication patterns between daughters and mothers are related to borderline trait expression (Cheavans et al., 2005). Therefore, the relationship between BPD traits, emotion regulation, social cognition, and relationship quality of mothers and their adolescent daughters serves to partially explain BPD etiology. The current study will evaluate how BPD levels, emotion regulation, and social cognition interact within an individual, how concordance and discordance between mother and daughter BPD traits potential moderate the relationship between mother and daughter BPD trait levels, and whether emotion regulation concordance predicts the levels of BPD traits within the daughter. Approximately 80 mothers and their adolescent daughters are completing questionnaires assessing BPD traits, emotion regulation, social cognition and relationship quality. Results and discussion points will be addressed in the presentation once data analyses has been concluded.

Megan Lafond ’21

Faculty Mentor: Professor Douglas Dexter, EDUCATION

Funding Source: Joann E. Walthour Undergraduate Research Fund

Inhibition and its Impact on Reading Comprehension in Early Childhood Education

The purpose of this research is to explore the role of executive functioning in reading comprehension and its effects related to early childhood education. Executive functioning combines the use of six main cognitive processes needed to successfully respond to a task: planning, organizing, inhibiting/prioritizing, shifting, working memory, and self-monitoring. Reading comprehension is an extremely complex skill “that involves many interactions between the reader and what they bring to the text (previous knowledge, strategy use), as well as variables related to the text itself (interest in the text, understanding of the types of texts)” (Rhode Island Tutorial and Educational Services, 2013). Children who struggle with one or more of these six interrelated processes typically have difficulty with reading comprehension skills and tasks. This current research project uncovers how vital the specific role of inhibition plays in relation to success in both reading comprehension and decoding in early childhood. As a result of these findings, the researchers will develop and apply an evidence-based intervention specific to inhibition in an early childhood classroom. Conclusions, implications for future research, and pedagogical recommendations for current and aspiring early childhood educators will be provided.

Angela Lai ’22

Faculty Mentor: Professor Brian Smith, CHEMISTRY

Funding Source: Drs. Anthony and Joyce D. Kales Undergraduate Research Fund

Additive Control over Acetaminophen Crystallization from Solution

The ability to control the crystallization of molecules has been and continues to be a major challenge in drug formulation. The capacity for solid materials to exhibit polymorphism, or to exist in two or more crystalline forms with different conformations in the crystal lattice, is instrumental in determining solubility and bioavailability in pharmaceuticals. It is known that both additives and crystallization conditions play a defining role in what polymorph of a molecule nucleates. Acetaminophen is an ideal model drug system, with multiple known polymorphs: stable form I (monoclinic), metastable form II (orthorhombic), and unstable form III. Using Differential Scanning Calorimetry (DSC) and Powder X-Ray Diffraction (PXRD), the composition of polymorph mixtures can be easily characterized. By incorporating a library of additives, we evaluate the key structural properties that control polymorph selectivity of acetaminophen crystallization from solution.

Tracy Li ’21

Faculty Mentor: Professor Peter Jansson, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health

Nutrition-based Therapies on Positive Medical Outcomes in Depression

Nutrition is one of the foundations of medicine in disease risk reduction and treatment. Nutrition therapy, the food-based treatment including nutrient supplementation, is proved to have outstanding performance in different medical fields. In the current United States medical system, there is a significant gap between clinicians and nutritionists. Nutrition therapy is not commonly practiced in real-life treatments because clinicians often have minimal training and experience in nutrition. Exposed to an overwhelming number of clinical research studies and publications relating to mental wellness and nutrition, practitioners are challenged to jump out of their field of expertise and add diet therapy into their prescriptions. The overall intent of this project is to help clinicians better understand and integrate nutrition therapy into their practice. This project focuses on integrating the results from the latest clinical literature showing the linkages between nutrition-based therapies and patients’ mental wellness. In the literature review, I applied MeSH terms “Depressive Disorder/diet therapy” and “Depressive Disorder, Major/diet therapy” for a more narrowed field. As a result of this review, probiotics treatment and the

SMILES (Supporting Modification of Lifestyle in Lower Emotional States) trial, a Mediterranean-style diet, are found to be effective against depression and anxiety symptoms.

Gavin Lindsay ’21

Faculty Mentor: Professor Hasan Arslan, CHEMISTRY

Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Synthesis and characterization of a push-pull hydroquinone polymer

Electrochromic substances are materials that change color depending on the applied potential through oxidation-reduction reactions. Ideally these materials change from colorless to a bright color when the potentials are switched. This project is specifically focused on synthesizing a molecule that could switch at mild potentials using a reversible redox reaction with a quinone/hydroquinone group. Even though we achieved a dramatic color change using acid/base chemistry, our ultimate goal is to do so electrochemically. For this reason, we turned our attention to the quinone form of the redox active compound. In this oxidation state, the compound is highly electron deficient and it can be reduced electrochemically to form the zwitterion. Our early attempts to reduce the quinone to the zwitterion in solution resulted in decomposition, presumably due to a side reaction between the zwitterion and quinone. It should be noted that the quinone form is highly electrophilic and reacts readily with even weak nucleophiles. To circumvent this issue, the compound was polymerized to create a porous, insoluble polymer with the redox active push-pull system. The counterions were then replaced with nonreactive hexafluorophosphate ions via an ion exchange. Enclosing the redox center with nonreactive polymer is expected to prevent unwanted side reactions, allowing for reversible switching between the quinone and zwitterion. Characterization of compounds and polymeric materials was achieved using ultraviolet-visible (UV-Vis) and infrared (IR) spectroscopy.

Peter Liu ’22

Faculty Mentor: Professor Lucas Waddell, MATHEMATICS

Funding Source: Program for Undergraduate Research

How significant is the initial population when using a genetic algorithm to solve the quadratic assignment problem

Our research is related to quadratic assignment problem. It is one type of optimization problem. This type of problem has a large variety applications in our daily life such as college campus planning or keyboard designing. But due to the constraints of the problem and large quantity of possible solutions, the precise solution are only limited to only size-40 problem. Recently, one approach to find good solutions of larger size QAP is using genetic algorithm. Genetic algorithms are based on Darwin’s theory of evolution, in particular, his idea of the survival of the fittest. Although it is generally believed that the makeup of the initial population can have a large effect on the final success of the algorithm. There is no systematic study has been performed to support this claim. Our research aims to explore the effect of the quality of the initial population on the performance of a genetic algorithm when solving the QAP.In our research, we developed a specific algorithm in python. We use five different methods to generate initial populations that have different qualities. We tested our algorithm and five different initial populations on seven different problem sizes and make them evolves for 2000 generations. After running 10 trials for each method, the data we collected suggest that the even though the populations started with different initial population, but they do not show any statistically different after 200 generations.

Carrie Loomis ’22

Faculty Mentors: Professor Ellen Herman, GEOLOGY & ENVIRONMENTAL GEOSCIENCES; Professor Molly McGuire, CHEMISTRY

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Effect of Iron Precipitates on Dissolved Iron Oxidation

Acid mine drainage occurs when iron is released from the mineral pyrite, which is associated with coal. Iron oxidizes in the presence of water and oxygen. The purpose of this Acid Mine Drainage study was to further understand the effects of iron precipitates on the rate of oxidation of dissolved iron. Experiments were performed in an annular flume with a quartz sand bed to best simulate a natural riverbed. The experimental design was three doses of acid mine drainage simulation chemicals added without cleaning the flume bed. This practice allowed for iron precipitates to form and accumulate over the quartz sand bed. Doses of simulation acid mine drainage chemicals were administered after the concentration of dissolved iron had become consistent. The results of the experiment were an unexpected change in rate of oxidation after the third dose. The expected experimental curve decayed and become more irregular as iron precipitates accumulated on the flume bed. More experimentation is necessary to replicate the results of this experiment.

Catherine MacKay ’21

Faculty Mentor: Professor Anjalee Hutchinson, THEATRE & DANCE

Funding Source: Douglas K. Candland Undergraduate Research Fund, Program for Undergraduate Research

UnHeard/UnSpoken -- the creation of a devised theatrical production

Devised theatre is the product of a collaborative process in which an ensemble of writers, actors, and designers create a theatrical performance from scratch. This process stems from themes the ensemble would like to explore and how they translate onto the stage. The ensemble then finds a way to break the themes down into smaller scenes that are later pieced together into full-scale production.

In the fall of 2019, the Department of Theatre and Dance produced a devised performance piece in which I served as the Assistant Director/Dramaturg. As an Assistant Director/Dramaturg, I helped create and support the artistic vision of the show alongside the Director and my research faculty mentor Professor Anjalee Hutchinson, setting up the foundation of the narratives that the ensemble will be telling onstage in the Department of Theatre and Dance fall production. In my research, I looked for an answer to the question “How does an assistant director/dramaturg translate themes and storytelling methods into resonant narratives for devised theatrical productions?”

Our production was performed on campus in October. Our production was then selected to be performed at the Kennedy Center American College Theatre Festival at the University of Maryland College Park. We were one of eight productions selected to be performed at the festival out of over sixty productions that entered. At the festival, we performed for an audience of over 600 people and received the prestigious award of the “Golden Hand Truck” for the fastest load-in and load-out.

Sandra Madanat ’21

Faculty Mentor: Professor Christine Buffinton, MECHANICAL ENGINEERING

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

Cardiac Flow Loop for Assessing TAVR Placement In Patient-Specific Anatomy

Aortic stenosis is a disease in which the aortic valve (AV) connecting the left ventricle and aorta narrows. This can lead to more complications, one of which is heart failure. One of the main causes of aortic stenosis in younger patients is bicuspid aortic valve, where two leaflets of the normal tricuspid valve and congenitally fused. The traditional surgical aortic valve replacement (SAVR) is invasive and involves sternotomy and bypass while transcatheter aortic valve replacement (TAVR) is a newer procedure that is minimally invasive. TAVR is approved for tricuspid aortic valve replacement, but not for bicuspid aortic valve, which involves higher risks of difficulty in the valve-in-valve insertion and variable aortic root anatomy, leading to improper seating and leakage. The goal of this research was to develop a tabletop flow loop that will model the aorta and insert 3D printed valves to test for different bicuspid valves. A new compliance chamber was designed and manufactured to be placed in the system. After doing a series of calculations to determine the exact height of the tank and initial height of the fluid in the tank, the achieved pulse pressure was 40 mmHg while blood pressure was 120/80 mmHg. The goal compliance ranged between 1.5-2 ml/mmHg assuming stroke volumes between 60ml – 80ml. The ultimate size for the compliance chamber was 12.2 inches in height and 3.5 inches in diameter. The series of different calculations helped derive a conclusion that the pressure of the air matters most when determining the compliance.

