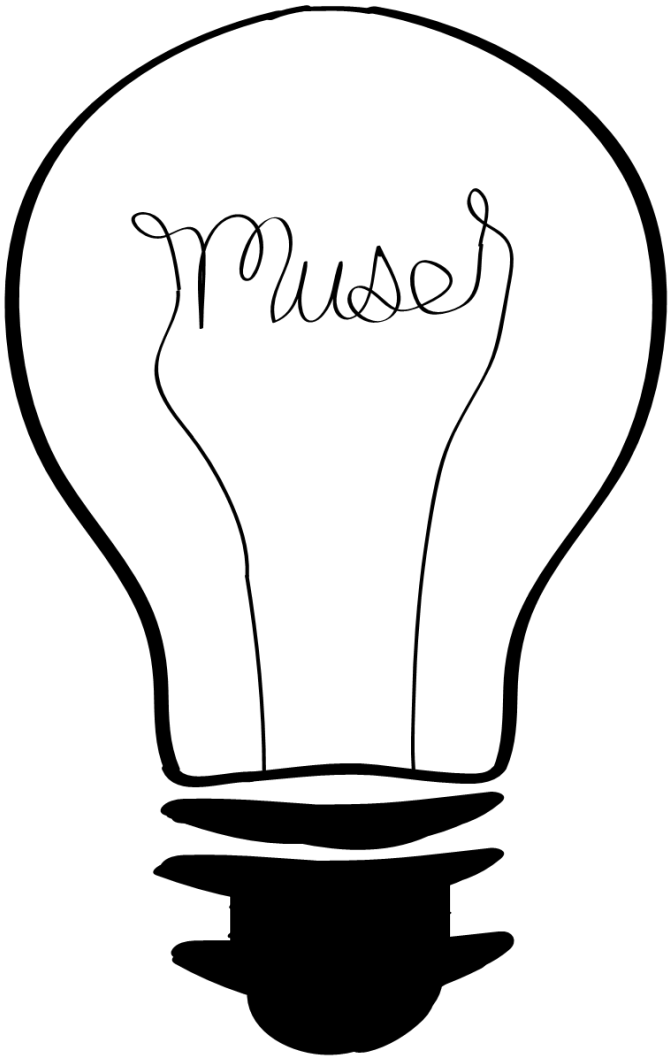
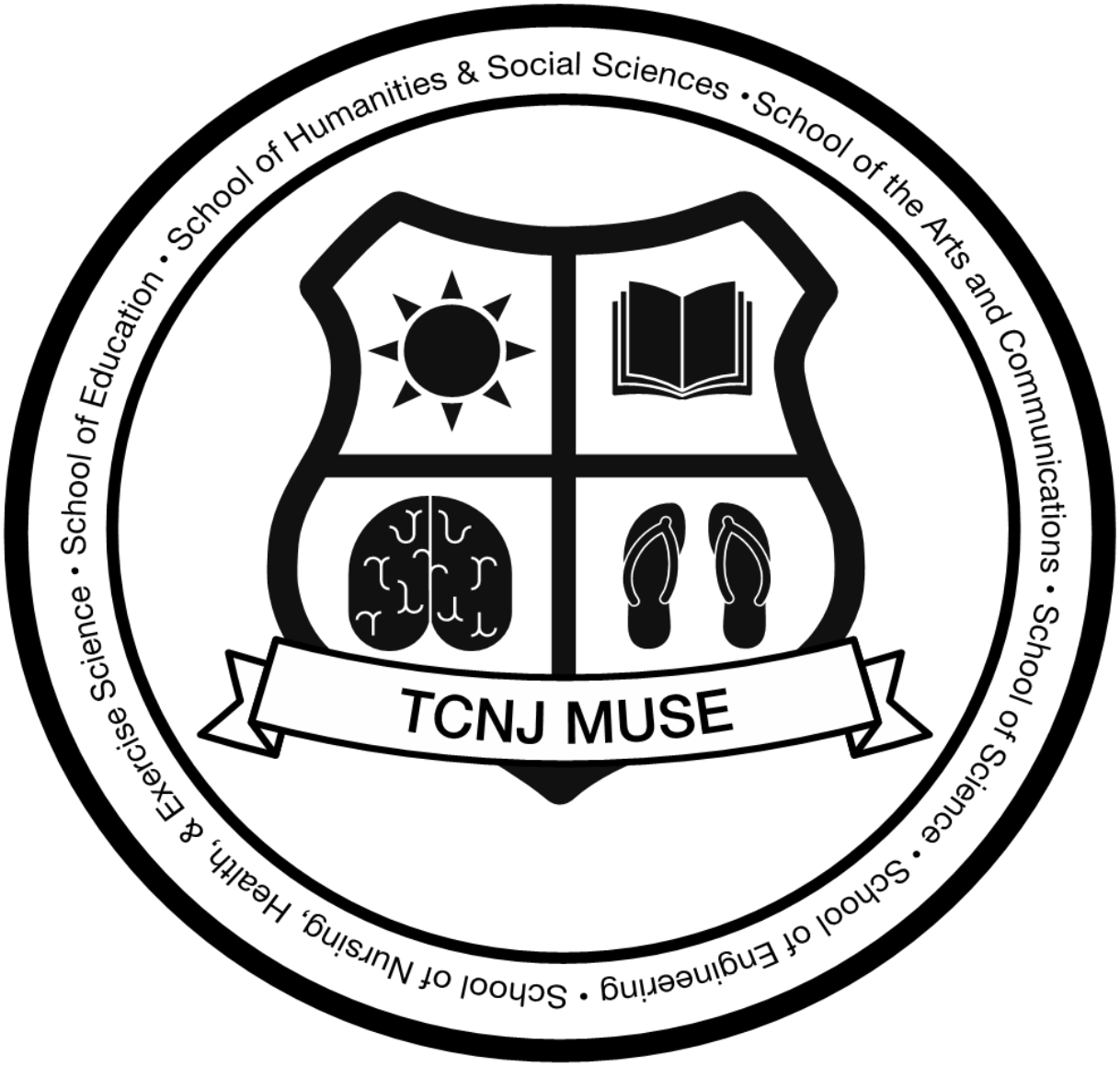


