The College of New Jersey

MUSE 2019

Abstract?

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School of Arts & Communication

Department of Art & Art History

Drum Sphere

Alanna Trainor

Faculty Mentor: Professor Eduardo Villanueva

“Drum Sphere” is a hugely ambitious sculptural construction consisting of 36 wooden and fiberglass drum shells attached in a spherical arrangement around a steel frame which is then suspended from the ceiling of an exhibition space. Each individual drum is being wired with a “trigger”, an electronically programmable drumstick which I am currently designing and prototyping. The primary source of institutional research to support this piece will take place at the Morris Museum in Morristown NJ. Only an hour away from TCNJ, the museum is in possession of one of the largest collections of mechanical musical instruments, the Murtogh D. Guinness Collection. During the MUSE program, the advancement of the piece is focused on the production of Drum Sphere armature as well as the preliminary assembly of drum shells on armature.

Department of Interactive Multimedia

Fresh Start 2019

Miles Cumiskey & Olivia Knutson

Faculty Mentor: Professor Joshua Fishburn

Our team worked on Fresh Start, an interdisciplinary effort that combines public health and communications research with programming and gamification techniques. Fresh Start is an educational game designed to inform incoming college students about alcohol misconceptions and provide strategies to drink mindfully and foster behavior change. It is inspired by the visual novel game genre and utilizes a combination of interactive narrative, playful mini-games, reinforcement messaging, and regular feedback to create an engaging experience that also addresses key learning objectives. We used the Unity Game Engine and the C#

language to build the game, and the YarnSpinner Unity plugin to integrate the narrative. Our team also includes Dr. Yifeng Hu, Deanna Amarosa, Emma Cheng, Katrina Gutierrez, and Katie La Capria.

Department of Journalism

Trenton Makes Music

Amani Salahudeen

Faculty Mentor: Professor Kim Pearson

Research Question: Does the onoto interface reflect the way in which members of the community organize their music culture better than the current structure? We need to develop an interface that reflects Trenton residents' networks. Hypothesis: a homepage that has spacial arrangement that invites exploration will be more engaging than the current hierarchical arrangement. We are currently getting feedback on the current website before we proceed with AB testing.

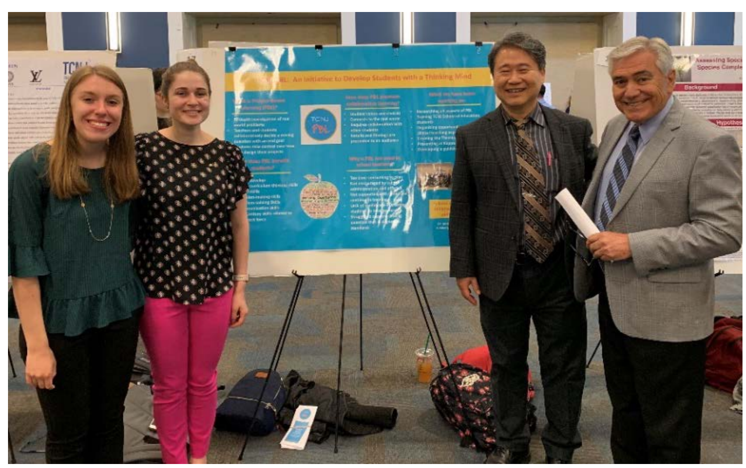
School of Education

Department of Elementary and Early Childhood Education

Developing an effective teaching model of infusing inquiry-based learning (IBL) into integrated Science, Technology, Engineering, Arts and Mathematics (iSTEAM) education in the elementary schools

Kimberly N. Cook & Kristen E. DiGiacomo

Faculty Mentors: Dr. Alex C. Pan & Dr. Anthony E. Conte



The project is geared towards investigating the benefits of Project Based Learning (PBL) and Inquiry Based Learning (IBL) for both teachers and students. This will be done through conducting literature reviews and examining current PBL and IBL experiences to develop teaching modules. The majority of these studies are based around iSTEAM (integrated Science, Technology, Engineering, Arts and Mathematics) subjects. These findings will be implemented during the undergraduate clinical experiences for junior and senior elementary and early childhood education majors. During the fall semester, the project team hopes to visit school sites that are implementing PBL and IBL in their classrooms and collect data. Also included in the project is a working copy of a PBL and IBL manual on the developed teaching modules. Additionally, these findings will be used to create presentations for the upcoming Kappa Delta Pi (International Honor Society in Education) Convocation.

Department of Special Education, Language and Literacy

Determining Language and Inclusion for Deaf-Plus Children

Julianna Kamenakis & Allison Shapiro

Faculty Mentor: Dr. Steven Singer

Educators have long argued about the best ways for Deaf children to communicate and where or how they should be educated. The two notions are inseparable for Deaf students who most often learn language at school (manual or oral/aural). Since the passing of PL 94-142 (1975) and the IDEA amendments, most Deaf students have moved from segregated schools to their neighborhood schools (Stinson & Anita, 1999) where all students might benefit from learning and socializing together—the foundations of inclusion (Jorgensen & colleagues, 2010). However, Deaf advocates question interpretations of inclusion and LRE for Deaf children (NAD, 2002). Might inclusion for Deaf students with multiple disabilities be different? In this ethnography, the authors examined the experiences of five families that had school-aged children who were Deaf-Plus and used signed language to communicate. Research questions included: 1) What were the experiences of parents navigating communication and education for their children and 2) What did inclusion mean for their children? Using semi-structured interviews, participant observations, and focus groups to collect data, the research team conducted an inductive coding analysis using a constant comparison approach. The team developed three themes: 1) Managing critical medical needs provided time for parents to explore communication options 2) “Anything else is more inclusive than my child being babysat in a special ed. room unable to communicate.” 3) Emergence of atypical gender roles and language learning for the whole family. As educators continue to discuss communication and placements for this population of Deaf students, it behooves them to consider how students’ individual characteristics might benefit learning and create more inclusive experiences.

School of Engineering

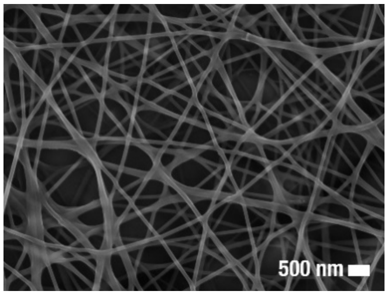
Department of Integrative STEM Education

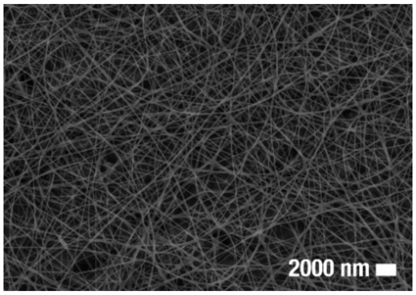
Enhancing reusability of nanofiber membranes for remediation of metal-contaminated water

Keith Wojciechowicz & Jason Orbe

Faculty Mentor: Dr. Matthew Cathell

We use a naturally-derived polymer from algae to produce nanofiber membranes (Figures 1 and 2) that can be used to remove heavy metals from contaminated water. In the past, we have shown success in removing toxic metals such as lead, mercury and cadmium. The nanofibers are held together through electrostatic bonding with calcium ions. The downside of this strategy is that it limits the reusability of nanofibers that have been use for water purification — rinsing the contaminant metals from the nanofibers also removes the calcium, causing the nanofibers to disintegrate. Our current work this summer is focused on crosslinking our nanofibers with epichlorohydrin. The permanent covalent bonds formed by the epichlorohydrin will allow us to reuse the nanofiber membranes for repeated water remediation cycles.





Developing Outdoor Curricular Examples through Socially-Relevant/Culturally-Situated Learning Activities in Engineering

Chris Coombs

Faculty Mentor: Dr. Tanner Huffman

Mr. Chris Coombs and Dr. Tanner Huffman are investigating outdoor educational experiences with relation to STEM and Engineering education. We are specifically interested in characterizing the instructors' mindsets and actions to ensure a successful experience for the students. Using qualitative research methods, Chris has interviewed and examined several model outdoor educational programs including in-school alternative education, summer camps, and prolonged educational excursions. Chris will use the knowledge generated through this research to design and development of curricular examples for implementation using socially-relevant/culturally-situated learning activities in engineering in outdoor educational environments.