Soni Madnani ’20

Faculty Mentor: Professor Nina Banks, ECONOMICS

Funding Source: Bucknell Institute for Public Policy Summer Fellowship

Sadie Alexander’s Role on President Truman’s Committee on Civil Rights

My research examines the role that Sadie Tanner Mossell Alexander played on President Truman’s Committee on Civil Rights in 1947. Through funding from the Bucknell Institute for Public Policy Summer Research Fellowship Program, I was able to assist Professor Nina Banks uncover Sadie Alexander’s role on the committee. Professor Nina Banks is a feminist economist who has been researching the life of the first African American to recieve a Ph.D in economics - Sadie Tanner Mossell Alexander. Much of this research comes from digging through extensive archives at the University of Pennsylvania, Alexander’s alma mater. Under Professor Banks’ mentorship, I learned how to conduct and organize archival data. This included shifting through personal letters about the committee’s work, analyzing business correspondence to and from the committee, reviewing newspaper clippings and much more. These documents and historical materials allowed us to conclude that Alexander played a key role in the committee’s deliberations and final report, To Secure These Rights. The Report was the most important civil rights document since Reconstruction and its recommendations laid the foundation for the landmark 1964 Civil Rights Act.

John Mahon ’20

Faculty Mentor: Professor Douglas Collins, CHEMISTRY

Funding Source: Department of Chemistry, Stephen Glenn Hobar Memorial Research Award

Long lived Criegee intermediates

Although people in developed countries spend 90% of their time indoors, relatively little is understood about the chemistry that affects air quality in these environments. Indoor environments differ from outdoors in their high surface area-to-volume ratio and episodic exposure to ozone, an air pollutant and potent oxidant. Ozone has a well-known reaction with alkenes, but during this process an intermediate known as a Criegee intermediate (CI) is formed. The CI is known to be highly reactive and can lead to the formation of irritants and inflammatory agents. In addition, the ability of ozonolysis reactions to initiate chain oxidation is a topic of intense interest to many fields. To test the properties of CI, we deposited mixtures of oleic acid (an alkene) and methylparaben (MP) onto glass capillaries, which were placed in a flow tube reactor where they were exposed to ozone. The CI+MP product is being used as a probe for the presence of the CI, which cannot be measured directly. Capillaries sampled at various time periods after the initial ozone exposure to test the lifetimes of the CI via rates of product formation. The CI+MP product continued to form even after ozone exposure was stopped and oleic acid was depleted. This implies that the CI or a precursor has a far greater lifetime than what was previously believed. In order to learn about this mechanism in greater detail, we also plan to use nitrogen dioxide gas, a stable radical, to capture the CI after ozone exposure.

Ariana Majer ’20

Faculty Mentor: Professor Mark Haussmann, BIOLOGY

Funding Source: Department of Biology, National Institutes of Health

Abnormal acute stress responses are associated with telomere loss in Japanese quail

During stressful events, vertebrates initiate a physiological stress response, which in part releases hormones known as glucocorticoids. However, among individuals there is incredible variation in the stress response that may relate to survival. While the influence of stress on disease is multifaceted, recent work has reported that chronically high baseline glucocorticoids are related to shortening telomeres. Telomeres are conserved sequences of noncoding DNA that cap the ends of eukaryotic chromosomes and protect the information stored in DNA. When shortened to a critical length, telomeres can induce a permanent termination of cell growth and division, which contributes to the aging phenotype. Evidence suggests that telomere shortening is a risk factor in multiple diseases and can result in increased mortality. Here, we measured telomere lengths four times over a period of 1.5 years in a Japanese quail (Coturnix japonica) model and sought to determine if changes in telomere length correlate with natural variation in the stress response. We found that, while telomeres generally decreased with age, changes in telomere length between 1 and 6 months of age correlated with individual stress responses. Specifically, we found that telomere length was more likely to increase in birds with healthier stress responses, whereas it was more likely to decrease in birds with less healthy stress responses. These results suggest that an individual’s stress response pattern is correlated with how telomeres change over the first 6 months of life and suggest that an unhealthy stress response may result in reduced lifespan.

Thomas Matsumura ’22

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING

Funding Source: Program for Undergraduate Research

Measuring Lower Limb Muscle Activity and Kinematics in Variable Toe Pattern Gait

Our research focuses on using current human movement analysis technology to address knee pain caused by femoral anteversion, an inward twisting of the thigh bone. Surgical intervention is highly invasive and not always effective, so we have proposed the use of surface electromyography (EMG) and VICON motion-capture cameras to measure joint kinematics and muscle activity patterns. We have collected initial pilot data on one healthy subject which shows clear differences in muscle activation at rest and during different gait patterns. In the near future, we hope to use these methods to develop a protocol to employ on healthy subjects for different gait patterns (normal, toe-in and toe-out gait). Additionally, we aim to determine activities to maximize muscle activity such as lunges and box jumps to further collect data from. We believe that different gait patterns and activity will lead to knee muscle extensor activity differences. The data we collect is a collaborative effort with Dr. Mark Seeley of Geisinger with an end goal of informing effective surgical procedures as well as broader biomechanical implications.

Kayla McCellon, Graduate Student

Faculty Mentor: Professor Bill Flack, PSYCHOLOGY

Funding Source: Program for Undergraduate Research

College Hookup Culture in Relation to Sexual Assault

Sexual assault, hookup culture, and alcohol unfortunately make up three major aspects of a typical college experience. With Greek life and the intensification of male privilege on college campuses, the perpetuation of hookup culture is inevitable.

Gender roles in this environment are manipulated to appeal male dominated spaces, such as frat parties. This review will describe the published findings and theories on how and what happens to college students when they begin working towards their 4-year degree. Research has determined that when hookups involve alcohol use prior, there is a much greater likelihood for sexual assault to occur. In particular, this review will describe the strong relationship between hooking up, sexual assault, and alcohol abuse. It will also describe the distinction between men and women's motivations and views of hookup culture, known repercussions, and possible solutions.

Cheyenne McKinley '20

Faculty Mentor: Professor Sarah Lower, BIOLOGY

Funding Source: National Science Foundation Grant (NSF), The C. Graydon and Mary E. Rogers Faculty Fellowship

Evolution of a firefly femme fatale: a Transcriptomic Analysis

Identifying the genetic basis of phenotypic variation within and across species is a key objective of genetic research. With the advent of inexpensive genomic sequencing and the development of bioinformatics tools, it is possible to identify candidate genes related to phenotypic variation across a wide array of organisms. However, much of this work has been limited to model systems with a plethora of tools for genetic manipulation and functional characterization. Fireflies are an excellent system for studying phenotypic variation because of their wide behavioral diversity. Many fireflies have a single species-specific flash pattern that is used for mate identification and choice, do not eat as adults, and the variety of light signal patterns is hypothesized as a primary driver of reproductive isolation and speciation. However, fireflies in the Photuris genus are aggressive mimics - females of these species mimic the flash patterns of prey species to lure males in to eat them and thus, have multiple flash patterns. Most Photuris species are known for this predatory behavior and the genetic basis for this variation has yet to be studied. To explore this, we compared selective constraint on genes between a predatory firefly, Photuris quadrifulgens, with those from a non-predatory firefly, Photuris frontalis, using publicly-available transcriptomes derived from head tissue. We identified nine gene families evolving under positive selection, including genes involved in digestion, vision, and detoxification. These results highlight the utility of comparative methods to identify candidate genes in non-model organisms, which is crucial in understanding phenotypic variation in many organisms, not only in model systems.

Owen Meng '20

Faculty Mentors: Professor Alan Cheville, ELECTRICAL & COMPUTER ENGINEERING; Professor Le Paliulis, BIOLOGY

Funding Source: Program for Undergraduate Research

Open-Source Micromanipulators

To measure the balancing forces of chromosomes during cell division, cell biologists apply force to the chromosomes via a glass needle, and then observe the deformation of the needle to deduce the amount of the force. This process requires a micromanipulator to operate the needle, which offers controlled steps of micrometers. Existing micromanipulators on the market lacks ideal features such as adjustable sensitivity. In this research, an open-source micromanipulator was designed with the purpose of customizability. This micromanipulator is based on the Raspberry Pi platform with three configurable linear stages controlled by a flight control joystick. Both of the hardware and the software are open-source and accept modification and customization.

Rashid Mills '21, Liv Cabrera '22, Atakora Appiah-Padi '20, James Jennings '20

Faculty Mentor: Professor Jaye Austin Williams, AFRICANA STUDIES

Funding Source: Melon Summer Teaching Grant

Revisiting August Wilson in the 21st century: Blackness Qua Queerness

August Wilson, born Frederick August Kittel, was a Black poet and playwright raised in the predominantly African American Hill District of Pittsburgh, Pennsylvania. Born to a German immigrant baker and Black housemaid, Wilson, one of five children, experienced racial harassment endemic of 1940s Jim Crow America. Inspired by Harlem Renaissance writers Arna Bontemps, Langston Hughes, and Ralph Ellison, Wilson sought to expand the theatrical literary canon to include the lived experiences of Black Americans - both the spectacular and mundane. His plays have been performed all over the world, garnering two Pulitzer prizes. Although Wilson has been widely studied, we believe that a more in-depth analysis of his plays enables a clearer understanding of the black condition. In particular, Wilson's plays illustrate the tension between black people and society's institutional interchanges. Wilson's plays represent black people attempting to have businesses and create prospects, yet their efforts are continually thwarted. In support of our study of Wilson, we have also examined the racial makeup, history and crime statistics of Pittsburgh from 1950 to 2018. This data aids our contextualizing of Wilson's portrayals of Pittsburgh during the times in which the plays are set, as well as that of actual black Pittsburgh residents today. While Pittsburgh is the focus of Wilson's plays, they address and represent a condition that is vast, this study continues to reveal the black condition across “amerikkka” and the world as dire.