TCNJ
THE COLLEGE OF
NEW JERSEY



MUSE 2015

The College of New Jersey

TCNJ prides itself on the teacher scholar model in which faculty are not only excellent instructors to our students, but also generate new knowledge or creative projects in their disciplines. TCNJ's MUSE (Mentored Undergraduate Summer Experience) Program is the embodiment of the teacher scholar model by fully integrating faculty scholarship/creative projects with student learning and training. The 2015 MUSE program brought together 42 faculty members and 76 students from across campus over the course of 8 weeks in the summer during which faculty mentors created a transformative educational experience for students while pushing their own scholarly agendas forward.

The key to the success of MUSE is that students study at the cutting edge of their faculty member's discipline to generate new knowledge without the confines of student class schedules. Students develop the scholarly questions and the processes to answer those questions with their mentor. Students learn the importance of the background and context of their mentor's project while pushing the boundaries of current knowledge. They quickly learn that big scholarly questions must be broken into achievable outcomes by limiting the scope based on their current resources. TCNJ's MUSE students are ready to continue to tackle world problems through their disciplines by taking smaller steps towards the overall goal.

This training to think like a scholar is important to the future workforce. These skills are critical to the workforce so that MUSE students can become leaders and problem-solvers in their careers. The MUSE students learn excellent resilience and alternate strategies when projects do not proceed as planned. Students solve problems where the solution may never have been available before and many find out they may be the only person to ever try to solve this problem. Graduates will be ready to solve critical problems in their careers because they have already tried to solve a major scholarly or creative problem.

This strategic priority to enrich our scholarly community on campus could not have been done without the financial and personnel support of many groups and people. The Director and all the students and faculty of MUSE thank the Office of Academic Affairs with leadership from Provost Jaqueline Taylor and Associate Provost Kit Murphy and invaluable administrative support from Norma Garza and Ann Guarnaccia and student program assistants Will McDermott and Lea Palacios. We thank the Offices of Residential Education and Housing, Conferences and Meeting Services, Catering Services, Finance and Business Services, and every School and Department office and Chair with MUSE students for their administrative support. We thank the Faculty Student Collaboration Program Council for guiding the vision of MUSE, reviewing proposals and recommending funding: Annie Nicolosi, Donka Mirtcheva, Jerry Petroff, Carol Wells, Karen Yang, Angela Sgroi, Susan Ryan, and FSCPC Chair Curt Elderkin.

The development of our students would not be possible without the generous support of TCNJ and external organizations. We would like to thank the following organizations: Bristol-Myers Squibb, The National Science Foundation, Research Corporation for Scientific Advancement, Petroleum Research Fund, National Library of Medicine, TCNJ Academic Affairs, TCNJ Foundation, TCNJ School of Science, TCNJ School of Engineering. The support of these organizations

Dr. Jaret Crawford & Dr. Benny Chan, Co-Directors

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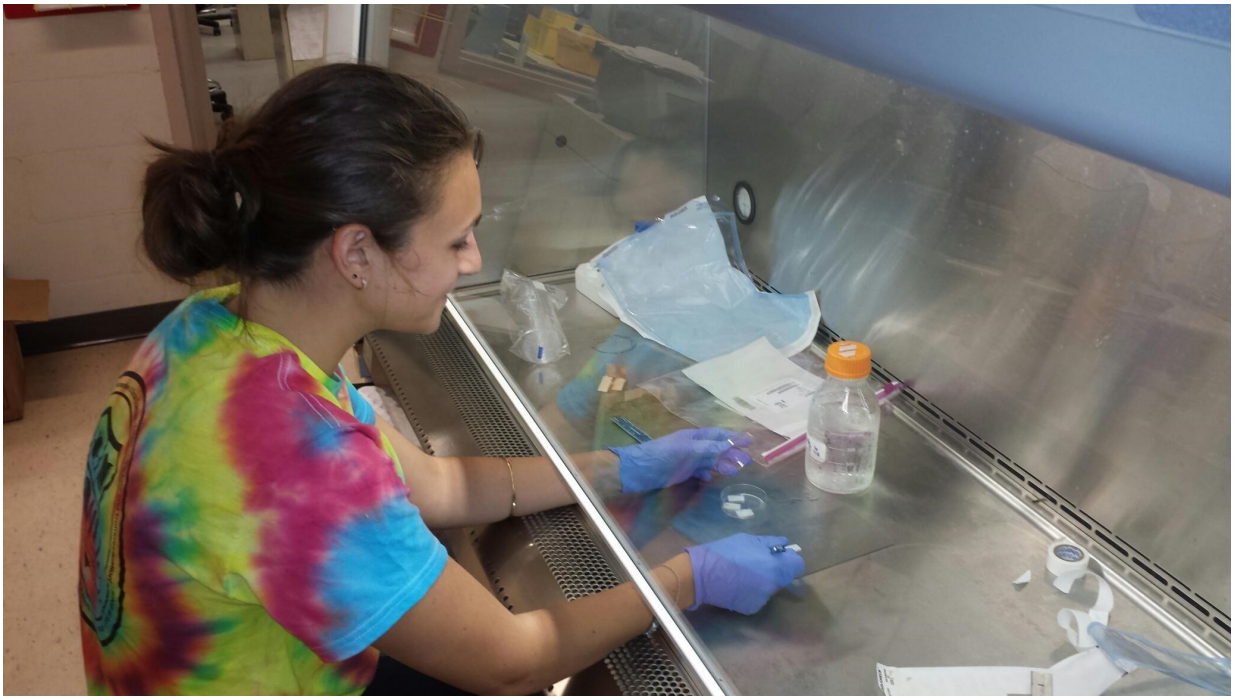