Department of Civil Engineering

Development of a Test Method to Determine Transverse Modulus and Rupture Strength of Tubular Fiber Reinforced Composite Materials

Sofia Zapata & Zachary Michonski

Faculty Mentor: Dr. Andrew Bechtel

In order to verify a new test for the transverse flexural strength of tubular Fiber Reinforced Polymer (FRP) composite materials, rings and flat specimens were created. The flat specimens were tested according to existing test standards. The rings were cut into sets of three arches, and these arches were tested in a new experimental test fixture.

New Jersey Traffic Visualization

Robert Dinger, Thomas Dinger & Steven Villaverde

Faculty Mentor: Dr. Thomas Brennan

This project used massive amounts of data collected from Traffic Message Channels (TMC's) input into Excels 3D-mapping function. We created a video showing increases and decreases in travel time throughout the entire state of New Jersey. The data was scrubbed of its lower confidence scores and run through a series of matlab scripts that binned the data and found its free flow speed and percent increase/decrease in travel time. The scripts output the data into a manageable format so each day can be input into excel. This new representation of the data can be used in the study of how traffic is formed and show which areas of New Jersey have the highest congestion rates.

Regional Calibration of the Peak Rate Factor for the NRCS Dimensionless Unit Hydrograph Equation for the State of New Jersey

Henry Bader & Erin Harrington

Faculty Mentor: Dr. Michael Horst

Determining an accurate peak flow value as a result of an intensive rainfall (design storm) is paramount to the proper design of hydraulic structures such as bridges, culverts, levees, and dams. The Natural Resources Conservation Service (NRCS) provides a method for determining the peak flow of a design storm and is the most widely used method throughout the engineering community for design storm analysis and predictions. However, even with its widespread use most of the engineering community does not correctly utilize the equation or method. Our goal is to to use prior research on the "correct" peak rate factors for watersheds located specifically in New Jersey to calibrate the peak rate factor for all NJ watershed areas that have the available rainfall data. Once all available watersheds have properly calibrated peak rate factors and have been verified, said values will be posted on a map of New Jersey using GIS software and map data from the NJ Department of Environmental Protection. The final map will be used to identify regional similarities highlighting the error of current methods and promoting an accepted "correct" method of determination of a more accurate design storm.

Department of Biomedical Engineering

Improving Thumb Function in an Orthotic and Assistive Robotic Exoskeleton

Gabriel Sta. Rosa

Faculty Mentor: Dr. Brett Busha

About 54 million Americans suffer from Arthritis, or similar debilitative disorders, which result in a reduced ability to grasp and hold an item with the hand, such as a water glass or a handbag. For several years, TCNJ student researchers and I have been designing, building, and testing powered exoskeletons for the human hand (documented in eight peer-reviewed and published conference proceedings). The long-term objective of this effort is to produce a wearable device that can greatly improve the pinching and grasping efforts in people with mild to moderate impairment of hand function. The device will use a combination of a 3D printed plastic structure, six electric motors, six movement sensors, a mini-computer, and battery pack. The new design will allow one-dimensional movement of all 4 fingers and two-dimensional movement of the thumb, allowing users to employ a much wider range of grasping maneuvers.

A Robust Stochastic Model of the Cardiorespiratory System

Nicholas Markovic

Faculty Mentor: Dr. Brett Busha

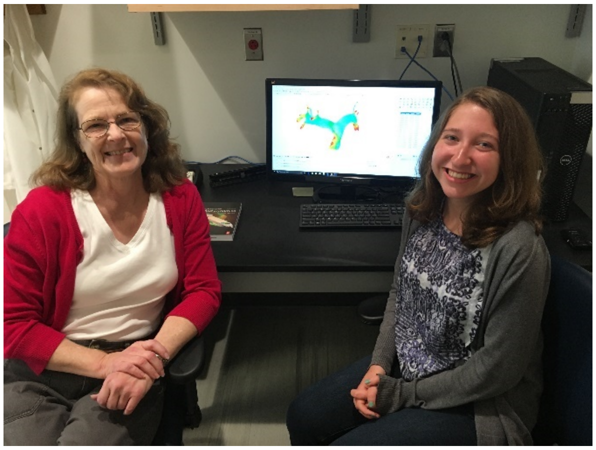
The control of the cardiorespiratory system is a very complex process. Neuronal centers in the brainstem that determine heart rate, blood pressure, and breathing rate receive continuous streams of information from the body and from other parts of the brain. Additionally, the cardiorespiratory control centers integrate information from the past, in order to better predict the body's future needs. It is known that even during controlled experiments, the output of the cardiorespiratory control systems exhibit some random behavior, where there is no clear relationship between the characteristics of sequential heartbeats or breaths. The inherent balance between randomness and periodicity is a natural and healthy characteristic of any physiological control system, including the control of breathing and heart rate. Most mathematical models of physiological control systems are designed with deterministic functions, thus every time the model is run with the same initial conditions an identical output is generated. However, most physiological control systems do not behave deterministically, and are better modeled with stochastic functions; where the output of the model varies for each iteration, even after using with identical initial conditions. If the robust temporal scaling of a physiological signal is indicative of a healthy and stable control system, the progression towards a more random organization may indicate a control system with a reduced stability. If a model of the cardiorespiratory system could reproduce this behavior, it would be a new asset for noninvasively determining the health of the cardiorespiratory control system. The objective of this effort is to improve and optimize the stochastic and mathematically Integrative computational model of the human cardiorespiratory system that was previously designed in my laboratory, with the ultimate goal of reproducing and/or predicting the intrinsic temporal scaling characteristics of the normal blood pressure, cardiac, and respiratory system function.

Three-Dimensional Modeling of the Pulmonary Artery

Kristen Zozulia

Faculty Mentor: Dr. Constance Hall

Heart function is routinely monitored in patients in intensive care units using a catheter and sensor system. The type of system analyzed in this project is the pulmonary artery catheter, PAC. This PAC, in

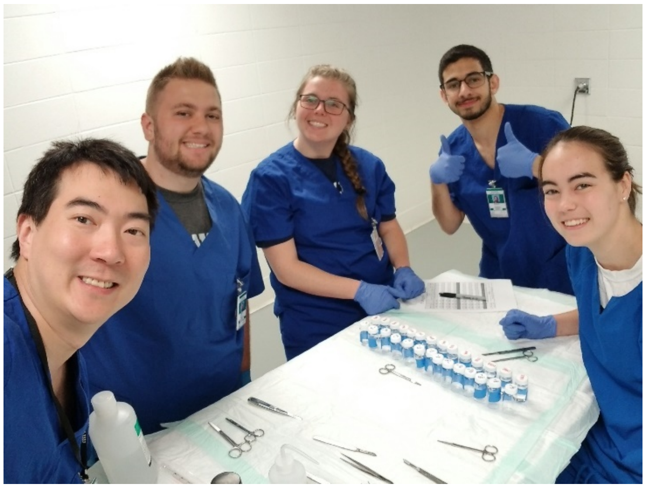


addition to detecting pressures and oxygen levels, utilizes a heating element within a section of the catheter that continuously delivers heat to the blood in random pulses. The use of a heating filament allows for the calculation of cardiac output by looking at the temperature difference between the heating filament and the downstream temperature sensor. The clinicians testing the catheter suspect that some regions of blood are exposed to temperatures that may damage blood components needed for normal clotting function. In an effort to quantify their concerns, computational modeling is utilized for prediction of temperature and blood flow parameters such as pressure and velocity. In order to get an accurate flow and temperature profile, an anatomically realistic 3D model of the pulmonary artery is developed from cardiac images of both male and female subjects. The results of the project will serve to better inform clinicians and device designers about the catheter's function and unintended effects. This project will also foster the development of greater expertise in the application of computational techniques to clinical problems, advancing and broadening modeling techniques.