Okkar Min ’20

Faculty Mentor: Professor Brandon Vogel, CHEMICAL ENGINEERING

Funding Source: Dean’s Fund for Summer Undergraduate Research in STEM

Poly(l-lactic acid) nanoparticles produced by impingement jet mixing solvent displacement: Optimization of process parameters for particle size and polydispersity

Many researchers are concentrating on developing polymer nanoparticles for controlled drug delivery because they are small enough to diffuse through tissues, target to specific tissues and in some cases, penetrate through cell membranes to deliver the drug more locally, mitigating side effects seen with intravenous injection. There are still difficulties in producing polymer nanoparticles at scale and in a size range (60 to 80 nm in diameter) that are large enough to avoid many of the biological barriers such as macrophages and other immune cells, and yet small enough to have reasonable diffusion rates through tissue. Another outstanding issue is to find out how the polymer nanoparticles can be purified from excess surfactant used when making the particles.

In this work, we looked at the effect of process parameters (amount of surfactant, location of surfactant, quench volume, and flow rate) on the polymer nanoparticle diameter produced with impingement jets mixing in a batch-fed process through solvent displacement. Solvent displacement uses a solvent for the polymer that is miscible with water. When the polymer solution mixes with water, the polymer precipitates and the solvent diffuses into the water. Excess surfactant is added to stabilize the polymer nanoparticles in order to prevent aggregation. We find that the quench volume and the surfactant concentration have the biggest effect on polymer nanoparticle diameter and the other parameters have little effect.

John Mirsky ’23

Faculty Mentor: Professor Elizabeth Durden, SOCIOLOGY & ANTHROPOLOGY

Funding Source: The Office of the Provost and Department of Sociology

The Effect of Religious Attendance and Prayer on Subjective Health Outcomes

Drawing on data from the 2008 General Social Survey, this research investigates the relationship between both religious attendance and prayer on self-reported health outcomes. Cross-tabulations and logistic regression analysis are utilized in order to determine these relationships. In addition to the primary relationships of interest, this present study also examines the extent to which health is impacted by certain demographic and socioeconomic control variables. In stark contrast to previous research, neither religious attendance nor prayer were found to have a significant relationship with health. However, results may illustrate a bifurcation of previous literature which has not been presently discussed. In such a case, research that utilizes respondents aged 18+ does not find significance among the variables of interest, yet the inverse is true of research that only utilizes elderly respondents. Age, race, educational attainment, and household income were all significant indicators of health outcomes, consistent with findings from previous literature. Of particular note, age remained significant through all models subsequent to when it was added.

Brody Mistrot ’21

Faculty Mentor: Professor Brian Smith, CHEMISTRY

Funding Source: Department of Chemistry, Kalman Fund for Undergraduate Research in the Sciences

Understanding Covalent Organic Framework Nucleation Through Small Molecule Structural Analogs

Covalent Organic Frameworks (COFs) are porous, crystalline polymers with designable structures self-assembled from rigid organic monomers. This class of materials has potential applications in separations, catalysis, and energy and gas storage, due to their large internal surface areas. Most of these applications require introducing chemical functionalization into the framework scaffold. The model system used in this study is the 3D, imine-linked framework, COF-300. Despite the purported interchangeability of COF monomers, recent attempts to synthesize functionalized versions of COF-300 have been unsuccessful. This failure is due to a lack of mechanistic understanding of the nucleation and growth processes. We hypothesize that a thorough understanding of model small molecule crystallization will provide a better insight into functionalized COF nucleation. To achieve this, we have begun preparing a library of single crystal structures of structurally relevant imine-linked compounds. While the direct analog to COF-300 exhibits a similar packing structure to the target framework, functionalized analogs often show significant packing deviations. These initial results suggest that monomer functionalization significantly changes the nucleation species, which directly impacts potential COF growth. By establishing trends in model system crystal structures, we aim to understand how functional groups affect compatibility with COF nucleation for the design of next-generation materials.

Lydia Naughton ’21

Faculty Mentor: Professor Gregory Pask, BIOLOGY

Funding Source: Kalman Fund for Biomedical Education/Fellows Fund

One Big, Smelly Family: Decoding the Odorant Receptors in the Indian Jumping Ant

Eusocial insects exhibit complex social hierarchies in their colonies, and in order to achieve this high level of coordination, there must be an effective communication system. Insect olfactory receptors (ORs) in the antenna are able to distinguish among a vast array of odorants, and the detection of these minute chemical cues drives insect communication. The Indian jumping ant, Harpegnathos saltator, serves as an optimal model for studying social olfaction due to the complexity of behaviors associated with its primitively eusocial caste system. Previous studies have focused on decoding a single subfamily of OR genes, but two-thirds of the entire family remains relatively unexplored. This research aims to characterize the pheromonal sensitivity of a selection of highly expressed H. saltator OR genes from across this expansive receptor family. In order to determine the response profile of an individual OR gene, we can genetically manipulate the fruit fly genome to express genes of interest and perform electrophysiological techniques to measure neuronal activity in response to various pheromones. This research displays the impressive discriminatory power of insect ORs in the presence of a myriad of chemical stimuli. In addition, the breadth of stimuli and responses demonstrated in this study contributes to our understanding of the basic requirements for eusocial communication. These findings can be applied to the future study of social insects with topics including whether certain OR genes are conserved across other species of ants, and whether there exists an olfactory signature along the evolutionary path to complex eusociality.

Elyse Nissley ’21

Faculty Mentor: Professor Jennie Stevenson, NEUROSCIENCE

Funding Source: Joann E. Walthour Undergraduate Research Fund

Effects of a Glucocorticoid Synthesis Inhibitor on Isolation-Induced Anhedonia in Prairie Voles

Poor social support is associated with numerous adverse health consequences in social animals, including elevated glucocorticoid levels and depression-like behavior. A highly social and monogamous species, the prairie vole (Microtus orchrogaster) is an ideal animal model for studying the mechanisms of social isolation due to their bonding behavior and sensitivity to isolation. Evidence that the hormone oxytocin can prevent isolation-induced elevations in plasma glucocorticoid levels and protect against other consequences of isolation suggests that glucocorticoids may be responsible for the harmful effects of chronic isolation stress. We designed a pilot study to investigate the effects of various doses of a glucocorticoid synthesis inhibitor, metyrapone, in chronically-isolated female prairie voles. Animals received metyrapone treatment in isolation for four weeks. Blood sampling and sucrose preference testing occurred before and after the isolation period to assess glucocorticoid levels and anhedonia (an index of depression). To determine sucrose preference, we measured the amount of a 1% sucrose solution consumed relative to total fluid consumed in a two-hour test session. Data from the sucrose preference tests showed very little difference between baseline preference and final preference across all doses of metyrapone and within the control group, indicating that neither control nor experimental animals experienced isolation-related anhedonia. Our next step is to use radioimmunoassay (RIA) to analyze blood samples and demonstrate whether there were any differences in glucocorticoid levels among metyrapone doses and control. We also propose a new study to validate our anhedonia findings.

Ian O’Keefe ’20

Faculty Mentor: Professor Brandon Vogel, CHEMICAL ENGINEERING

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

Solid-Phase Extractive Polymerization As a New Method for Polyanhydride Synthesis to Limit Oxidation during Polymerization and Improve Purity for Controlled Drug Delivery

Polyanhydrides are an attractive class of erodible polymer for controlled drug delivery because they can exhibit bulk or surface erosion and they have been shown to stabilize several classes of drugs including macromolecular therapies. The traditional method of polymerizing polyanhydrides is melt polymerization where an activated acetylated diacid prepolymer is heated at 180 °C under vacuum for 1 h to 3 h. The vacuum helps to remove the condensation by-product, acetic acid, generated during polymerization. While this method is effective at producing polymers with molecular weights greater than 15 kg/mol, the intense heating can lead to thermal degradation, oxidation, and discoloration of the polymers. Another issue with this method is the quick increase in the viscosity of the melted prepolymer and growing polymer during polymerization leads to poor stirring and removal of acetic acid. To overcome the drawback of melt polycondensation we have developed a less thermally aggressive method of polymerization that we call solid-phase extractive polymerization. In this method, we use a solvent to facilitate the polycondensation while also extracting the acetic acid by-product with basic aluminum oxide. Using sebacic acid as a model diacid, we studied the effect of a solvent boiling point on the polymer molecular weight. Interestingly, we find that high boiling point solvents allow for temperatures close to that of melt polycondensation but they are not efficient at removing the acetic anhydride because the number of solvent cycles is low. Low boiling point solvents cycle many times but they do not heat the prepolymer enough to get appreciable polymerization. Methylcyclohexane and acetonitrile provide a balance in temperature and number of cycles through the basic aluminum oxide extraction media to produce polymers in the 15 kg/mol to 30 kg/mol range in 1 h. The polymers made with this method also do not exhibit significant signs of oxidation or discoloration. We believe this method may be applicable to many polymerization methods that generate a by-product.

Ephraim Oliphant ’22

Faculty Mentor: Professor Ned Ladd, PHYSICS & ASTRONOMY

Funding Source: Program for Undergraduate Research

Alfven Waves and the Sun’s Corona

The corona, the low density outer layer of the sun, can only be viewed during a solar eclipse. It has a temperature of over a million degrees kelvin, while the layer beneath is much cooler. Currently, the cause of this is not well understood. Alfven waves, which propagate on magnetic field lines, could explain this temperature differential. Theory predicts that Alfven waves with frequencies 0.01-0.5 Hz can heat the corona, causing an observable oscillation in its brightness. Using Fast Fourier Transforms of two image series taken during the 2017 solar eclipse, we searched for periodicity in coronal brightness indicative of Alfven wave heating.

John Owen ’21, Tyler Luong ’22, Sebastien Bickford ’21

Faculty Mentor: Professor Stewart Thomas, ELECTRICAL & COMPUTER ENGINEERING

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

Enabling the Internet of Vegetables

To ensure healthy crop growth, it is important to monitor fields to make sure plants are healthy. To assist in this plant monitoring, we propose developing a wireless sensing system capable of monitoring plant health by measuring plant biopotential. Toward this end, we present low power circuits that enable digital wireless communication of a plant’s input voltage as well as circuits that are powered by harvesting energy from a plant biopotential and other ambient sources.