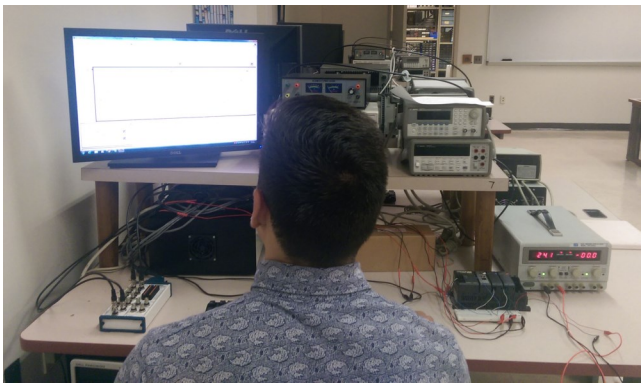

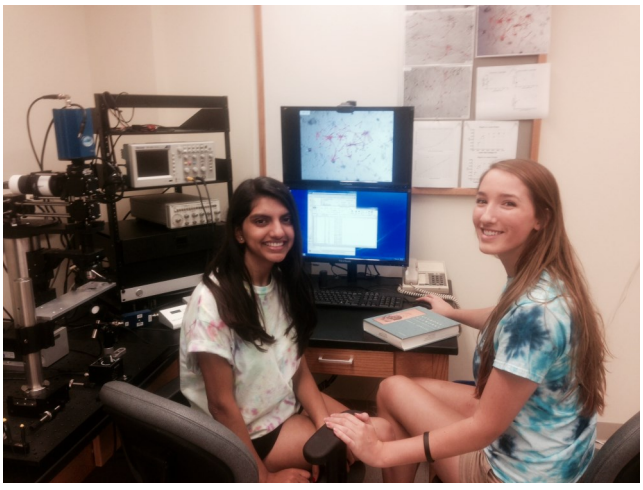

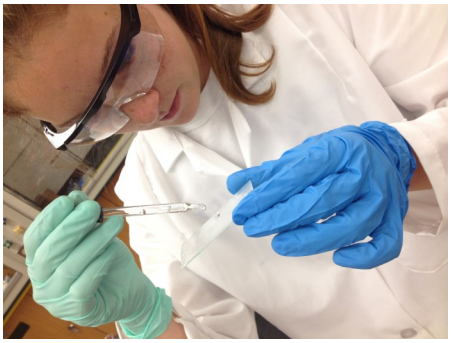

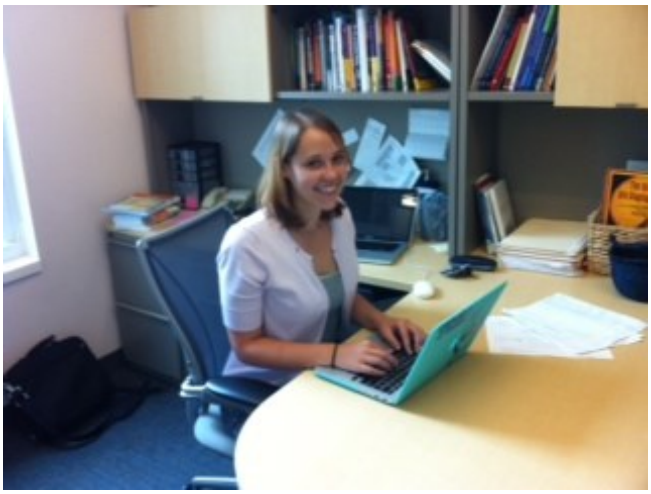

Ortler Kettles 1&2, Ortler Mountain Range, and Experimentation with Lazer Cutter

Amanda Intili
Jessica Hargwood
Faculty Mentor: Elizabeth Mackie (Art and Art History)

2015 MUSE Project

The Ortler Mountain Range is a continuation of another MUSE project that started in 2008. This project is split into three different works. In the first work, the students and mentor will be producing handmade paper in preparation for a large sculptural book installation. The final piece will be expressing concern for the Ortler Mountain range in Italy due to the effects of global warming. Using white and red paper, patterns are created from the shapes of kettles, holes from melting glaciers, forming on the mountains.
In the second work, the MUSE team will be making a second edition of one of Elizabeth Mackie's original handmade books. The accordion styled book explored the hundred year history of glacier retreat on King Ortler, Sulden, Italy.
The last work includes the production of lazer cut books experimenting with images of rice and hair. The group will be creating handmade paper for the projects and exploring the effect of burning images with the lazer cutter. This project includes the production of an alternative book structure, reaching approximately 20 ft long.