Bone Strength Changes from Space Radiation Exposure in Rats

Rosalie Connell, Patricia Thomas & Calvin Okulicz

Faculty Mentor: Dr. Anthony Lau



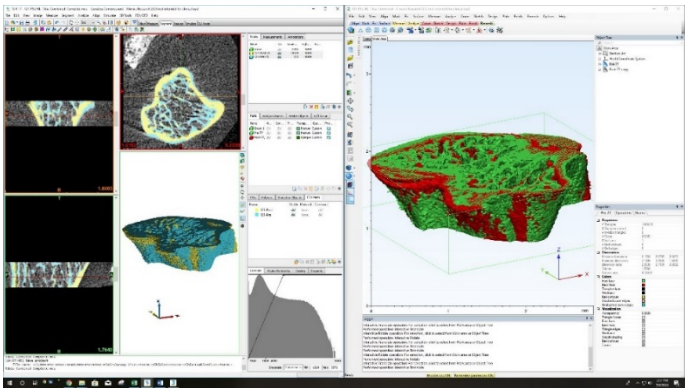
This project involves biomechanical analysis of bones from rats who were exposed to varying types and levels of space radiation. At the beginning of MUSE, the students traveled to Brookhaven National Labs to collect bone specimens from rats that exposed to space radiation. Each student is in charge of a particular aspect of the bone strength analysis. Rosalie Connell is performing structural mechanical testing to break the rat bone femurs in 3-point bending and perform femoral neck testing. Calvin Okulicz is performing microindentation with a spherical indenter to obtain the Young's Modulus of the bone specimens. Patricia Thomas is performing Vicker's microhardness testing to obtain the material hardness and fracture toughness of the bone. Combining all three analyses provides a comprehensive multi-length scale approach to assess bone strength changes in these rats after exposure to space radiation.

Finite Element Modeling of Bone in Mice Subjected to Hind-Limb Suspension and RANKL

Benjamin Hezrony

Faculty Mentor: Dr. Anthony Lau

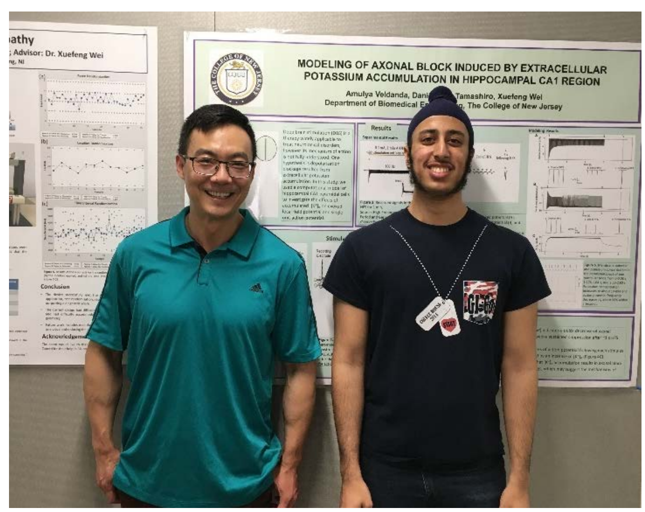
Benjamin's project is a continuation of last year's MUSE Project and it work during the year through the BME department's Research Track. Ben's studies bone strength changes in a mouse animal model for disuse and osteoporosis. The mice are subjected to Hind-Limb Suspension to remove the weight from the legs to simulate disuse and unloading during the absence of gravity during spaceflight. The administration of RANKL is a model to simulate post-menopausal osteoporosis. Ben is working with high resolution microCT scans of the mouse bones and performing computational finite element modeling simulations to investigate how the microstructural strength of the bone is affected by the Hind-Limb Suspension and RANKL.



Computational Study of a Novel Time-Varying Stimulation Waveform for Deep Brain Stimulation

Avneet Chawla

Faculty Mentor: Dr. Xuefeng Wei

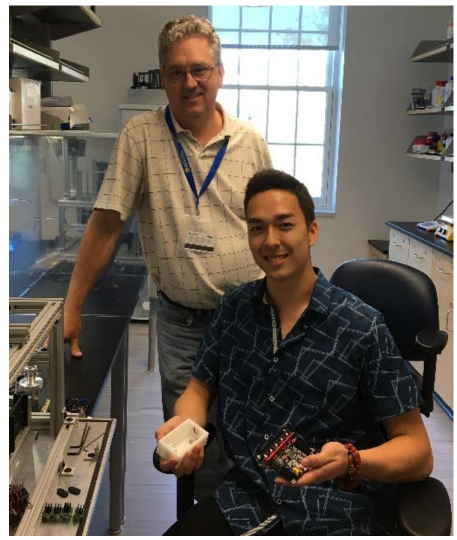


Deep brain stimulation (DBS) is a neurosurgical procedure involving the implantation of a medical device called a neurostimulator (sometimes referred to as a 'brain pacemaker'), which sends electrical impulses, through implanted electrodes, to specific targets in the brain for the treatment of brain disorders such as Parkinson’s disease and tremors. Treating these disorders requires sequences of high-frequency square wave pulses in a fixed interval with a fixed intensity. This treatment has limitations when it comes to the safety and effectiveness of DBS. Therefore, a novel waveform stimulation needs to be developed with some flexibility to optimize DBS. The objective of the study is to use computational models to investigate a novel time-varying stimulation waveform with a ramped-intensity phase and an attenuating- frequency phase for deep brain stimulation. This work will provide new insights into the mechanisms of DBS through novel stimulation waveforms, which is significant for advancing the application of DBS.

Soft Tissue Gripping System for Bioreactor to Instron Interface

Axel Delakowski

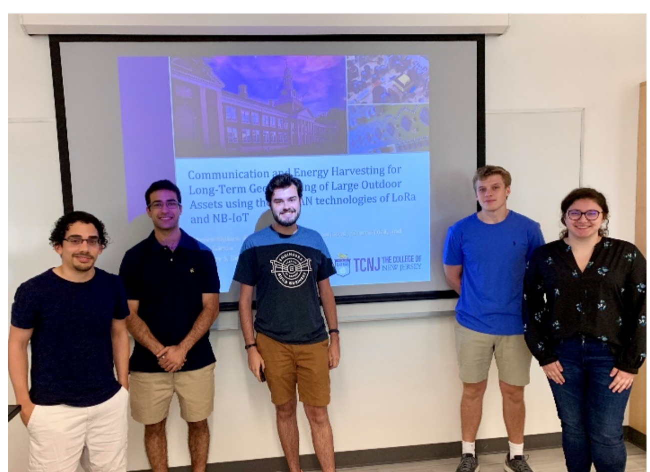
Faculty Mentor: Dr. Christopher Wagner



This summer focused on design, manufacture, and testing of a grip system for holding intact native tissue in a bioreactor system designed by our lab. This system was designed to be able to quickly and easily be moved from the bioreactor to a mechanical testing frame to measure important mechanical property changes resulting from tissue grown in the bioreactor. Future work will evaluate differentiation responses of stem cells grown on the tissue in the bioreactor as a function of applied cyclic strain. This work is the start of the 2-year research track project investigating enthesis formation and development signals. The enthesis is an important soft tissue to bone transition. It exhibits mechanical and cellular gradients that help in dispersing forces experienced by the body. Ligament and tendon injuries typically damage the enthesis and surgical repair techniques are not able to reform the structure, making the repair prone to failure. The soft tissue grip system designed this summer will serve as a model for designing a system specific for bone tissue engineering, which will allow us to analyze enthesis formation. Finally, 3D Bioprinting may be used to develop scaffolds for directed enthesis formation.

Electrical and Computer Engineering

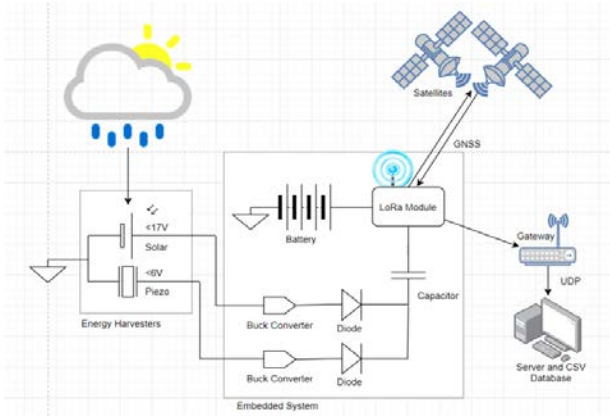
Communication and Energy Harvesting for Long-Term Geo-Tracking of Large Outdoor Assets using the LPWAN technologies of LoRa and NB-IoT



Steven Hollain, Patrick Stefanacci, Emily Driscoll,
Connor Dick & Keith Garcia

Faculty Mentor: Dr. Anthony Deese

There are two primary objectives of this research. One is to implement and refine communication link between tracking modules and central database using a low-power wide-area network (LPWAN) via either: Long



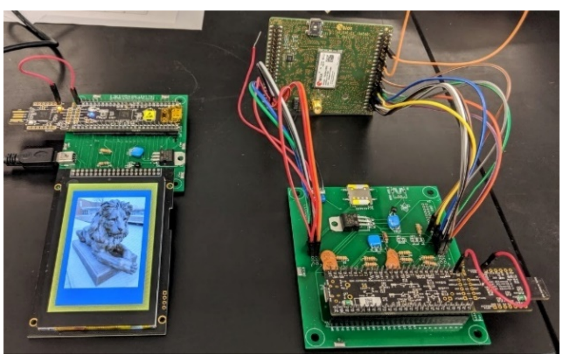
Range Wide-Area Network (LoRaWAN) or Narrowband Internet of Things (NB-IoT). The second objective is to allow this communication hardware to operate without human/manual intervention with a lifetime of 5+ years, cost less than $100 per unit, range greater than 1000 feet, and energy harvesting capability of at least 20mWh/day. This hardware should be designed and prepared for field-testing by the end of summer 2019.