Jaewon Park ’20

Faculty Mentor: Professor Andrew Sloboda, MECHANICAL ENGINEERING

Funding Source: Diane L. Hymas Undergraduate Research Fund in Engineering

Time Series Data Analysis for Classification of Upper Body Motion in Bench Press Exercises

Inertial measurement units (IMUs) are widely used in navigation systems for satellites, unmanned vehicles, smartphones, and wearable devices. Recently, IMUs have begun to play a role in measuring and analyzing complex human motion. If data from body-mounted IMUs is treated as a time-series and analyzed using different mathematical tools, aspects of the motion can be isolated as features. Individual features can then be grouped into feature vectors that allow for discrimination and comparison of motion.
In this study, orientation (quaternion), acceleration, compass, and gyroscope data were collected from seven IMUs mounted on 33 human participants performing bench-press exercises. This data was used to create features for use in classifying the motion between one correct form and four deviations. Types of features derived at this stage included mean, maximum, form factor, entropy, and various others. These features become the input, or training data, for classification algorithms. Two machine learning algorithms, random forest and support vector machines, were found to be effective in this project as classification tools to determine which of the five bench-press forms the participants were performing when given their IMU data. Different methods of optimizing hyper-parameters were explored. With leave one subject out cross validation (LOSOCV), a validation method for determining classification accuracy for each individual subject, the algorithms were capable of predicting the right labels the five exercise forms at an accuracy of 81%. Further analysis was performed on the impact of reducing the number of IMUs, shortening the feature space, and considering subsets of the subjects.

Zane Patterson ’22

Faculty Mentor: Professor Eric Kennedy, BIOMEDICAL ENGINEERING

Funding Source: Program for Undergraduate Research

Investigating the Distribution of Playground Injury Severities from Public School Surveillance Reports

Playground injuries are the most commonly treated injury among children aged 1-10 in American emergency departments. Past playground injury studies, though, have not accounted for injuries of lower severity to an appropriate degree due to using data from emergency departments. Public school health departments, though, treat injuries of all severity levels, many of which are playground injuries. This study was conducted using a public-school injury database to determine the frequency and severity of playground injuries in different areas of the body.

The database used to conduct this study came from a large American public-school district with over 100 elementary schools. Using an anonymous injury surveillance form, injury data from September 2016 to June 2018 was analyzed, investigating the frequency and severity of playground injuries.

Within this 22-month period, a total of 2,807 playground injuries were analyzed within the district. Overall, head injuries comprised the majority of injuries suffered on playgrounds (56%), nearly three times the incidence of upper-extremity injuries (19%). However, upper extremity injuries were twice as likely as injuries in other body regions to be of higher severity and require outside medical treatment.

While impact attenuation standards for playgrounds are focused on the management of head injury risk, the injury rates suggest the need for further attention, such as the development of a device to simulate upper extremity impact, to better understand characteristics of surfacing materials for different injury mechanisms. This information would be useful to develop new or revised playground safety standards.

Minh Anh Phan ’22

Faculty Mentor: Professor Stu Thompson, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Making the ReadySetFit App Kayak-Friendly

In response to the widely reported increase in obesity and related health problems in the US, a team of faculty, staff and students at Bucknell University have authored a mobile app that incentivizes exercise through the use of crowdsourced public-facing humanities content of local interest. ReadySetFit, available on both the IOS and Android phones, is a completely student-coded app that leverages a Google Maps platform and the Google My Maps application. The user can select from a set of walking paths that have been created using Google My Maps, which contain points of interest that present cultural/historical information to the user as he or she approaches the physical location of each point.
The app already hosts two dozen paths which range from paths on Bucknell’s campus to historical walking paths in surrounding river towns to paths in historic Philadelphia. Therefore, this research project was designed to extend the app to make it accessible for water activities with the ultimate goal of guiding people to explore the historical and environmental beauty of the Susquehanna River, especially the West Branch, through kayaking. The outcome of the project led to adjustments of the existing geofence system, incorporations of river safety practices, and development of new kayaking paths. The main objective of the app besides promoting a healthy lifestyle, is to better strengthen the connection between people and the surrounding environment.. Through the app, users will receive environmental information about the area, which in turn brings various benefits to the environment.

Drew Phipps ’20

Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Department of Geology & Environmental Geosciences Marchand Fund, Program for Undergraduate Research

Detrital Geochemistry and Geochronology of the Late Devonian Spechty Kopf Formation: Improved Constraints on Sediment Provenance and Depositional Age

Foreland sediment deposition of Pennsylvania’s Devonian and Mississipian aged sedimentary strata thin and fine westward across the state. The orientation and location of this sediment indicates collisional tectonics of the Acadian Orogeny. Geochemical make up and depositional timescale for this sediment is not well known. An exposed outcrop in Mountain Top, Pennsylvania allowed for detrital muscovite geochemistry and U/Pb geochronological analyses of three geologic formations: Catskill, Spechty Kopf, and Pocono. Together, these analyses provide information to best determine maximum depositional age and provenance source for the Pennsylvania sediment.

Filtered U/Pb detrital zircon ages (n=253) from three sandstone samples located in the Catskill and Spechty Kopf Formations resulted in age populations of Acadian(359-416Ma, 6.7%), Taconic(416-440Ma, 7.5%), Grenville(900-1200Ma, 32.4%), and Pre-Grenville(1200-2832Ma, 36.4%). The youngest Acadian aged sediment found in the lowest stratigraphic sample site indicates a maximum depositional age of 366Ma for the entire sampled area. Previous studies of the underlying Catskill Formation have constrained overlying sediment to an even younger maximum depositional age of 361Ma.

Detrital muscovite geochemistry of incompatible elements Li, Cs, Sn, Tl, and Ga(n=169) was conducted on six sample sites. The results show a mixture of provenance source types with the Catskill and Pocono Formations indicating a largely igneous provenance source and the Spechty Kopf Formation indicating a largely metamorphic source. In general, larger incompatible element percentages correlate with igneous provenance sources while lower incompatible element percentages correlate with metamorphic.

Drew Phipps ’20

Faculty Mentor: Professor Christopher Daniel, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Department of Geology & Environmental Geosciences Marchand Fund, Program for Undergraduate Research

Detrital Muscovite Geochemistry and Detrital Zircon Geochronology of the Late Devonian Spechty Kopf Formation: Improved Constraints on Sediment Provenance and Depositional Age

Foreland sediment deposition of Pennsylvania’s Devonian and Mississipian aged sedimentary strata thin and fine westward across the state. The age and location of this sediment are the product of a rising mountain range to the east during the Acadian Orogeny. The geochemical make up and depositional timescale for this sediment is not well known. An exposed outcrop on Route 309 in Mountain Top, Pennsylvania allowed for detrital muscovite geochemistry and U/Pb geochronological analyses of three geologic formations: Catskill, Spechty Kopf, and Pocono. Together, these analyses provide information to best determine maximum depositional age and provenance source for the Pennsylvania sediment.

Filtered U/Pb detrital zircon ages (n=253) from three sandstone samples located in the Catskill and Spechty Kopf Formations resulted in age populations of Acadian(359-416Ma, 6.7%), Taconic(416-440Ma, 7.5%), Grenville(900-1200Ma, 32.4%), and Pre-Grenville(1200-2832Ma, 36.4%). The youngest Acadian aged sediment found in the lowest stratigraphic sample site indicates a maximum depositional age of 366Ma for the entire sampled area. Previous studies of the underlying Catskill Formation have constrained overlying sediment to an even younger maximum depositional age of 361Ma.

Incompatible element concentrations including Li, Cs, Sn, TI, and Ga (n=169) were measured in detrital muscovite from the Catskill, Spechty Kopf and Pocono Formations. Results from the Catskill and Pocono Formations show relatively low incompatible element concentrations indicating a largely igneous provenance source. Results from the Spechty Kopf Formation show relatively high concentrations of incompatible elements indicating a largely metamorphic source.

Brenna Prevelige ’20

Faculty Mentor: Professor Mark Haussmann, BIOLOGY

Funding Source: Department of Biology, National Institutes of Health

The cost of nutritional restriction and catch-up growth in Leach’s Storm-Petrels (Hydrobates leucorhous)

Throughout their lifespan, organisms must invest energy into growth, self-maintenance, and reproduction. However, energy is limiting, so trade-offs exist when individuals allocate more to one system while neglecting another. When food is scarce during development, growth is often limited, but compensatory or “catch-up” growth allows individuals to recover from stunted growth when food is available. However, these rapid growth periods often come at a fitness cost, one of which may be advanced cellular aging as seen through shortened telomeres and oxidative stress. Telomeres protectively cap the ends of chromosomes and act as a main mechanism driving cellular senescence. Their susceptibility to cellular insults allows them to serve as a biomarker of aging, and telomere maintenance is highly related to organismal longevity. We experimentally manipulated food availability to determine the effects of food restriction and subsequent growth on cellular aging in a natural breeding colony of Leach’s Storm-Petrels (Hydrobates leucorhous) during the nestling stage. Morphometric data indicated periods of rapid catch-up growth for nutritionally restricted chicks. These individuals also showed increased oxidative stress and reduced telomere length, indicating a fitness cost to either the nutritional restriction, the rapid growth, or both. This study provides the first mechanistic links between experimentally manipulated nutritional conditions on growth, oxidative stress, and telomere dynamics in a natural population and presents a more complete picture of the consequences of adverse nutritional conditions on fitness.

Ziang Qin ’22

Faculty Mentor: Professor Philip Asare, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: Department of Electrical & Computer Engineering

Bucknell Farming Irreation Management Study

Our study focuses on the installation of an irrigation management system on the Bucknell farm. We need to find a system that helps the farmers make decisions on the crops on their farms.

We analyzed the option for a water volume sensor recording the volume of water used in the farm, the option for a rainfall sensor recording the rainfall on the farm, and found some suitable sensors suitable for collecting data.

In the future, we will choose a rough user perception of the moisture in the fields. We will integrate the systems and develop methods to help the farmers obtain the data we collected. We will make appointments and field trips to the farm to investigate what the farmers need.