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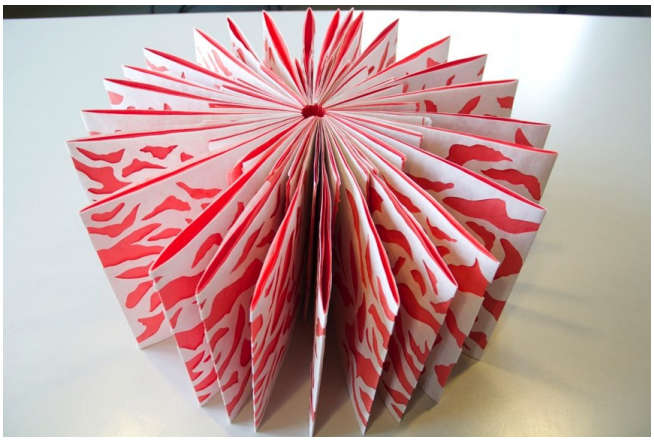
Project Statement

As with the other projects, this piece explores the kettle formations on the Ortler Mountain Range. After creating a scale model, the composition of the first handmade paper was not strong enough to sustain the book structure. Therefore, the project will focus on paper strength experimentation.



Roman Provincial Portraiture

Shannon Kelly
Faculty Mentor: Professor Lee Ann Riccardi

The ultimate goal of this project is to determine when and where provincial coinage deviated from the official currency minted in Rome. This will be achieved by analyzing the imperial portraitures on 3rd century coins from Roman provinces in Greece and Asia Minor. By analyzing the imperial portraitures, we are hoping to find the circumstances that may have led artists from these areas to either intentionally or unintentionally differ. The project involves identifying and sorting through known dies and grouping coins together determining if they could realistically be based on the same image of an emperor or imperial family member; essentially finding and comparing visual archetypes.

Shannon Kelly—Personal Statement

I've learned and practiced the methods used to determine die links and now have experience with a large research project with many sources and specimens that requires both extreme attention to detail and organization.

Documentary
Nicole York
Faculty Mentor: Dr. Susan Ryan (Department of Communications Studies)

2015 MUSE Project

This project extends and refines material that was produced during earlier projects related to performing arts education in Trenton. This project allows us to work closely with David Lee White, the director of community outreach at Passage Theatre, to make a documentary that reflects his previous work integrating theater into school programs while exploring a current project related to the history of Trenton High School. Arts education can have a powerful impact on academic achievement particularly among students from lower socioeconomic backgrounds. Performing arts, like theater, improve literacy and oral communication skills that transfer into other academic areas.

The following questions will animate the interviewing, shooting, and overall shaping of the documentary. How long lasting are the literary and oral improvements and how difficult is it to negotiate the many factors that complicate students' lives? This question plays a pivotal role in cities, such as Trenton where more than 25% of the population live below poverty. Since few students will go on to become professional performers, how do the skills, discipline, and emphasis on creativity influence their character development? How do the educators themselves relate to the successes, and failures of programs that cannot always reach students in the way that they envision?

Nicole York—Personal Statement
I am collaborating with Dr. Ryan on the research and preliminary shooting of a documentary on the long-term impact of theater and arts education on Trenton-area youth.

School of Humanities & Social Sciences

Social Support Systems for English Language Learners &Trenton Youth Voices Project
Destiny De La Rosa
Faculty Mentor: Dr. Stuart Roe (Counseling Education)

2015 MUSE Project

The first project focuses on examining social support systems for English Language Learners in the public school system with a special emphasis on Spanish speaking learners. Interviews will be conducted in both Spanish and English for later transcription and analysis. In addition, a literature review regarding supporting English Language Learners will also be developed.

For the Trenton Youth Voices project, we will be conducting focus groups with age groups to gather the opinion of Trenton adolescents regarding ways to improve opportunities for city youth, ages 12-22.

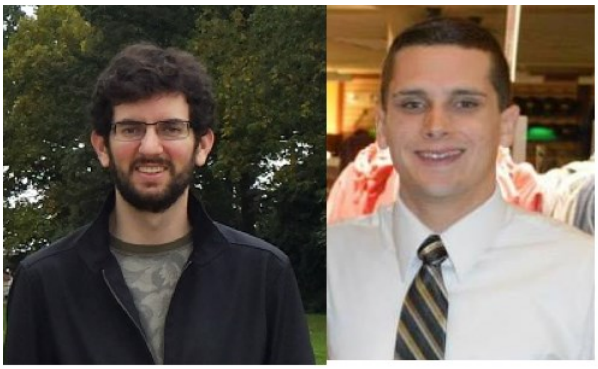
The Impact of Street Geocoding on Crime Hot Spot Prediction
David Summerton
Faculty Mentor: Professor David Mazeika (Criminology)

2015 MUSE Project

This project documents the accuracy of competing methods criminal justice agencies and researchers geocode crime data. Geocoding is the process by which criminal incidents such as murder and robbery are given a spatial reference in the form of an x/y coordinate, and mapped and analyzed. Being able to accurately geocode crime data allows practitioners and researchers to predict where crime will occur in the future, identify the home of suspected serial

offenders, target reentry services for returning citizens, and other important public policy problems.

Currently, most juvenile and criminal justice agencies rely on street geocoding, a method by which addresses are assigned an x/y coordinate based on where they are expected to fall along a street segment. One of the main drawbacks of this approach is the routine's interpolation procedure, which often leads to imprecise spatial references. One competing methodology is to create unique address parcels for an entire jurisdiction, and geocode each crime to this polygon's centroid. The benefit of this approach is that specific property boundaries can be used to determine the location of the incident. By comparing these two methods, this project assesses the impact inaccurate street geocoding methods have on the prediction of crime hot spots—micro locations, often not much larger than a few street segments, that contain a disproportionate amount of crime.