Rule-Based Control of Humanoid Robots Using Image Realization Algorithms

Madison Bland & Shane Chiovaru

Faculty Mentor: Dr. Seung Kim

Petri nets are used to graphically model various sequences of actions which can be representative of real-world situations. Different variations of Petri nets have been developed. Implementing fuzzy logic creates a Fuzzy Petri net and implementing time into transitions creates a Timed Petri net.



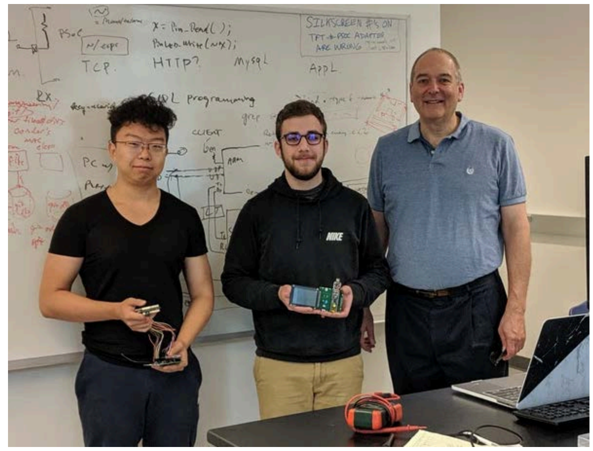
Both types of Petri nets allow more robust models to be developed. Using the NAO humanoid robots the tasks of stabilization and communication are being established. Algorithms are being developed to accomplish each of these tasks using real-time image processing and recognition. Petri nets models will be used to simulate the tasks which will be implemented using the NAO robot.

Architecture and Engineering of the T-COM: A Connected mHealth Device for Treating Tobacco Dependence Among Disadvantaged Populations

Jordon Sinoway & Ziyang (Condor) Gao

Faculty Mentor: Dr. Larry Pearlstein

Dr. Pearlstein is working with a team of TCNJ faculty (from Communications, Economics & Nursing) to study a novel intervention aimed at treating tobacco dependence among low-income populations. As part of this effort, MUSE students Jordan Sinoway and Condor Gao are working on research and development toward a connected mobile health device, the TCNJ CO Monitor (T-COM), which will combine several proven modalities for treatment. The T-COM will be a handheld personal device that combines a breath carbon monoxide sensor, motivational text and audio messaging, gamification features and built-in wireless network connectivity. The MUSE students will design printed circuit boards for prototyping the touch-display module and the 3G modem. They will also work on software diagnostics for display and cloud database access.

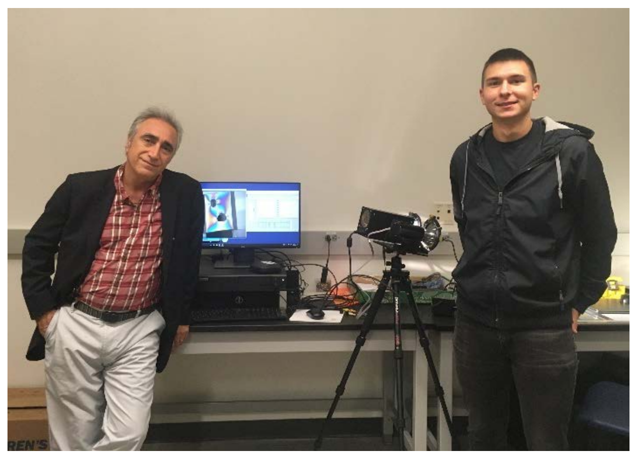


Mechanical Engineering

Research into Photo-Elastic Methods of Stress Analysis and its Applications

Adam Vicente

Faculty Mentor: Professor Bijan Sepahpour



Performance Characteristics of engineering products plays a critical role in remaining competitive at the demanding international markets. A key factor in optimization of design has to do with minimal use of materials. This in turn, would reduce the weight; leading to the lesser the need for input power/energy. However, the designers would not be able to make sound decisions without reliable information on the types and levels of stresses at play. Ordinarily, they resort to conventional analytical, Finite Elements, or experimental methods of stress analysis. There are situations in which the geometry of the component may be highly irregular and complex. For such circumstances, the above techniques would not suffice. This project focuses on the Photo-Elastic Methods (P-E.M.) of stress analysis. Equipped with this tool and knowledge; the designers would be able to view the full spectrum of the stress distributions and make highly informed decisions on: a) reinforcing the high-stress areas and b) removing unnecessary material from the low stress regions. An added advantage of the use of these methods has to do with clear signatures of “Machining” Stresses as well as “Assembly” stresses. Neither of these types of stresses may be detected by any of the other techniques. The addition of the educational module of Photo-Elastic Methods to our engineering programs at TCNJ gives the graduates an edge in graduate- level research and higher capabilities in more reliable and advanced optimization of design in industry.

School of Humanities and Social Sciences

Psychology

When is Distinctive Information Better Recalled and Why?

Jonathan Oflazian

Faculty Mentor: Dr. Tamra Bireta

The isolation effect is one of the most well-documented phenomena in the study of memory. It states that if given a list of items (such as words or phrases) to study and then recall at a later time, individuals will be better at recalling the item that is most unique or distinctive (the isolate). In Dr. Bireta's laboratory, we have found some circumstances that consistently show isolation effects with a given set of stimuli, but not with others; or if they are shown, the statistical effect size is smaller. We have conducted several experiments in our lab that manipulate these circumstances and are currently researching why we would obtain the results we did. We are also using statistical software to analyze our previously collected data and determine whether the isolation effect is dependent on the presentation and type of distinctive stimuli or on the nature of mental processing in the individual. The latter is a core component of many current theories of memory, so findings that stand in opposition to it would suggest new directions of research in the field of memory. After coauthoring a manuscript on this subject, we plan to submit the paper for publication to a peer-reviewed journal (Memory & Cognition).

Negative Emotion Mediating the Effects of Rumination on the Use of Conflict Strategies in Romantic Relationships

Elisa Liang

Faculty Mentor: Dr. Ashley Borders

The purpose of my study is to investigate the role of rumination in romantic relationships, particularly during relationship conflict. Rumination, or repetitive thinking about negative affect, is linked with various maladaptive behaviors, such as aggression and anxiety. Research suggests that rumination may be related to the use of negative conflict strategies within couples, but there are not many studies that focus on it in this context. The current study addresses this gap by examining the association between rumination and four relationship conflict strategies - aggression, withdrawal, positive problem-solving, and compliance. In addition, I will be assessing negative emotion, specifically anger and sadness, as a potential mediator of this association. In doing so, I hope to further understand the underlying mechanisms by which rumination may affect relationship functioning. I collected my data from a longitudinal, three-time-point study with a sample size of 113 couple members. We predicted that higher levels of rumination would be associated with greater use of aggression, withdrawal, and compliance, and lesser use of positive problem-solving. Furthermore, we predicted that negative emotion would mediate the association between rumination and the use of conflict strategies, such that higher rumination would lead to more anger and sadness, which in turn would lead to the use of more negative conflict strategies.

Employee Coaching: A Critical Review

Ileana Androvich

Faculty Mentor: Dr. Jason Dahling

This project involves reviewing and connecting all the previously published works regarding employee coaching. We will assess what we do and do not know about the topic. There is a lot of ambiguity and inconsistency about what employee coaching is, what it includes, how it fits into management, what factors affect it, and what the outcomes are of it. Our goal is to write a comprehensive paper to bring all these questions and information to light that will then be submitted for publication.