Amber Quinlan ’20

Faculty Mentor: Professor Douglas Dexter, EDUCATION

Funding Source: Douglas K. Candland Undergraduate Research Fund, Program for Undergraduate Research

Creating Effective Multicultural Classrooms: How Gen Z can Lead the Way

The purpose of this study is to review the literature surrounding multicultural education, implementation, and training. Multicultural education focuses on making education equitable for all learners, including culturally and linguistically diverse learners. As the United States population grows more diverse, it is necessary for all teachers to receive proper training and experience in multicultural education. However, current research suggests this is not happening at an adequate level. Can advanced classroom technology be an answer to this issue? Can a new generation of teachers (Gen Z), with their technological and global savvy, lead the charge to better multicultural classroom environments? This paper seeks to answer those questions by assessing what constitutes a good multicultural classroom, reviewing current training methods (both in-service and pre-service), and how Gen Z and new technology may assist in bridging the crucial gap between current teacher training and applied classroom practice. Conclusions and recommendations for teacher training programs and current educators are provided.

Gray Reid ’20

Faculty Mentor: Professor Matthew Slater, PHILOSOPHY

Funding Source: Douglas K. Candland Undergraduate Research Fund

Perceptions of Vaccinations

This project looked to explore the ways that college students perceive the need for vaccinations with their willingness to get one. In looking at the literature that exists surrounding vaccinations in college students, there was not a lot that could be determined about how these individuals respond to the idea of getting vaccinated. To examine this a short survey was sent out that asked students to respond about their experiences with vaccines, how they feel about the U.S.’s vaccination emphasis and how much they know of the history of vaccines. Whilst an initial pooling showed that many students were very pro-vaccination, conversations with older generations have shown that there may be a generational discrepancy in significance of vaccines. Further analysis and exploration will be taken to better understand the views of Gen Z on vaccines.

Erin Rigney ’20

Faculty Mentor: Professor Rob Jacob, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Detecting a Susquehanna River Paleochannel along the North Branch near Mifflin Township, Pennsylvania: A multi-method geophysical survey to determine depth to bedrock

Pennsylvania has experienced many episodes of glaciation in the last two million years. Early Pleistocene glaciers extended far into Pennsylvania, damming, and possibly altering, parts of the Susquehanna River (Ramage et al. 1998). A geologic survey was conducted to find depth to bedrock across a valley adjacent to the North Branch of the Susquehanna River in Mifflin Township, Pennsylvania to determine if this area was once a pathway for the Susquehanna River. Two geophysical methods were used to explore the characteristics of the subsurface along two profiles that run perpendicular to the axis of the valley and determine whether these characteristics indicate the presence of a paleochannel. Profile 1 is located near the topographic high of the valley. Profile 2 is located at a lower elevation closer to the junction of the current path of the river and potential paleochannel.

Seismic refraction and electrical resistivity data were analyzed to determine thickness of the subsurface layers as well as depth to bedrock along both profiles. Seismic data along both profiles indicate a shallow interface between slower seismic velocity material overlying a material with higher seismic velocity. However, electrical resistivity data along both profiles indicate a shallow interface between a more resistive layer overlying a less resistive material, indicating that bedrock is not present within these upper few meters. While there is no clear evidence to suggest that the valley being investigated is a paleo-channel of the Susquehanna River, some insight into the area as well as survey methods has been gained.

Tyler Rome ’20

Faculty Mentor: Professor Andrew Sloboda, MECHANICAL ENGINEERING

Funding Source: Department of Mechanical Engineering

Using Inertial Measurement Units to Classify Bench Press Exercise

Inertial measurement units (IMUs) have been used to successfully classify lower body exercise motion. Recently, initial efforts have been made to do the same kind of classification for upper body exercise. This study investigated classifying bench press exercise into one correct and four different incorrect classes. The incorrect motions included four errors: (1) shoulder blades not drawn down and back such that the chest is flat, (2) bar grip too wide, resulting in excessive arm abduction, (3) wrist bent so that the hand and forearm are not aligned, (4) bar lifted straight up and down instead of following an arc. Data was collected for 20 repetitions of the correct form and 10 repetitions of each incorrect form from 33 test subjects. Six Yost IMUs were attached to each subject on the back of the hands, forearms, and upper arms, while an additional sensor was attached to each subject's sternum. An observer monitored each repetition to ensure the type of motion being requested was carried out to the best of each subject's ability. The data collected included 3-axis accelerometer, 3-axis gyroscope, 3-axis magnetometer, and orientation (quaternion) data. MATLAB and Python code was used to collect, extract, and filter this data. It was then interpolated, resampled to 30 Hz, and segmented to obtain data representing each repetition. Acceleration, gyroscope, and magnetometer magnitudes as well as Euler angles were then computed to be used in feature creation for machine learning classification.

Carly Rovner '20,
Renee Russell, Graduate Student

Faculty Mentor: Professor Peter Judge, PSYCHOLOGY, ANIMAL BEHAVIOR

Funding Source: Graduate Summer Research Fellowship, Department of Psychology

Squirrel monkeys (Saimiri sciureus) demonstrate pronounced individual differences in understanding a puzzle task

We replicated a study originally conducted on chimpanzees and gorillas with five female squirrel monkeys (Saimiri sciureus) to test their understanding of a puzzle task. A reward was suspended in a transparent tube by a series of metal rods arranged vertically. In phase 1, the reward was placed on the second-highest rod. In phase 2, the reward was on the second-lowest rod. An efficient method of retrieving the reward was pulling out any combination of rods below the reward to allow the reward to fall out. An inefficient method involved pulling rods above the reward. If monkeys used efficient methods for a minimum of four out of five trials in two subsequent days, they progressed to phase 2. Phase 2 tested whether the monkeys spontaneously used efficient methods to solve the task. Efficiency would indicate cognitive flexibility and an understanding of the affordances of the task, while inefficient methods would indicate habitual behavior and cognitive conservatism. One monkey met the criteria for phase 1, and spontaneously passed phase 2 with all efficient responses. None of the other monkeys passed phase 1, and could not be tested for cognitive flexibility on this task. Results indicated that squirrel monkeys are capable of this task, however, the task was too difficult for the majority of monkeys. One squirrel monkey demonstrated cognitive flexibility, and comprehended the affordances of the task in a manner similar to that of apes.

Clara Sandu '20

Faculty Mentor: Professor David Evans, NEUROSCIENCE

Funding Source: Bucknell-Geisinger Research Initiative (BGRI) Grant

A Systematic Review of Misophonia: Definition, Clinical Correlates, Natural History, and Neural Substrates

We report results of a systematic review of misophonia, a condition marked by aversion to particular sounds–– such as those of chewing and eating––that is associated with significant subjective distress and, potentially, responses of rage. This review explored numerous databases (PubMed, Web of Science, Google Scholar) using relevant search terms including "misophonia," "misophonic," and "selective sound sensitivity." From this review we report the clinical presentation of the condition, comorbidities, natural history, and neural correlates. Misophonia is a relatively common, yet complex condition, typically of childhood onset, that is associated with several comorbid conditions (most notable anxiety, obsessive-compulsive disorders, and conduct disorders). Several neural substrates including, but not limited to, the hippocampus, amygdala, posteromedial cortex, and the ventromedial prefrontal cortex have been implicated in the pathogenesis of misophonia. Additionally, we present data from a nationally-representative cohort of 3200 families with children between the ages of 1 and 18 years of age. We examine the prevalence, frequency/intensity, age, and sex distrbutions of misophonia symptoms, as well as explore the structural neural substrates of misophonia is a pilot sample of 16 males and 17 females. Areas for future research include phenomenology, clinical correlates, epidemiology, neurophysiological substrates, and treatment.

Karen Santizo '21

Faculty Mentor: Professor Kat Wakabayashi, CHEMICAL ENGINEERING

Funding Source: The Katherine Mabis McKenna Environmental Internship Program

Fabrication and Characterization of Hemp Fiber Bio-composites

Composite materials contribute to more environmentally friendly products. A composite is a class of materials that is made up of multiple parts, some of which have low densities, high resistance to corrosion and robust mechanical properties. Through the use of epoxidized soybean oil and locally sourced hemp fibers, it is possible to create completely bio-based composites that are similar in mechanical properties to a petroleum-based product, while decreasing our carbon footprint. The creation of these composites began with having a layer of hemp fibers in a mold and then adding bio-epoxy to the mixture. The trials yielded unreliable composite product due to the bio-epoxy disrupting the placement of the fibers, causing the mechanical properties to vary greatly. With this error, we moved towards a different direction that could create better products. The research has now moved towards using hemp fibers with bio-derived thermoplastics. These plastics can be heated and cooled many times without changing their mechanical properties and can therefore be renewable. We use Solid-State Shear Pulverization (SSSP) to combine the hemp fibers and the thermoplastics. SSSP is a technique that effectively disperses fibers in a polymer matrix to achieve compatibilized polymer/ fiber composites. Research has also been done on silane and alkaline treatment on the fibers in order to improve their mechanical properties.

Holden Scharpf ’22

Faculty Mentor: Professor Kenny Mineart, CHEMICAL ENGINEERING

Funding Source: The Helen E. Royer Undergraduate Research Fund

Adhesion and Elastic Modulus in Block Copolymer Gels Measured by Shear Test and Microindentation

The goal of my research is to quantify the adhesive strength of polymer gels as their molecular connectivity is decreased. Additionally, I aim to identify why such a relationship exists. Polymer gels exist throughout nature; gastropods, such as snails and slugs, produce a mucus. Snail slime is so diluted, ranging from 91%-99% water, that it is often used as a lubricant. So, it is surprising how it can be sticky. Thus, we have been analyzing diluted polymers seeing how the decrease in connectivity increases the adhesiveness of the gel. The polymer gels we have been analyzing are made of mineral oil and a combination of di-block and tri-block polymers. As the percent composition of di-block polymer increases and tri-block polymer correspondingly decreases (since their total is held fixed), the molecular connectivity of the gel decreases. Adhesive strength was tested by placing a piece of gel in between two glass slides. Then, the glass slides were sheared apart and the applied stress was recorded throughout. We analyzed the polymers in a series where total polymer composition was 20% and the composition of the di-block and tri-block were varied from 100% tri-block and 0% di-block, to 40% tri-block and 60% di-block. We found that the adhesive strength increased as the di-block composition increased. We also tested the gels using microindentation for additional validation of the observed trend. We also measured the modulus of the gels, noticing trends of decreasing stiffness in gels as the di-block composition increased.