Borderline Citizens: The United States, Puerto Rico, the Politics of Colonial Law and Migration, 1898-1948
Steven P. Rodriguez
Faculty Mentor: Dr. Robert McGreevey (History)

2015 MUSE Project

This MUSE project focuses on editing Dr. McGreevey's book manuscript titled Borderline Citizens: The United States, Puerto Rico, and the Politics of Colonial Law and Migration, 1898-1948. The project focuses on processing primary sources that Dr. McGreevey acquired from archives in Puerto Rico, which involves extracting relevant quotes and providing an accompanying translation.

Steven P. Rodriguez—Personal Statement

In addition to this work, I am conducting research for my senior honors history capstone, which mainly draws on the archives available at the Princeton Firestone library and a collection of documents I acquired at the Archivo General de la Administration in Alcalá de Henares, Spain.

Dirham Hoards from Medieval Western Eurasia, c. 700-c. 1100
Kevin Moncayo
Conor Reid
Faculty Mentor: Professor Roman K. Kovalev (History)

2015 MUSE Project

This project involves directly working with Professor Kovalev to complete his decade long research on– the catalog entitled Dirham Hoards from Medieval Western Eurasia, c. 700-c. 1100. Many of the key interrelations in medieval western Eurasia can best be understood by examining the hoards of Islamic silver coins or dirhams from this period. The dirham was comparable to the modern US dollar during the early Middle Ages and was the single most important coin in western Eurasia. As historical sources, dirhams are far superior to the contemporary coins of Christian Europe, because each dirham, unless worn or poorly struck, bears the name of the ruler, mint, and year of issue. Consequently, when dirhams appear in Sweden, it can easily be determined who issued them, in what cities, and at which time. While some of the dirhams discovered were obtained and deposited as Viking booty or tax payments, the vast majority where the product of commerce. Finds of dirhams thus provide unique data about trade relationships in medieval western Eurasia. The great tenth-century commerce between central Asia and European Russia as well as the trade ties between Rus-

sia and Scandinavia in the Viking Age can be reconstructed using these dirhams. The dirhams found in Sweden or Poland can lead to understanding political changes in the Near East and to measure the output of Islamic mints.

The major obstacle to using dirham hoards as a source for the history of western Eurasia has been the lack of a single, comprehensive catalog describing all the hoards deposited throughout all of western Eurasia. To remedy the situation, Professor Kovalev's graduate school advisor and mentor, the late Th.S. Noonan, began compiling such a catalog in 1975. Professor Kovalev joined him in the project in 1996 and continued adding to it after Noonan's passing in 2001. At the moment, it is nearly complete and contains almost 1700 hoards with the total of half a million coins, arranged in the catalog by hoard name, place find, date find, and the description of the coins by dynasty, ruler, mint, and year. Students can assist by tallying up all of the coins in the hoards, as well as by counting up the numbers per dynasty, per ruler, per mint, and per year. Equally important is to be sure that the almost 200 different mints, hundreds of dynasties and rulers are all properly spelled and organized alphabetically and/or chronologically. The hoards, themselves, also have to be checked for their proper chronological enumeration and listing. On accomplishing the above noted tasks, it will be possible to create a number of detailed and extensive cross-reference indexes, and maps. In the end, working on this catalog will provide valuable first-hand experience and background in conducting numismatic and historical research. But, aside from numismatic research and theory, there will also be exposure to historical geography, early Islamic history, economics, archival work, and cataloging, all invaluable subjects, methods, and experiences for the future.

Popular Protests in Europe

Symone Yancey

Faculty Mentor: Dr. Toloudis (Political Science)

MUSE 2015 Project

This project focuses on how street protests, since 2005, have become both more common in Europe and more inclined to target the European Union (EU), instead of national governments. In Greece, Spain, France, and other countries, ordinary citizens have taken to the streets in increasing numbers, as the fallout from the financial crisis of 2008 and the subsequent sovereign debt crisis continue to percolate. These protests, although they might take place in Athens or Madrid or Paris, are increasingly aimed at the policy-makers in Brussels, where the administrative and legislative heart of the EU is located. What explains variation in the scale and targets of popular protests over time and across different European countries? One answer, to which the news coverage of the financial crisis lends some plausibility, is that protests are responses to the social dislocations wrought by the crisis: unemployment, poverty, and/or curtailing of publically provided benefits and entitlements. Another possibility is that citizens are rejecting what they see as the main cause of the crisis: the EU and, in particular, the single currency (the Euro). The street protests, demonstrations, and riots are not a response to the failings of big banks or corporate capitalism, Dr. Toloudis suggests, but a response to shifting contours of democratic accountability across Europe.

In order to investigate Dr. Toloudis's claim, this project focuses on developing an event dataset which he has been working on since the fall of 2013. This dataset chronicles incidents of popular protest across the European Union from the beginning of 2005 to the end of 2012.

Symone Yancey- Personal Statement

Through this work, I am reading hundreds of newspaper articles on protests across Europe which is greatly expanding my knowledge of the European political system. It has given me a better understanding of what is on the European people's minds and how they feel about their ability to effect a change when needed. Working within the MUSE program has also helped me obtain and refine many other skills. For instance, I now have a better understanding of how the data collection process works, I have had a lot of practice networking through making use of various events hosted by the planning committee, and overall, my time management has been positively affected. It is an honor to be a part of a program that is assisting me in fulfilling my personal curiosity while also aiding me in my future career plans, and I cannot think of a more rewarding and productive way to be spending my summer.