Making the Connection: Exploring the Linkage between Civil Trial Verdicts, the Decision to Appeal and Appeals Court Reversals

Peter Shenouda

Faculty Mentor: Dr. Tao Dumas

Although a trial must occur before an appeals court may review a case, appeals court decisions are rarely studied in connection to the trial court that initially adjudicated the case. Scholars almost exclusively study trial and appellate courts in isolation from each other. The resulting dearth of scholarship in this area means that we know relatively little about the factors that cause unsuccessful parties in trial courts to seek an appeal. The decision to appeal a case to a higher court represents an important decision-making process that occurs prior to an appellate proceeding and ruling. Why does the losing party in a trial appeal the verdict? Additionally, exploring this process also provides the potential to better specify models of appeals court decisions. This research first seeks to shed light on the factors that lead to an appeal, and secondly, to facilitate better models of appellate court decision-making by controlling for the selection process by which trials become appeals. Once models control for selection bias in the cases that go on to appeal, what factors lead an appeals court to overturn trial court verdicts? Using civil trial outcomes for an eighteen-year period, we will test the hypothesis that the size of the award rendered in the trial, litigant resources, judges' partisan identifications, trial location, and case issues and injuries will predict which cases go on to appeal. This research is intended as a first step in beginning to address this significant deficit in the literature by collecting and analyzing an original dataset of trial court decisions and their outcomes on appeal.

Children's Learning from Surprising Events

Natasha Chaudhari & Cassidy Peters

Faculty Mentor: Dr. Aimee Stahl

In this study, we are interested in whether toddlers learn more effectively from events that violate, rather than accord with, their expectations. Our previous studies have shown that infants and children better learn novel information about objects that behave in surprising, impossible ways, but it is unknown whether they would also learn from objects that behave in surprising, improbable ways. We showed 2- and 3-year-olds events that were either probable (50% chance of occurring), improbable (5% chance), or impossible (0% chance), and taught them a novel word to describe the event. To date, we have found that children learn most effectively after the surprising, impossible event, and do not show any learning enhancement from the surprising, improbable event. These studies help elucidate the circumstances under which children learn best.

The Transition from Infertility to Motherhood

Cassandra Halper

Faculty Mentor: Dr. Jessica Barnack-Tavlaris

The diagnosis and experience of infertility poses a significant psychological burden. Some of the myriad social and psychological consequences reported by people with infertility include losing a sense of

control over one's life, relationship distress, depression, anxiety, career disruption, isolation, and financial hardship (e.g., Cousineau & Domar, 2007). Due to modern technology, many women are able to resolve their infertility and become mothers. While there is considerable literature examining the psychosocial aspects of infertility, and books written to help people cope with the diagnosis, there are few empirical studies and/or books examining the transition from infertility to motherhood or the psychological impact of infertility on the experience of motherhood. There is a need for more qualitative data to further our understanding of women's experiences with the transition from infertility to motherhood. Such data can inform psychological interventions and research, as well as provide a supportive resource for other women who are going through this transition. During the Fall 2018 and Spring 2019 semesters, Dr. Barnack-Tavlaris conducted 24 interviews with mothers who experienced infertility before becoming a mother. The purpose of the study was to understand the transition from infertility to motherhood and the ways in which infertility affects one's experience with motherhood. For MUSE, Dr. Barnack-Tavlaris and Cassandra Halper are coding and analyzing these interviews using thematic analysis. Thematic analysis requires maintaining a flexible and iterative coding process, which involves being open to additional codes as they are discovered. The support of MUSE is allowing us to become immersed in the data, which will help us achieve valid and reliable conclusions, and high-quality outcomes.

Political Science

District, Resources and the Personal Vote in American State Legislature

Kiana Stockwell

Faculty Mentor: Dr. Daniel Bowen

Our research project examines the personal vote – the electoral security incumbent legislators gain by representing constituents – in state legislative elections. Using precinct-level data in the first election after redistricting offers researchers the opportunity to compare electoral performance of incumbent legislators in areas in which they have represented constituents to those which are new to the district. The difference in performance between the two, accounting for various other factors, represents the personal vote. Since states do not make precinct-level data easily accessible, our MUSE project tackles this extensive data collection effort in the 2012 election cycle. We expect that legislative resources, staffing in particular, help legislators cultivate a personal vote. We also expect that gerrymandered districts decrease the personal vote and incentivize partisanship by reducing name recognition of legislators and confusing voters.

Women, Gender & Sexuality Studies

Placing Akili Dada in the Greater Girlhood Studies Context

Alessandra Thomas

Faculty Mentor: Dr. Marla Jaksch

The girl-child has been placed at the center of development efforts by the international community in recent years following the Nike Foundation's launch of The Girl Effect. A non-profit organization that seeks to connect girls regionally and globally through various online media, The Girl Effect has gained considerable traction in the international setting as an actor that pushes for the empowerment of girls around the world. The proliferation of top down development initiatives that call for economic investment in the girl following the launch of The Girl Effect, however, has seemed to erase the humanity of the girl-child, instead painting her as an economic asset. Our research this semester is part of Dr. Jaksch and her colleague's larger manuscript project titled A (Re)Turn to the African Girl: African Feminist Girlhood Studies and Development, in which she seeks to return that humanity to the girl-child by placing her in both a historical and contemporary context while highlighting the voice of the girl as an active agent in her own reality. This summer we worked together on a chapter in the manuscript in which we focus on the grassroots, Kenyan organization of Akili Dada, a leadership incubator that provides scholarships to its participants and develops African girl leaders through service based work and leadership training. Akili Dada has a unique bottom-up approach to development centered around the girl-child that is unique in this era of girl based development. During this project, I have learned key feminist research methods and language. I have done extensive research on the field of girlhood studies and the Akili Dada organization, I have helped Dr. Jaksch create an annotated bibliography for the Akili Dada book chapter, I have prepared for an interview with members of the Akili Dada organization, and I have created a timeline. My timeline was created in order to place Akili Dada in the greater Kenyan political context, the international political context, and the greater girlhood studies context.

English

The Ethics of Hospitality in Literature

Jada Grisson

Mindi McMann

Our project focuses on the question of hospitality as it relates to land conflicts in Israeli and Palestinian literature, as well as South African literature. We are studying how hospitality remains a fraught ethical term, challenging discourses of national identity, particularly when they are tied to land. The metaphor of hospitality allows us to analyze these conflicts in terms of who the "host" is and who is the "guest," and what role such titles play in terms of claims to the land in question. Additionally, using a methodology of deconstruction, we have looked at how quickly the question of hospitality turns to hostility. In fact, the etymologies of 'hostility' and 'hospitality' share a common root: the root of the word hostis is the Sanskrit ghas meaning 'to eat', 'to consume', or even 'to destroy." Thus, in our argument we propose that the tension between the invitation to join and the threat to destroy are closely related and are key to the land conflicts in discussions of reconciliation.

School of Nursing, Health and Exercise Science

Nursing

The Mentoring Experience: The Perception of African American Nurse Leaders and Student Mentees

Yasmin Chahir & Adrianna Mohan

Faculty Mentor: Dr. Yolanda Nelson

Mentoring is a mutual and collaborative learning relationship between two, sometimes more, individuals with common goals and shared accountability for the outcomes and success of the relationship. "Moving Forward Together" is an African American Student Nurse Mentorship Program founded in September 2017 to support the growth of African American nursing students. Its mission is to positively impact the lives of African American nursing students by providing support, fostering character development, enhancing leadership skills, and building self-confidence. To assure the best practices are being utilized in the mentorship program, phase one consisted of an extensive literature review examining the current perceptions of mentoring for African American nurse leaders and students. Phase two included sending out a mixed methods research survey utilizing Qualtrics. It is our goal that once the survey is completed and analyzed, information will be disseminated, published, and shared with other departments. These findings will provide in-depth insight for participant attitudes, experiences, and perceptions of the process of mentoring and perceived mentorship experience.

Public Health

The Quality of Life of Caregivers Caring for Older Adults with Alzheimer’s Disease

Diana Da Silva

Faculty Mentor: Dr. Marina Souza

'The Quality of Life of Caregivers Caring for Older Adults with Alzheimer's Disease' is a descriptive-exploratory research that uses a qualitative approach. The purpose of this study is to analyze the quality of life of caregivers who care for older adults with Alzeheimers Disease. The study was conducted in the municipality of Betim, located in the Metropolitan Area of Belo Horizonte, Minas Gerais State which is the 3rd largest urban agglomeration in Brazil. 32 interviews were conducted in Brazil with informal caregivers from July 2018 to April 2019. Public Health student Diana Da Silva has worked closely with Public Health Professor Dr. Marina De Souza and Brazilian research team at the Pontifical Catholic University of Minas Gerais, Brazil in order to review the data that was collected and analyzed using Bardin's Theory. The research article is currently being written and will be peer-reviewed. An outcome of this project will be to finish the article and submit it for publication.