Zack Schiffer ’20

Faculty Mentor: Professor Brian Smith, CHEMISTRY

Funding Source: Department of Chemistry

Atmospheric Headspace Control over Polymorphic Crystallization of Acetaminophen

Between preclinical trials, three phases of clinical testing and FDA approval, a pharmaceutical company can expect it to take roughly fifteen years for a drug to reach the consumer market, at a cost in excess of $200 million. A central challenge in pharmaceutical formulation is controlling the crystal form, or polymorph, of the active pharmaceutical ingredient (API). API polymorphs, despite having the same chemical composition, can exhibit different properties, such as solubility, which directly impact dosing levels and bioavailability. In this study, acetaminophen is used as a model system to evaluate the key conditions determining polymorph selectivity. Using differential scanning calorimetry (DSC) and powder X-ray diffraction (PXRD), thermodynamic data corresponding to melt recrystallization of the three polymorphs of acetaminophen is analyzed. Here we establish that controlling the atmospheric headspace around acetaminophen as it recrystallizes significantly alters the polymorph that results. In particular, we observe that humidity plays a major controlling factor in selectively crystallizing the metastable Form III of acetaminophen. We discuss how these conditions control both initial crystal nucleation and long-term structural stability.

Steven Sedig ’21

Faculty Mentor: Professor Alan Cheville, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: Schotz Family Interdisciplinary Fund

Stitching the Gap Between Design and Technology

The main purpose of this project is to attempt develop a culturally-sensitive solution for the hindering lack of electricity in various regions across Sub-saharan Africa. This project is specifically focused on the West African nation of Ghana. The major idea is that integrated circuit chips will be developed to harness solar energy and produce a sustainable light source. The intention is that the electronic components will be seamlessly incorporated into either furniture or fashion to allow users easy access to this light, without dramatically having to alter their lifestyle. The hope is that this solution will be able to provide additional hours of light for students to study into the night, thereby simultaneously promoting education and renewable energy.

Ruth Segall ’21

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING

Funding Source: Culliton Family Fund for Undergraduate Research

Collagen Fiber Alignment in Orthopedic Tissue

Skeletal muscle tissue has many morphological properties that contribute to proper function. There are multiple biological components that contribute to the structure of muscle tissue, including the extracellular matrix (ECM). The ECM plays a crucial role in muscle fiber force transmission, maintenance and repair. Scanning electron microscopy (SEM) images show the alignment of collagen fibers in orthopedic tissue. A protocol has been formulated that preps the tissue for SEM that consists of dissection, fixation and dehydration, as well as an alternate protocol to decellularize the tissue to have the collagenous network without the muscle cells. The SEM images are analyzed for fiber directionality and dispersion and the data are extracted for further analysis such as plotting and modeling. This protocol has been performed on both regular muscle tissue such as the porcine tibialis anterior muscle and aponeurosis sheath which connects muscle to tendon. The images obtained from both muscle and aponeurosis tissue show that collagen fiber alignment does have some variability of waviness and/or dispersion but follow a general orientation direction. Understanding the collagenous network of muscle and aponeurosis tissue can allow us to understand the effects of disease and damage and create computational models that represent how the ECM functions under load.

Claudia Shrefler ’21

Faculty Mentor: Professor Abby Flynt, MATHEMATICS

Funding Source: Clare Boothe Luce Research Scholarship

Redefining Food Access in Rural Counties of Pennsylvania

The U.S. Department of Agriculture narrowly defines food access as the percent of individuals in urban census blocks living more than one mile from a major supermarket or grocery store, and the percent in rural census blocks living more than ten miles from a major supermarket or grocery store. A comprehensive review of the literature suggests that there are many other variables that better model food access than just physical proximity to a grocery store. The goal of my research was to perform statistical analyses on a multitude of variables in order to better define food access, focusing specifically on rural counties in Pennsylvania.

I collected and cleaned multiple publicly-available datasets that included variables, such as meal cost, commute time, median income, etc. for the 67 counties of Pennsylvania. I then performed exploratory data analysis to better understand the potential relationships between variables. Using the ggmap package in R, I mapped these analyses onto the map of Pennsylvania to visualize the results.

I then performed hierarchical spatial clustering on groups of variables that were said to have an influential effect on food access according to the literature review at the start of my research. I also mapped these analyses onto the map of Pennsylvania to clearly see patterns in the data. My research suggests that food access should be defined by variables other than just physical distance from a grocery store, which did little to explain food access/insecurity in the counties of Pennsylvania.

Benjamin Siciliano ’20

Faculty Mentor: Professor Brian Smith, CHEMISTRY

Funding Source: Department of Chemistry

Lactose-Modulation of Environmental Conditions Controlling Acetaminophen Polymorphism

Polymorphism refers to the capability of solid materials to habit two or more crystals forms with different arrangements of their components in the crystal lattice. Most active pharmaceutical ingredients are estimated to have more than one polymorphic form. Understanding of pharmaceutical polymorphism in the early stages of drug development helps to prevent formulation difficulties and improve quality during manufacturing. Polymorphs of the same material can have different physical and chemical characteristics, as well as different bioavailability, efficacy, and toxicity. Acetaminophen, which is available as a generic medication under the name Tylenol, is a well-studied model of pharmaceutical polymorphism. Previous studies have shown that both sample compression and the presence of lactose can direct which acetaminophen polymorph is crystallized. In this study, we investigated the interdependent effects that compression and headspace control have on acetaminophen polymorphism during melt crystallization, and how this control can be modulated according to the mass percent of lactose in the sample. Through differential scanning calorimetry and powder X-ray diffraction, we show that identical conditions can favor a different polymorphic form according to the amount of lactose present. This suggests that the relative importance of compression and headspace also depends upon low mass percentages ($<1\%$) of additives.

Maxwell Skirpan '20

Faculty Mentors: Professor James Baish, BIOMEDICAL ENGINEERING; Professor Christine Buffinton, MECHANICAL ENGINEERING

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

Hemodynamic Analysis Of Blood Flow In Embryonic Hearts Developing Persistent Truncus Arteriosus

In the congenital heart defect persistent truncus arteriosus (PTA), the developing outflow tract fails to septate into the pulmonary artery and the aorta. Hearts with PTA develop compact myocardium with the passive elastic modulus increased by factors of two (left ventricle) and four (right ventricle) compared to control. This research aims to create a computational model of blood flow through both normal and the mutant (PTA) ED12.5 mouse hearts to determine whether differences in pressure or wall shear stress could be associated with the observed modulus changes.

Each model geometry created in Solidworks consists of two ventricles and the inflow and outflow tracts. The geometric models were imported into COMSOL® 5.4 for finite element analysis. Both ventricles were comprised of a free inner channel and a surrounding porous, trabeculated myocardium. Blood flow was modeled using laminar flow equations for the inner channel and the Brinkman equations for the trabeculated domain. The control and mutant models were compared using the calculated pressure and shear stresses in each ventricle.

While average shear stresses at the open/porous and compact/porous interfaces in both the control and mutant models ranged from 0.08 – 0.25 Pa, average pressures were significantly higher, from 6 – 10 kPa. Additionally, the fluid pressures in both the left and right ventricles were found to be 40% lower in the mutant heart than in the control. Overall, the cushions restrict the cross sectional area of the outflow tract. To overcome this greater resistance, the control heart exhibits higher pressures in the ventricles.

Sam Soldatis '20

Faculty Mentor: Professor Rob Jacob, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Kalman Fund for Undergraduate Research in the Sciences

Delineating Bedrock-Alluvium Interface And Pleistocene Paleochannel of the West Branch Susquehanna River Using the Gravity Method; Montgomery, Pa

Early Pleistocene glaciation (~970ka) in Central Pennsylvania shaped the present-day geomorphology surrounding the Susquehanna River. This glaciation event produced an ice-dam, constraining flow of the West Branch of the Susquehanna River creating glacial Lake Lesley north of Montgomery, Pennsylvania. Local well-logs indicate that outwash floods during subsequent glacial melting and modern fluvial geomorphic processes deposited unconsolidated sand and gravel throughout the valley, providing sediment cover up to 30m thick. We report here on a follow-up gravity survey to a previous survey of the region which evaluated the ability to use relative gravity to map alluvial thickness across a broad region. The previous survey indicated an area of increased alluvium thickness north of Montgomery, Pennsylvania suggesting a possible paleochannel of the West Branch Susquehanna River buried beneath the alluvial valley fill. This project increases the resolution of gravity data with intent to delineate the subsurface alluvium-bedrock interface.

A LaCoste & Romberg gravimeter was employed to collect relative gravity measurements. Gravity readings were taken along three transects to identify lateral changes in gravity in the study area. After data collection, we applied necessary corrections to ensure changes in gravity were solely due to differences in the subsurface framework. Results show an anomalous decrease in gravity readings localized approximately 1km north of the present river. We interpret this to indicate that alluvial cover is thickest here, suggesting an infilled, scoured bedrock channel formed by the Pleistocene location of the Susquehanna River. Depth-to-bedrock modeling provides the topography of the alluvium-bedrock interface beneath the surface.

Allison Sullivan '20

Faculty Mentors: Professor Emily Stowe, BIOLOGY; Dr. Betsy Read, California State University San Marcos; Dr. Rosalina Hristova, California State University San Marcos

Funding Source: NSF Research Experience for Undergraduates at California State University San Marcos

Brown Blob Trials from the Benchtop: Extracting and Sequencing RNA from Microcoleus

As urbanization increases and new technologies bring about land use changes, the abundance of nitrates and phosphates in freshwater systems increases. The cyanobacteria, Microcoleus anatoxicus, produces toxins in response to these environmental stressors. Cyanotoxins have been linked to canine deaths in New Zealand and California and may pose unknown risks to humans in the future, especially in bodies that are used for drinking water. Few studies, however, have examined the genetic underpinnings of anatoxin production. To do so requires isolating and sequencing RNA under various conditions. The main question of this experiment was to identify the methods required to isolate pure and intact RNA with the purpose of examining the genes responsible for anatoxin production under relevant environmental conditions. Here we employed transcriptomics to examine M. anatoxicus under the following growth conditions: 1) high light with nitrogen, 2) high light without nitrogen, 3) low light with nitrogen, and 4) low light without nitrogen. We determined that a modified CTAB extraction method was the most effective means of extracting high quality RNA from polysaccharide rich samples.