Health Disparities Awareness
Noelle Skrobola
Faculty Mentor: Dr. Barnack Tavlaris (Psychology)

2015 MUSE Project

The purpose of this project is to prepare a professional manuscript on a study about health disparities awareness and beliefs. Health disparities are preventable differences in the burden of disease experienced by disadvantaged groups. Many Americans are unaware that these inequalities exist. Those who are aware of the inequalities often lack an understanding of the factors that cause them. Lack of awareness of social determinants of health may help maintain prejudice or discrimination toward affected groups. One goal of this study was to understand what the public knows and thinks about health disparities and how the public understands factors that contribute to one's health and well-being. A second goal was to understand the individual factors that predict health disparities awareness and beliefs.

Noelle Skrobola- Personal Statement

As a student collaborator I am developing the skills to write a scientific manuscript. With Dr. Barnack Tavlaris's help and feedback in our meetings, I can refine my writing skills which will assist me in the future as I plan to pursue a Ph.D. I will also develop a deeper understanding of data-set, the body of pre-existing literature on the topic, and the potential implications the findings have for psychological theory and public health interventions. Having this publication under review (or maybe even accepted!) will undoubtedly help my graduate school application stand out in this competitive field.

Memory & Aging: The Associative Deficit In Older Adults
Olivia Laura
Faculty Mentor: Dr. Tamra Bireta (Psychology)

MUSE 2015 Project

This project revolves around writing a paper. The paper is based on participant data that has been collected through a previous research study. The study aims to explain when and why older adults tend to display an associative memory deficit - that is, difficulty linking two pieces of information together and remembering them later.

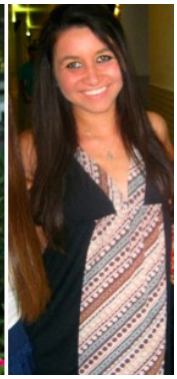
In the study, younger college student participants and older adult participants viewed pairs of words and were asked to recognize the pairs later. Some participants were told to create a sentence that linked the two words together, while others were not. Half of the younger participants saw the word pairs for only 4 seconds each, while the other half , along with the older adults, saw the word pairs for 10 seconds each. The data shows that being provided with a sentence-making strategy helped older adults link information together in order to overcome the associative deficit and allowed them to perform as well as younger adults during the shorter time frame. When the college students had as much time to view the word pairs as the older adults, the associative deficit in older adults remained. Thus, older adults may be able to benefit somewhat from mnemonic strategy use, but may not be able to totally overcome the associative deficit to the point where they perform as well as younger adults given the same resources.

Social Group Categories are Imbued with Ideological Meaning, but Some more than Others

Serena Wasserman
Faculty Mentor: Dr. Jarret Crawford (Psychology)

2015 MUSE Project

The purpose of this project is studying the varying degrees to which certain groups are perceived as being inherently ideological. While some groups, such as whites, blacks, and Catholics, do not carry inherent ideological meaning to any great extent, other groups, such as Atheists, Evangelical Christians, and welfare recipients are perceived to be inherently liberal or conservative even in the absence of an ideological label.



This project examines how the extent to which a group is imbued with ideological meaning affects prejudice toward the group, perceptions of dissimilarity from the group, and willingness to vote for a person belonging to that group. The prediction is that people form attitudes toward unlabeled, inherently ideological groups operating under the assumption that those groups hold their assumed ideological values. Contrastingly, for groups imbued with less ideological meaning, people rely on ideological labels in order to form opinions.

Serena Wasserman- Personal Statement

Through this research I am learning how to write the introduction, methods, and results sections of a scholarly research paper and I have also gained valuable experience working with SPSS, a commonly used software program for data analysis.

Feedback Orientation and GPA

Alexa Migton
Saba Butt
Faculty Mentor: Dr. Dahling (Psychology)

2015 MUSE Project

How does monitoring one's academic performance affect overall GPA? This project involves a study in which participants were asked how they respond to feedback and how frequently they check their grades online in order to determine whether or not these variables affected their overall GPA. The study found that students who responded well to feedback were more likely to monitor their grades using an online learning management system, which in turn resulted in a higher GPA. These findings are consistent with current theory. In addition, the study found that high combined SAT Verbal and Quantitative scores strengthened the relationship between monitoring grades and overall GPA. These results indicate the importance of high cognitive ability in grade improvement strategies.

Alexa Migton & Saba Butt - Personal Statement

Working on this project has given us experience researching theory and working with a statistics program in order to run analyses, analyze data, and report findings.

School of Education

Growing Green Thinkers: Young Children's Concepts of Environmental Sustainability

Jennifer Liang
Faculty Mentor: Dr. Lauren Madden (Elementary and Early Childhood Education)

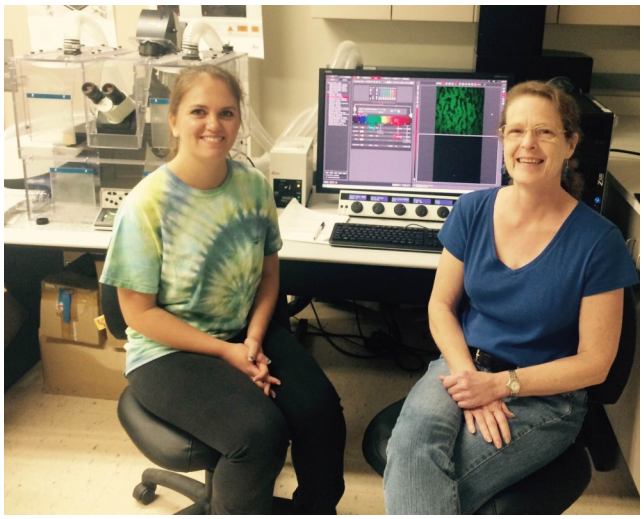
2015 MUSE Project

In order to build a body of competent environmental sustainability educators, it is critical to understand the current ideas and conceptions that young children hold about environmental sustainability. The current literature does not fully paint the picture of what young children know about the environment. This project investigates the question: What are preschool students' initial understandings of environmental sustainability and how do they change after exposure to short term instruction about the environment? This question was investigated a qualitative approach. Three local pre-kindergarten classes at nearby elementary schools were used as study sites. Data was collected using two sources: transcripts from small group discussions with students and student drawings. In the discussions, a semi-structured open-ended format was used to learn more about the students' perspectives. The students were encouraged to speak and draw their responses. These responses were recorded along with a transcript of our conversations. At the conclusion of the discussion, a short activity about trees as habitats was conducted. The project finished with a return trip to the school one week later to have a follow-up conversation using the same format to allow documentation of any changes in students' perspectives.