School of Science

Computer Science

Stopping Data Annotation in Sequence-to-Sequence Settings

Matthew Zidar

Faculty Mentor: Dr. Michael Bloodgood

The goal of this project is to determine the optimal amount of data to use in machine learning for sequence-to-sequence settings such as when training machine translation systems. The research involves first determining what sizes of data are used for training, tuning, and testing state of the art systems. Subsequently, the research also involves developing new algorithms to determine the optimal sizes and proportions of training, tuning, and testing data. We will complete the construction of enhancements to our computational infrastructure to support novel experiments testing our new algorithms. Visualizations will also be constructed in order to help investigate the optimal proportions and sizes of the data.

Virtual Reality Classroom

Jan Matthew Tameta & Alyssa Popper

Faculty Mentor: Sharif Mohammad Shahnewaz Ferdous

Our research started by identifying the major contributing factors in learning, especially for children with ASD. We then prioritized which factors we want to include to be customizable in our simulation. We are building a VR simulation to run on the HTC Vive system. In the next step, we will recruit students with and without ASD between 10 to 15 years of age and run a human subject study. Our independent variables are customizability (customized simulation vs non-customized) and presence of ASD. Participants will learn about an age-appropriate STEM concept via our virtual reality classroom. Before the study, participants will sign a consent form, answer basic questions about the concept to be learned (to establish baseline knowledge), and complete a simulator sickness questionnaire. After the study, they will answer the same questionnaire and a technology acceptance questionnaire.

Maximizing Resource Utilization through Occupancy Detection

Allison Russell & Mark Meddleton

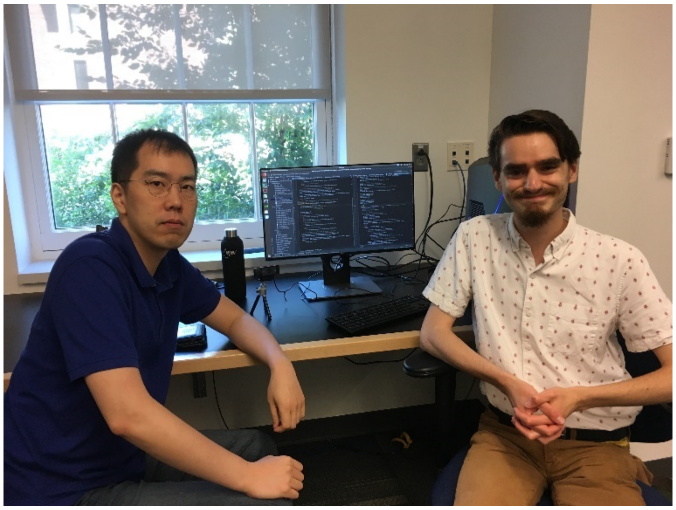
Faculty Mentor: Dr. Deborah Knox

The TCNJ Library App project aims to maximize resource utilization through real time occupancy detection and by helping students find an available study room or a library public-access computer. Research students are working with Raspberry Pi computers, PIR sensors and the programming language Python, seeking to improve the accuracy of motion detection in library study rooms. In addition, we are working with the Information Technology department to install our computer occupancy detection system onto library PC computers.

Computational Models for Subjective Attribute Prediction in Multimedia Data

Alexander J. Viola

Faculty Mentor: Dr. Sejong Yoon



We are interested in understanding the irrational nature of the human decision-making process and build computational models to mimic and analyze it. Humans are not as rational as one might think, and many factors can affect the decision-making process. Visual perception is one of such factors, as it is the key input to the process. Recent studies in the computer vision community have identified several underlying attributes of data that are different from traditional, tangible properties such as objects and scenes within an image or a video clip. These subjective attributes include, but are not limited to: interestingness, evoked emotions and sentiment, memorability, aesthetics, creativity, and popularity. We believe these attribute are keys to understanding of the irrational process. In our summer project, we are investigating ways to build computationally models that can predict the human memorability given multimedia data, such as images and videos.

Biology

Variation in Physiology and Behavior of a Migratory Songbird in Relation to Habitat and Life History Stage

Alexandra Immerso & Sriya Revankar

Faculty Mentor: Dr. Luke Butler

We conducted a field study of variation in the behavior and physiology of a forest-dwelling migratory songbird in relation to human-caused habitat degradation and life history stage. We compared territory-defense behavior and several blood-based measures of physiological health between male Ovenbirds breeding near or far from a road that transects our field site in the New Jersey Pine Barrens. Data were collected at three distinct stages: early in the breeding season (at the start of nesting), late in the breeding season (when young fledge the nest), and early in the post-breeding molt (plumage renewal). Our study aims to illustrate how a long-distance migratory songbird adjusts its physiology and behavior to meet the demands of different life history stages. Additionally, differences between birds breeding near and far from the road may illustrate potential health costs of a common form of human habitat alteration for forest-dwelling songbirds.

Exploring the Evolutionary History of the CUP-SHAPED COTYLEDOM (CUC) Gene Family in the Honeysuckles (Lonicera, Caprifoliaceae) and Relatives

Aaron Lee & Maryum Bhatti

Faculty Mentor: Dr. Wendy Clement

The honeysuckles (Lonicera, Caprifoliaceae) have a diversity of fused organ structures and provide a model study group to evaluate evolutionary and developmental aspects of this trait. We are interested in the genetic basis of organ fusion and past studies have shown that the CUC genes regulate the presence of fusion in model plant species. The goal of this project was to isolate CUC genes from honeysuckles and related species and to evaluate how they evolved, specifically in the Dipsacales, and more broadly in the Asterid lineages. We used a two-pronged molecular and bioinformatic approach, which included using PCR and cloning at the bench and mining publicly available genomes and transcriptions at the computer, to achieve these goals. We found that, of the two known CUC genes, there was a loss of one gene and a duplication of the other gene specific to the honeysuckle family (Caprifoliaceae). This may provide support for the diversity of fused organ morphologies so common in the honeysuckles.

Using Museum Data to Study Phenology Changes of Pine Barren Plants

Matthew Fertakos

Faculty Mentor: Dr. Wendy Clement

This summer I spent my time expanding on the research I completed for my senior honors thesis concerning flowering time of plants in the Pine Barrens of New Jersey, which is a unique habitat filled with endemic species. This project explores how phenology, or flowering time, in plants native to the pine barrens has changed over the last 200 years in our changing climate. At the start of the summer, my work had included 4 species, and I have been working to expand this sampling to represent a community of plant species in the Pine Barrens. I have now increased species sampling to 10 species. I accomplished this through the use of digitized herbarium specimens publicly available online, first downloading images of specimens, cleaning and filtering the associated data, and then scoring each individual plant's reproductive stage based on the image. I used the statistical software, R, to analyze the data and look for changes in flowering time that might correlate with mean annual temperature or year.

Basic Mechanisms of Shell Formation in Marine Invertebrates

Luisandra Lugo & Justin Sison

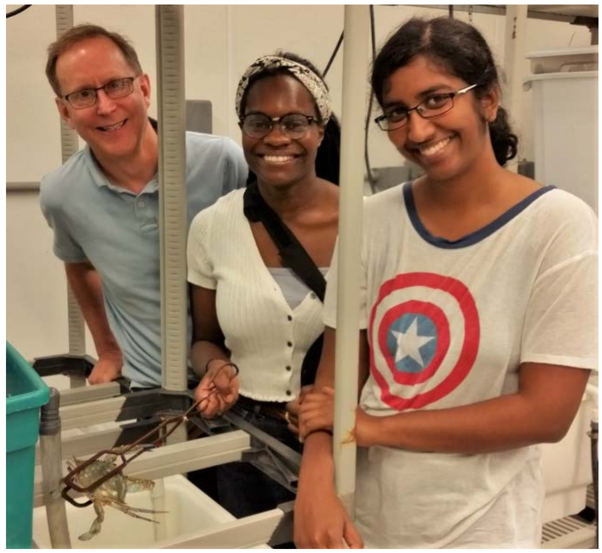
Faculty Mentor: Dr. Gary Dickinson

Our MUSE research investigates how marine invertebrates build their shells and how they adhere to substrates in the marine environment. We are particularly interested in assessing how shell and adhesive properties vary among closely related species, and how those properties vary within the same species when exposed to varying environmental conditions. We employ a variety of both qualitative and quantitative techniques to assess shell and adhesive properties, including micromechanical testing, light and electron microscopy, and elemental analysis. This summer, we have focused on two projects: 1) characterizing barnacle shell structure and adhesive strength for four species of barnacles collected from three different geographic locations (two in the Western Atlantic in New Jersey and North Carolina and one in the North Sea). 2) Assessing the effect of local seawater chemistry on elemental content of the coral skeleton. For this project, deep sea corals were collected from six different sites within the Gulf of Mexico. Both projects will provide insight on how alterations in the environment, for example due to climate change, may impact marine invertebrates.