Mikaela Thomas ’20

Faculty Mentor: Professor Martin Isleem, LANGUAGES, CULTURES & LINGUISTICS-Arabic

Funding Source: Honors Thesis

The Power of Language: An Analysis of Language Use and Attitudes in Morocco

This study examines the connections between language use and attitudes toward languages and dialects in Morocco. This North African country is historically multilingual, with communities speaking Moroccan Arabic (Darija), indigenous Amazigh dialects, French and English, in addition to the Standard Arabic used in government and within the Muslim community. The French protectorate period from 1912-1956 ushered in colonial language policies and imposed the French education system that enforced linguistic hierarchies. While the subsequent Arabization period attempted to reestablish the importance of Standard Arabic in Morocco, the policies failed to promote true multilingualism by ignoring the Amazigh languages. Today, Moroccans are multilingual, and each of their languages has unique sociolinguistic, political, and economic implications that shape the attitudes and identities associated with the languages. This thesis draws upon this historical background and the theoretical work by Bourdieu, Shohamy, and Bhabha, among others, to argue that while English use is on the rise in Morocco because of its economic benefits, French will remain the dominant global language in the country because of its historical importance. Original data on language use and attitudes was collected using an electronic survey targeting Moroccan university students. Data analysis is still in progress, but it is notable that French and English are highly regarded languages for their global scales, and overall the participants hold positive attitudes toward them.

Joseph Titman, Graduate Student

Faculty Mentor: Professor Brandon Vogel, CHEMICAL ENGINEERING

Funding Source: Graduate Summer Research Fellowship

Development of Two Novel Methods for the Synthesis of Polyanhydrides to Prevent Oxidation and Degradation

Polyanhydrides show considerable promise in biomedical applications as alternatives to traditional methods of drug delivery due to their zero-order erosion kinetics and surface erosion characteristics that allow for controlled drug delivery. However, pyrrolidone containing polyanhydrides exhibit thermal sensitivity under high-temperature melt polycondensation conditions. This thermal sensitivity results in degradation and oxidation of the polymer product. This research aimed to resolve these issues of degradation and oxidation by developing alternate methods for the synthesis of polyanhydrides containing pyrrolidone subspecies.

Two novel methods of synthesis were developed. The first method uses solid-phase extraction to remove the acetic acid byproduct formed during polymerization at moderate temperatures. Briefly, an activated diacid pre-polymer is placed in a hot solvent and refluxed. A Soxhlet apparatus is used with alumina in the thimble to absorb any byproduct and drive the reaction. The second method is a room temperature solution polycondensation that uses tosyl chloride to activate the monomer diacid.

Both polymerization methods produced polyanhydrides with molecular weights greater than 40,000 g/mol. The molecular weight was affected by the solvent choice and reaction time. We developed a simple model to explain how solvent boiling points affect molecular weight for the extractive Soxhlet polymerization method. No degradation and oxidation of the polyanhydrides occurred for both methods. The solution polycondensation shows a high degree of reactivity producing a large quantity of product despite small scale and dilute conditions. Now that proof of contempt has been achieved, future work involves using these two novel methods to produce polyanhydrides containing pyrrolidones.

Hanh Tran ’20

Faculty Mentor: Professor Sarah Lower, BIOLOGY

Funding Source: Department of Biology

Using computational approach to identify candidate odorant receptor genes in the most common firefly species in North America, Photinus pyralis

The insect odorant receptor, OR, gene family has been studied and hypothesized to play a critical role in reproduction. Odorant receptor proteins, located on the olfactory sensory neuronal dendrites, detect odorant chemicals such as pheromones and then mediate key behaviors such as mate choice. Although olfaction is known to play a predominant role in sexual communication, there is still a large amount of olfactory genes absent from most insect species. In this study, we investigate the sequencing data of one of the most common fireflies in North America, Photinus pyralis (Coleoptera: Lampyridae). This firefly species is well known for their use of light signals to attract mates, but our knowledge of their odorant receptors still remains elusive. Recent advances in genome sequencing have provided tools to identify the OR gene repertoires in P. pyralis sequencing data. The aim of this study was to develop an overview of P. pyralis' ability to detect chemical signals at the molecular level. Using bioinformatics analysis, I identified a set of 27 putative OR genes in the P. pyralis transcriptome. A phylogenetic tree was constructed from OR sequences of P. pyralis and other beetle species. It showed that all the candidate OR sequences of P. pyralis were clustered with at least one Coleoptera ortholog. Results of this study provide a foundation for future studies on the expression and function of the P. pyralis OR candidates. The study provides a better understanding of the molecular basis and evolutionary history of mating signals in the Lampyridae family.

Anurag Vaidya '21

Faculty Mentor: Professor Benjamin Wheatley, MECHANICAL ENGINEERING

Funding Source: Presidential Fellowship

Development and Implementation of Volumetric Compression Relaxation Testing of Skeletal Muscle

Computational models of human body— such as the Toyota THUMS model— are frequently used in the automobile safety industry. Such models rely on accurate material properties for body tissues. However, the compressive behavior of skeletal muscle is not fully understood yet. Thus, we have developed novel instrumentation that can help to investigate the effects of volumetric boundary conditions semi-confined compression (SC) and confined compression (CC) on stress relaxation of skeletal muscles.

For both CC and SC, two testing configurations were employed for stress relaxation testing: fast-compression ($\dot{\varepsilon}=15\%/s$) and slow-compression ($\dot{\varepsilon}=1\%/s$) to 15% strain with n = 3 for both SC and CC. All samples relaxed for 300s after compression. First Piola-Kirchhoff stress, peak stress, and nominal strain were determined through post-hoc analysis of initial specimen dimensions. To finely characterize relaxation behavior, a three term Prony series quasi-linear viscoelastic model was fit to normalized hold phase stress from all testing groups.

Despite similar strain levels, muscle in CC exhibited significantly higher peak stiffness than muscle in SC (p-value<0.001). In CC, muscle stiffness increases with strain rate (p-value = 0.02), which is consistent with previous studies. However, muscle's peak stress was not significantly different with strain rate for SC (p-value=0.29). The parameters from the viscoelastic model go on to support the notion that the relaxation behavior of skeletal muscle is not only rate-dependent, which is consistent with previous studies, but is also affected by the loading condition.

Shelby Valent, Graduate Student

Faculty Mentors: Professor David Rovnyak, CHEMISTRY; Professor Timothy Strein, CHEMISTRY

Funding Source: National Science Foundation Grant (NSF), Bucknell Graduate Summer Research Award

Structural Features of Stepwise Cholate Micelle Formation Using Chemical Shift Perturbations

Bile salts are naturally occurring amphiphilic molecules that are synthesized in the liver and can solubilize hydrophobic molecules. Emerging applications of bile salts include topical drug delivery, separations, and nano-materials processing. Little is known about bile micelle formation processes including number of monomers per aggregate, the structure of the various micellar aggregates, and the mechanisms by which micelles bind chiral guest molecules. This work gains insight into the structure of cholate aggregates by monitoring changes in heteronuclear single quantum coherence (2D-HSQC) NMR signals with varied cholate concentrations in the absence and presence of a guest molecule. Changes in the chemical shifts with cholate concentration (1-100 mM) reveal changing local environments around particular nuclei, indicating changes at precise locations of the structure. In addition, fitting the chemical shift data from HSQC spectra to a phase transition model reveals stepwise, discrete critical micelle concentrations (CMCs), and corresponding differences in interaction surfaces as a function of stepwise aggregation, indicating which locations on the cholate structure "see" changes during each aggregation step. Several trends arise in the chemical shift perturbation data which illuminate the evolving landscape of the micelle interior with successive CMCs. Detailed interaction maps of cholate as a function of aggregation are enabled by such data. Non-uniform sampling was employed to accelerate the acquisition of 2D HSQC spectra. The NMR derived results are furthermore shown to be consistent with unbiased molecular dynamics simulations of spontaneous bile aggregation.

Aditi Vijayvergia '21

Faculty Mentor: Professor Amal Kabalan, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: Program for Undergraduate Research poster presentation

A Service Robot for Hospital Patients

The use of robots has been on the rise in the past decade due to their reliability, technological precision, and advancement. They are being deployed in a wide variety of applications such as the automotive industry, medical operations, manufacturing, household cleaning and many more. This project proposes the enhancement of a line following robot for servicing the basic needs of patients in the hospitals. The main task of the robot is to fetch basic supplies such as water, ice, or approved medications to the patient in a timely fashion. This will reduce the workload on the nurses and provide excellent and timely service to the patients.

Chunzhen Wang ’20

Faculty Mentor: Professor Dave Kelley, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: PPL Undergraduate Research Fund

A Circularly Polarized Loop Yagi Array with a Parallel-Plate Driven Element

Traditional loop yagi antennas are widely used in everyday scenario but they are linearly polarized, which makes them impractical for use in earth-satellite links and many terrestrial applications. Circular polarization is good for these applications but most circularly polarized antennas exhibits a fairly narrow axial ratio bandwidth and could be difficult to construct. This research was aimed to solve one question. Could we find a loop yagi array design which has both wide bandwidth and easy fabrication processes?

A 12-element loop yagi was used as the basis for this new design, which has a center frequency of 300 MHz. On top of that, inspired by the well known circularly polarized micro strip patch antenna, I added two parallel plates with the feed point located on a wired bridge as the driven element. The dimensions of the parallel plates were determined via a careful process of trial and error. I optimized the axial ratio and input impedance by changing height and width of each plate, the position of the feed point and the distance between plates.

I showed that a loop yagi array antenna with a parallel-plate driven element can produce circular polarization over a bandwidth of roughly 2%. The gain is within 1 dB of the peak value over almost all of the 4% frequency range considered, and an impedance matching bandwidth of over 4% can be achieved using a quarter-wave transformer. The parallel-plate driven element is also mechanically robust and relatively easier to fabricate than traditional ones.

Yili Wang ’21

Faculty Mentor: Professor Brian King, COMPUTER SCIENCE

Funding Source: Gary A. and Sandra K. Sojka Fund for Research, Teaching and Scholarship in Developmental Disabilities, Neuroscience & Human Health

Identify Features of Images with High Interest from Children with Autism

Autism Spectrum Disorder (ASD) is a condition related to brain structural abnormality, impacting people’s skills of speaking, socializing, etc. Nowadays, no cure for ASD has been discovered, but researchers have identified some attentional biases from children with ASD. In our research, Deep Learning, a class of machine learning algorithms mostly based on artificial neural networks, is used to capture the characteristics of the objects that draw the attention of individuals with ASD.