School of Engineering

The Role of Microparticles in Flow Dependent Thrombosis

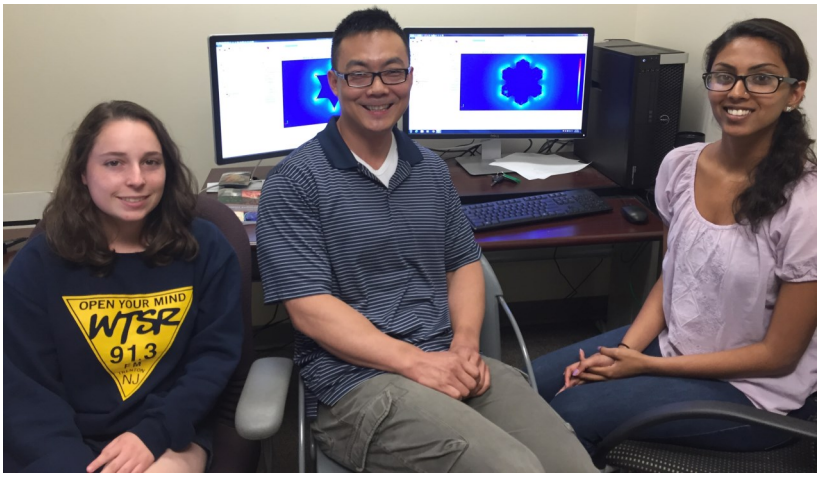
Christine DeZerga
Faculty Mentor: Connie Hall, Ph.D (Biomedical Engineering)



2015 MUSE Abstract

Thrombosis is the formation of a blood clot under pathological conditions and can lead to a heart attack or stroke. This condition may be accelerated by the presence of circulating cell-derived vesicles, termed microparticles (MPs). They adhere along with platelets to the vessel wall to form a clot. Blood flow conditions can differentiate based on a number of variables including the rate of change in velocity and recirculation patterns. Different physiological and pathological flow conditions were studied in order to determine how an increase in circulating MPs can affect the formation of a thrombus. Parallel plate perfusion chambers were used to simulate these flow conditions that represent normal physiological vasculature. The quantity of MPs that deposit at different flow conditions can be used to understand how fluid dynamics and mass transport contribute to their deposition. MPs were derived from a human cell line, combined with whole blood, and perfused over a collagen coated surface. Collagen is present in damaged blood vessels and initiates thrombi formation. MPs were fluorescently labeled orange and platelets labeled green to monitor the deposition of each using confocal microscopy. Three dimensional post-experiment image analysis can be done in the software to quantify volume and surface coverage of the thrombi as well as location of MP and platelet deposition in different fluid dynamic conditions. This information was used to make comparisons and draw conclusions.

Novel Electrode & Recording Electrode
Miriam Meller
Sindhuja Kuchibhatla
Faculty Mentor: Xuefeng Wei, Ph.D (Biomedical Engineering)

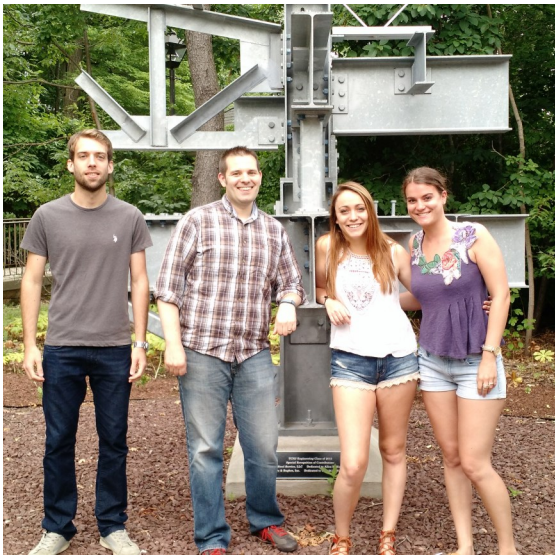


2015 MUSE Project

Surface electrodes are used for epidural spinal cord stimulation and epidural cortical stimulation for treatment of chronic pain and paralysis. This project focuses on developing a novel electrode design that creates a high current density variation on its surface. A high current density variation allows for neurons to be stimulated in the brain with a smaller power requirement, thus reducing patient discomfort and side effects. The surface electrodes are built on Solidworks 2014 and imported into a finite element analysis software called COMSOL Multiphysics. The finite element analysis showed a higher variation in current density distribution on the novel electrodes. Subsequently, the voltage values obtained from COMSOL Multiphysics are used to find neuron threshold potentials with a program called NEURON that simulates neurons firing. These thresholds are analyzed in Matlab to test the hypothesis that the novel electrode design requires less power compared with the original square electrode.