Differential Gene Expression in Response to Changes in Environmental Salinity

Maeve Franklin & Priya Sinha

Faculty Mentor: Dr. Donald Lovett



Our lab studies the process of osmoregulation (regulating the salt content of blood) in crabs. Our long-range goal is to understand how crabs modulate their osmoregulatory mechanisms when the salinity (the amount of salt in the seawater) changes. Sodium-potassium ATPase (NaK) is an enzyme that functions in transporting salt across cell membranes. Our current research is examining the degree to which both the activity levels of the NaK enzyme and the expression levels of the gene for NaK are modulated when a crab is moved from low (stressful) seawater salinity to optimal salinity levels. Our lab also has found that levels of the hormone Methyl Farnesoate (MF) in crabs increase when the seawater salinity dropped below the optimal level. We currently are determining the gene sequence for MF in order to measure changes in the expression of the MF gene in response to salinity change. Understanding how osmoregulation is modulated in crabs could provide insight into how other organisms, including humans, may regulate the salt content of their blood.

Autoresuscitation Responses in 5HT-Deficient Mice Following Developmental Exposure to Nicotine: A Combined In Vivo and In Vitro Analysis

Nicole Lester & Muhammad Siddiqui

Faculty Mentor: Dr. Jeffrey Erickson

The original intent our MUSE project was to assess the effects of developmental nicotine exposure on autoresuscitation in serotonin (5HT)-deficient Pet-1 neonatal mice, using whole animal physiology (plethysmography) in combination with electrophysiological recordings from the isolated brainstem-spinal cord. Autoresuscitation (or self-resuscitation) is a "last ditch" effort by newborn mammals to recover rhythmic breathing following prolonged apnea via gasping. A failure to autoresuscitate following prolonged apnea during a sleep period has been proposed as the proximate cause of death in Sudden Infant Death Syndrome (SIDS) in humans. Moreover, a deficiency of brain 5HT correlates strongly with SIDS, and exposure to cigarette smoke (most likely nicotine) is a major risk factor for SIDS. Since the Pet-1 knockout mouse is also deficient in brain 5HT, has an inefficient autoresuscitation response to experimentally induced apnea, and suffers increased neonatal mortality compared to normal "wild type" mice, we were interested in testing the effects of developmental nicotine exposure on their autoresuscitation responses. However, due to significant progress on this project during the spring 2019 semester, we decided instead to focus our efforts during MUSE on related studies using plethysmography to measure chemoreflex responses (both breathing and heart rate) by the Pet-1 mice to acute changes in environmental oxygen or carbon dioxide levels following developmental exposure to nicotine. During the time available, we were able to complete data collection for both sub-studies (O2 and CO2 gas exposures) and perform the initial data analysis on the breathing portions of these physiological recordings.

The Effects of Deer Overabundance and Invasive Plants on Suburban Forest Communities

Gina Errico & Devyani Mishra

Faculty Mentor: Dr. Janet Morrison

Suburban forests are a juncture for the natural environment and anthropogenic effects, such as deer overabundance and introduced species. Deer herbivory affects the vertical structure and diversity of forest plants, and nonnative plants affect diversity by competing with native plants; but it is not yet clear how these pressures interact to shape the forest community.

We study the response of six local forests to prevented deer herbivory and two invasive plants, *Microstegium vimineum* and *Alliaria petiolata*, in a project ongoing since 2012. This summer, we measured the species richness and cover, rate of deer browse on woody plants, and photosynthetically active radiation. Changes we have observed throughout our work include dramatic regrowth of plants in plots with protection from deer herbivory and great variation of invasion by both invasive plant species under observation.

Corn Snake Ecology, Behavior and Conservation

Emmalee Kugler & Alina Osborn

Faculty Mentor: Dr. Howard Reinert

Corn snakes (Pantherophis guttatus) are one of the rarest and most endangered snake species occupying the New Jersey Pine Barrens. This lab is initiating the first intensive study of the habitat requirements and behavior of corn snakes under natural conditions. Over the past two years, 50 snakes have been radio-tracked. During MUSE, we continued the radio telemetric and GPS monitoring of seven snakes. At each capture and relocation site, a series of quantitative structural habitat variables were measured and the vegetative components recorded. In addition, a series of random sites are similarly measured. These data as well as the active range areas and movement parameters will be used to determine the preferred habitat of free-ranging snakes based on size, sex, and reproductive condition.

Characterization of the Nitric Oxide Signaling System of the Opportunistic Pathogen Pseudomonas aeruginosa

Arshia Arasappan & Safreen Sain

Faculty Mentor: Dr. Zaara Sarwar

Pseudomonas aeruginosa is a pathogenic bacterium that causes infections in thousands of people in the United States alone. It is the major cause of chronic lung infections in patients with cystic fibrosis. There has been a recent increase in antibiotic resistance in infections, which makes P. aeruginosa a difficult

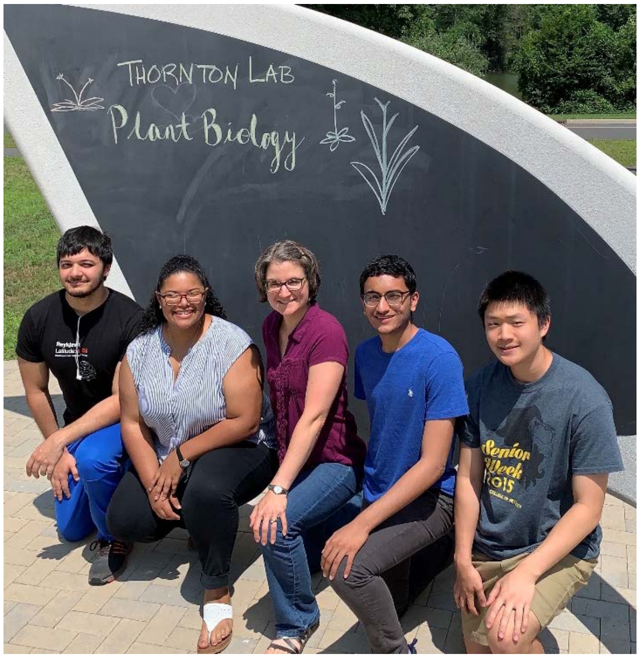
pathogen to treat. P. aeruginosa uses signal transduction systems to regulate cellular mechanisms such as metabolism, antibiotic resistance, and virulence. Enhancer-binding proteins (EBPs) are a family of signal transduction proteins used in P. aeruginosa to regulate a wide variety of cellular functions. The specific EBP that we will be focusing on characterizing is FhpR, which is associated with nitric oxide signaling. Nitric oxide in P. aeruginosa is used for energy, respiration, and virulence; therefore, characterizing FhpR is useful to understanding virulence and developing more effective antibiotics.

Identifying the Role of Cytochrome P450 Enzymes in Zea mays Plant Stress Responses

Grace Sandel

Faculty Mentor: Dr. Leeann Thornton

Research in the Thornton lab primarily concerns itself with the investigation of combined biotic and abiotic stress factors. We are investigating the role of Cytochrome P450 enzymes (CYPs) in plant stress response, in both wildtype strains of Zea mays plants and strains in which certain CYP genes are missing. Because of their ability to up and downregulate plant defense pathways, studying this superfamily of enzymes can help us to better understand plant biochemistry as a whole. The goal of this project is to describe the part that CYP27A plays in plant defense through monitoring the effects of combined environmental stresses on the plants, specifically soil salinity and insect herbivory. Furthermore, this mission seeks to add to the overarching lab objective to relate plant stress to the function that CYP450 enzymes play in the regulation of plant defense.