With the cooperation with the Geisinger Autism and Developmental Medicine Institute (ADMI), we are provided with a set of images labeled as having high autism interest (HAI) and low autism interest (LAI). Our Deep Learning model is built to take the images as arrays of pixels and output a binary result, either HAI or LAI, for each image. The accuracy of our model was only about 80 percent. However, the HAI images are found to contain mostly straight lines or straight angles. To testify our conjecture, another tool, rectilinearity, was used to detect the edge features of each image. By rectilinearity, the number of straight lines and the lengths of the lines contained in each image are counted and recorded. Though only the outer shape of the objects can be precisely captured, our results have shown a difference in the averages of lengths between the HAI and LAI images. Our future work would include extracting the objects in the images precisely with the inner details and adjusting the hyperparameters in our models. “

Devin Whalen ’22, Ryan Bailis ’21

Faculty Mentor: Professor Keith Buffinton, MECHANICAL ENGINEERING

Funding Source: Program for Undergraduate Research

The Dynamic Response of FREEs

Unlike rigid-body robots used in manufacturing and transportation, soft-robotic systems allow for automation in delicate environments near humans. Within the field of soft-robotics, pneumatically-controlled Fiber Reinforced Elastomeric Enclosures (FREEs) have emerged as a solution to the lack of available compliant actuators. FREEs produced from latex tubes and helically wound cotton fibers exhibit elongation, rotation, expansion, and off-axis bending when pressurized. Decoupled, these motions are understood. However, the dynamic response, crucial to understanding the coupling between certain motions, is largely unexplored. Through experimentation and mathematical modeling, this project has focused on altering material properties such as length, thickness, mass, and winding angle to characterize the dynamic properties of FREEs. Tests have shown that FREEs can be modeled as spring-mass-damper systems with rotational natural frequencies inversely related to mass moment of inertia. Following the dynamic response research, a comprehensive mapping of the workspace has been performed using a two-camera imaging system that records the pressures required to reach various points in the workspace. Using vision and pressure data, a control system that allows for intuitive input, tracking with reduced vibration, and adjustment for variances in the physical characteristics of FREEs has been developed. A pneumatic gripper has been designed to fit at the end of a coupled FREE module, giving it the ability to pick up and move objects.

Given the current state of manufacturing tolerances and the material degradation of FREEs over prolonged pressure excitation, having a robust control system is paramount to demonstrating the practicality of FREEs in commercial products.

Abigail Wukitch ’22

Faculty Mentor: Professor Moria Chambers, BIOLOGY

Funding Source: Department of Biology, Presidential Fellowship

The protective effect of chronic infection during secondary infection in Drosophila melanogaster

Using Drosophila melanogaster we explored the impact of chronic infection, on survival to lethal infections. Chronic infections were established through bacterial injection into the abdomen and persist for the rest of the flies’ lifetime. After one week the flies given a lethal infection through injection into the thorax. Chronic infection showed a protective effect and improved survival across diverse combinations of infections. For example, a primary infection of Serratia marcescens and a secondary injection of Providencia rettgeri, had 60% survival 3 days post-infection compared to 0% for control flies. The protective effect of S. marcescens is incredibly strong, and even administering an infection with a bacterial species, Providencia sneebia, that typically causes 100% mortality one-day post-infection, we see survival of 30% of our chronically infected flies. To distinguish whether this protection was due to altered resistance, the host’s ability to constrain bacterial load, or tolerance, the ability of a host to withstand the infection without altering pathogen load, we looked at the relationship between bacterial loads 10 hours post-injection and survival. The Serratia marcescens chronically infected flies showed improved resistance compared to controls and increased expression of antimicrobial peptide genes, which we hypothesize are responsible for this improved ability to control the lethal infectionFuture work will modulate the strength of antimicrobial peptide induction to test the causal relationship between antimicrobial peptide expression and protection during secondary infection by varying the primary infection dose, age of flies, and time between infections.

Matylda Zaklicki ’20

Faculty Mentors: Professor Ellen Chamberlin, GEOLOGY & ENVIRONMENTAL GEOSCIENCES; Professor Jeffrey Trop, GEOLOGY & ENVIRONMENTAL GEOSCIENCES

Funding Source: Program for Undergraduate Research

Sedimentological and Paleoenvironment Analysis of the Late Devonian Catskill Formation, North-Central Pennsylvania, USA

During the Late Devonian, sediments from the Acadian mountains were transported westward by rivers and deposited in fluvial environments, but the morphology of the rivers, avulsion style, and controls on basin infilling remain unclear. This study assesses the sedimentology, channel geometry, stratigraphic architecture, and avulsion style of the paleochannels and floodplains of the upper 200m of the Catskill Formation near Blossburg, Pennsylvania, using field-based lithofacies observations, high-resolution panoramic photographs, and terrestrial lidar scanning.

Floodplain deposits contain red mudrock with desiccation cracks, rootlets, pedogenic slickensides, and caliche nodules (distal floodplain), and interbedded mudrock and very fine grained sandstone crevasse splay and levee deposits (proximal floodplain). Floodplain deposits decrease in abundance upsection. Single-story sand bodies (71% of sand bodies) occur low in the section and are very fine-to medium-grained and cross-stratified. Multi-story sand bodies occur high in the section and consist of similar sandstones that are separated by scours between individual stories. Sampled paleochannel bar heights range from 0.6m to 3.5m with median grain sizes from 59.93μm to 204.58μm (clay to fine sand). Paleoslope values range from 2.55 x 10-5 to 2.67 x 10-4 across the study interval.
Variations in the abundance of crevasse splay deposits, proximal floodplain deposits, and distal floodplain deposits suggest that these rivers had both progradational and incisional avulsions during this time period, but did not have a significant upsection change in flow depth or paleoslope. Collectively, these results suggest a fine-grained bifurcating meandering river system during this time period.

Ruoying (Yvonne) Zhang ’21

Faculty Mentor: Professor Anna Kell, ART & ART HISTORY

Funding Source: Douglas K. Candland Undergraduate Research Fund

Apathy

This creative project was to explore people’s apathy as a default attitude in day-to-day life via a visual medium. Apathy is a status when people have lost their feelings, emotions or interests to their surrounding environment, people or situations. Current society has shaped people to be apathetic to the surrounding so that they can escape from the reality, avoid to be hurt, or achieve ultimate goals. This project focused on one major perspective of apathy which is self-centeredness. Self-centeredness can directly lead to the indifference to the outside environment. This work consists of several digital drawings of a girl taking selfies in front of a big mirror in different outfits. With the popularization of social medium, taking selfies might be the most observable display of self-centeredness and it must speak to lots of people as a common habit. I tried not to depicted the figures in details with high recognizable facial or physical characteristics because I want the audience to fit themselves into the figure's role. I want this figure to represent the wide public as a symbol of overloading apathy. I chose to create them digitally instead of painting or drawing traditionally because relying on electronic devices is also a contributor to the apathy now.

Nick Zhang '21

Faculty Mentor: Professor Stu Thompson, ELECTRICAL & COMPUTER ENGINEERING

Funding Source: Culliton Family Fund for Undergraduate Research

Verifing the reliablility and validity of phone GPS data

Tracking the tiredness of athletes can effectively extend their careers and improve their well-being. The long-term objective of this project is to reduce injury and track the performance of student-athletes by monitoring player statistics (position, acceleration, and orientation).

A real-time data recording system using smartphones is proposed to replace the existing tracking systems which cost thousands of dollars. For instance, a system including wearable sensing devices for all team members, an app on tablets for real-time monitoring provided by a large brand, Polar® comes with a price tag of $10k.

To verify that the GPS data collected by phones could be part of a system that is comparable to the commercial ones (specifically Polar®), GPS and accelerometer data were collected over the summer. A literature review confirmed that no study on phone GPS validity and reliability has been done before. Two devices of each iPhone 5s and Google Pixel 2 were tested as they were strapped on to a person walking around the hockey field on 10 different days. The GPS data, across devices and over time, are compared with the commercial system to evaluate the performance of the phones.

In summary, the GPS data from the phones have outliers that need to be removed by an algorithm; the data is reliable for only long collection periods (greater than one minute); the phone operating systems are not transmitting data at a consistent rate, which should be noted if a system is to be designed using data from phones.

Erin Zielinski '22

Faculty Mentor: Professor Kenny Mineart, CHEMICAL ENGINEERING

Funding Source: National Science Foundation Grant (NSF)

Creating Different Sized Reverse Micelles and Comparison of Their Diffusion

Organogels, materials primarily made of liquid that exhibit solid-like properties, are formulated here using mineral oil. These organogels are also loaded with reverse micelles, which have a hydrophobic exterior and hydrophilic interior, and thus can encapsulate polar molecules. As a result, these materials can be utilized as topical or transdermal drug carriers. Past studies by our research group have analyzed the diffusion of gels composed of mineral oil (MO), 20 wt% SEBS (poly[styrene-b-(ethylene-co-butylene)-b-styrene]) and varying amounts of sodium dioctyl sulfosuccinate (AOT), which forms reverse micelles with a radius of approximately 1 nm. Since larger entities typically diffuse slower than smaller ones, we predict the diffusion (speed of molecule movement) of reverse micelles can be altered using reverse micelle size. Before testing this hypothesis, we had to find surfactants that create different sized reverse micelles. Formulations of many surfactants were created and analyzed using visual observation, small-angle x-ray scattering (SAXS), and Fourier-Transform Infrared Spectroscopy (FTIR) analyses. Both Span 20 (sorbitan monolaurate) and Span 80 (sorbitan monooleate) were identified to create reverse micelles in MO. SAXS found that Span 80 and Span 20 form reverse micelles with radii of approximately 2 nm and 4 nm, respectively. Organogels were then created using MO, 20 wt% SEBS, and 1 wt% surfactant for diffusion measurements. This poster will present results from surfactant screening experiments, Span 20 and Span 80 structural characterization, and Span 20 and Span 80 diffusion in organogels.

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