Characterizing the Role of the CYP72A8 Enzyme in Arabidopsis thaliana Under Heat and Drought Stress

Rishi Yerram

Faculty Mentor: Dr. Leeann Thornton

The focus of my research centers around understanding the role of CYP72A8, a specific cytochrome P450 enzyme found in plants. This protein is predicted to play a role in initiating protective changes that help plants survive environmental stresses. In order to characterize the role of this gene, I utilize the model organism Arabidopsis thaliana and expose normal and mutant plants to a combination of stresses including heat, drought, and insect herbivory. Comparing mutants that are missing the A8 gene to normal plants is useful because it helps determine the role of the enzyme under stress. Using multiple stresses at once allows the plants being studied to mimic their natural environment; plants are exposed to a variety of stresses, often at the same time. These findings will provide further evidence as to the role CYP450 plays in the larger plant stress pathway.

The small plant, Arabidopsis, is a useful model organism for studying the genetics of plant stress responses. Below, the plants have been subjected to heat stress or caterpillar infestation. The leaves rotate for cooling in the heat stress and the leaves have been damaged by chewing in the caterpillar infestation. We compare the chemistry of the normal plants under these conditions to plants missing an enzyme that we hypothesize to be involved. These pictures are examples from Project 2 (CYP72A8 analysis).

Exploring the Biomechanical Function of the CYP72A14/CYP72A349 in Plant Stress Response

Malay Nanavaty

Faculty Mentor: Dr. Leeann Thornton

Cytochrome P450 enzymes (CYPs) are found in all organisms and drive key biochemical pathways responsible for the creation of defensive metabolites against environmental stressors (secondary plant metabolism). CYP72A14 is a CYP in Arabidopsis responsible for responding to the biotic stress of bacterial infection. CYP72A349 is an enzyme in Zea maize responsible for defense against caterpillar herbivory. This phenomenon has been confirmed through comparison of mutant and wildtype metabolic profiles in infected plants. Thus, the logical next step is heterologous expression and isolation of functional CYP72A14 and A349 to directly test the enzymes’ binding affinity with the suspected metabolites. The CYP genes from the plant will be expressed in a cyanobacterial system to acquire the target protein in abundance, with the ultimate goal of testing the affinity of potential substrates to the protein. Modification of a vector capable of carrying CYP72A14/A349 cDNA from E. coli stock into the cyanobacteria has been done. We have ligated our genes of interest into a viable backbone, which has effectively inserted our target genes into the cyanobacterial genome. The two genes have been incorporated into cyanobacteria over the course of the summer. I am optimizing enzyme production so that the proteins can be isolated and then tested. This project will allow us to determine which metabolites directly bind to the CYP enzyme through use of in-vitro protein binding assays.

Investigating the Regulation of Gene Expression: Can Histone Acetylation During RNA Synthesis Modulate RNA Splicing?

Olivia Marino, Olivia Biluck, Michelle Lin

Faculty Mentor: Dr. Tracy Kress

The major goal of our research is to understand a fundamental question in molecular biology relevant to all living things: how do cells regulate when and to what extent certain genes are turned on and off? Turning a gene on is called gene expression, and the regulation of gene expression is necessary for generating the different cell types in complex organisms (such as skin and blood cells). Flexible gene expression is also important for cells to be able to respond to changes in the environment. Our work on gene expression focuses on RNA, a molecule that serves as a "working copy" of the genetic instructions. RNA molecules are synthesized from the DNA genes, which store all of the genetic information of an organism. Instructions in different RNA molecules are utilized to build the thousands of proteins that a cell needs to develop its proper form and respond to the environment. A newly synthesized RNA molecule must be properly processed in order to prepare it to make a new protein. For example, in RNA splicing, special molecules cut away portions of the RNA that do not help make a proper protein. After cutting, the sequential parts of the RNA instructions are fused together to form a coherent molecular message. Processing steps, like RNA splicing, must be executed with precision to prevent the production of abnormal proteins that are non-functional or even harmful to the cell. The new, big unknown—and the focus of our work—is how the RNA synthesis and splicing processes are coordinated to regulate gene expression. Indeed, gene mutations that lead to imprecise RNA synthesis or processing underlie numerous human disorders, including cancer. Inside the cell, DNA is wound tightly around small proteins called histones making it difficult for the RNA synthesis machinery to access the DNA to synthesize an RNA molecule. Special molecules, called histone modification enzymes, unwind the DNA from the histone proteins, enabling RNA synthesis to proceed. This summer we are utilizing a combination of genetics, molecular biology, and biochemistry to test the hypothesis that histone acetylation, a modification that promotes RNA synthesis, regulates RNA splicing in Saccharomyces cerevisiae (bakers yeast). The proteins that regulate gene expression are conserved between yeast and humans, thus their work can provide mechanistic insight into how gene expression is regulated in human cells.

Chemistry

Structure, Function and Inhibition of Moth FPPSs

Akshaya Srinivasan & Maxwell Cerra

Faculty Mentor: Dr. Stephanie Sen

The growth and development of insects are highly regulated processes that are controlled by several hormones, including juvenile hormone (JH). JH plays a central role in regulating insect growth, maturation, and for some species, metamorphosis; as a result, disruption of its biosynthesis is considered a promising method for developing new insecticides. Our strategy has been to identify biochemical targets and develop small organic compounds that can block certain steps in JH production within the insect. For this MUSE project, we have expanded our studies on FPPS, a specific protein involved in JH biosynthesis. Two avenues were pursued. First, a unique insect FPPS found only in moths was cloned for expression and functional analysis. Second, we conducted computational studies on a second moth FPPS that we have previously demonstrated can be selectively inhibited, in order to better understand its structure and function, and to develop more potent inhibitors.

Molecular Dynamics Studies of Insulin

Jonathan Piscitelli

Faculty Mentor: Dr. Joseph Baker

Our group is using computer models of molecular systems to better understand the impact of deep eutectic solvents on the protein insulin. Specifically, we are studying how the deep eutectic solvent choline geranate stabilizes the active monomeric form of insulin over other inactive forms of the protein. Deep eutectic solvents have the ability to interact with and influence the stability of proteins, making them particularly useful in drug design. Understanding the ways that a deep eutectic solvent can alter the efficacy and delivery of insulin is essential to the development of diabetes treatment.

Molecular Dynamics Studies of Type IV Pili

Kimberly Jarquin, Christopher Lovenduski, Kevin Marin & Emma Webb

Faculty Mentor: Dr. Joseph Baker

Our group is using computer simulations to investigate the strength of bacterial filaments called type IV pili. Type IV pili extend from bacterial cells and are used in a wide variety of functions, including adhesion, motility, and infection. They are made of many copies of a protein called pilin, and can withstand very large tension forces. When type IV pili are stretched, they are known to elongate by approximately three times their initial length, and become significantly smaller in diameter. However, the details of this structural transition are unknown at the molecular scale. Our goal is to provide insight into how the structure of type IV pili change under force, which will provide a basic understanding of the strength and flexibility of these biopolymers.

Physics

A Light Induced Systematic Effect on Neuronal Network Bursting

James Clooney & Noah Devane

Faculty Mentor: Dr. Tuan Nguyen

From fireflies flashing simultaneously to brain cells firing in rhythmic patterns, synchronization is a ubiquitous phenomenon in nature. The underlying theory – synchronization of coupled oscillators – has captivated mathematicians and nonlinear physicists for the past sixty years. Neurons, grown in culture, also exhibit synchronous oscillations known as network bursting and are ideal testing grounds for theories of network synchronization. Network bursting begins around day in vitro (DIV) 5-10 and is characterized by nearly all neurons firing together with a constant frequency. During this time, the connectivity of these networks are mapped using laser scanning photostimulation (LSPS) and calcium (Ca) imaging in order to investigate how network properties determine synchronization. In this project, we studied a peculiar systematic effect associated with the mapping process itself. This effect caused both the amplitude and frequency to become highly irregular and therefore undesirable. We investigated various parameters including the uv laser power and high-power LED intensity used in LSPS and Ca imaging. Compared to our control experiments, we found that the LED power played the largest role. This was verified by reducing the frame rate at which we strobe the LED. While the effect has been minimized, it is still insufficient for long-term mapping. The next step is to decrease the noise characteristics of the camera, which would allow us to further reduce the LED intensity and/or the frame rate.