Deep brain stimulation (DBS) is currently used in the treatment of a number of neurological disorders such as Parkinson's disease and essential tremor. Current approaches to the selection of stimulation parameters are a significant clinic burden and often yield sub-optimal outcomes for patients.
This project also works on probing the neural recording properties of these electrodes which would allow clinicians to use feedback from brain signals to customize the electrical stimulation to the patient. This will be done using NEURON, COMSOL Multiphysics and SolidWorks as computational tools for constructing the electrodes, modeling the neuron in the thalamus, and simulating the signals recorded by the electrodes. Recording electrical signal could offer insight into the activity of neurons directly affected by stimulation, and therefore provide a potential feedback signal for the rational selection of stimulus parameters.

Improving Cross-Frame Design to Reduce the Effects of Skew in Steel I-Girder Bridges
Alyssa DeSimone
Goedele Van Landegem
Alexandre Deichmann
Faculty Mentor: Andrew Bechtel, Ph.D (Civil Engineering)



2015 MUSE Project

Alternative cross-frame designs will be analyzed for bridges with 30, 45 and 60-degree skew and compared to a bridge with no skew in the supports. These cross-frame designs are used to reduce the vertical stiffness, which will benefit the bridge design by reducing the skew effects caused by the cross-frames. Skew effects include girder rotation and cross-frame stress. The goal of this project is to determine how the reduction in vertical stiffness affects the secondary roles of cross-frames. The secondary roles include the deck profile, load distribution, redundancy and inelastic behavior. This project involves modeling skewed bridges using the finite element analysis software, Strand 7. The results of this project will be compiled in an article that will be submitted to the Transportation Research Board Annual meeting or the American So-

ciety of Civil Engineers Journal of Bridge Engineering.

Characterizing Bridge Functional Obsolescence Using Congestion Performance Measures Determined From Anonymous Probe Vehicle Data For The State of New Jersey

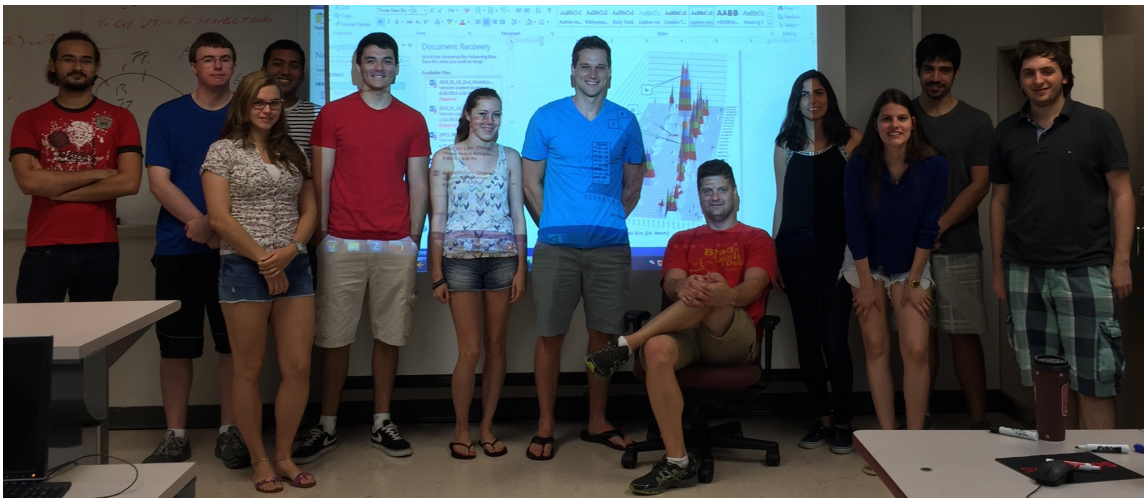
Kevin Gurski
Jessica Ansley
Faculty Mentor: Andrew Bechtel, Ph.D & Dr. Thomas Brennan (Civil Engineering)

2015 MUSE Project

Anonymous probe vehicle data, which is the data collected using telematics from cellular phones and GPS devices, is analyzed to determine congestion occurring on bridges throughout New Jersey. The data is in one-minute increments along various roadway segments. Several computer programs are used to complete the project. QGIS provides us with the ability to create multi layered maps in order to analyze specific locations throughout New Jersey using shape files. Computer codes use MATLAB and SQL software sorted several thousands of records, each with several million points of data into tables which could be easily analyzed to determine the congestion hours of each bridge.

Kevin Gurski & Jessica Ansley - Personal Statement

We learned how to write computer codes in both computer programming software MATLAB and SQL. Working on this project increased our ability to use multiple software programs which allowed us to analyze billions of data records.



Analyzing Young Drivers Crash Data to Measure the Effectiveness of Driving Simulators

Anthony R. Ferrentino
Faculty Mentor: Dr. Thomas Brennan (Civil Engineering)

Anthony Ferrentino– Personal Statement

Performing this project has allowed me to gain many valuable skills that may be of interest to employers. One of the most prominent skills I have gained is the ability to use the QGIS mapping software, an important software in the engineering profession. In addition, I have improved my paper writing skills by participating in this project, as I will be presenting my research to the Transportation Research Board. Finally, I have improved my ability to analyze data and to look for trends, such that I could sift through hundreds of thousands of results in search of results. In conclusion, this project has greatly increased my skills and abilities as a Civil Engineer.

Characterizing Interstate Corridor Groups based on Anonymous Probe Vehicle Data

Vladenir Medonca Carossa
Jéssica Carlos
Faculty Mentor: Dr. Thomas Brennan (Civil Engineering)

2015 MUSE Project

This project consists of the collection and analysis of anonymous probe vehicle data, crash data, weather data, and spatial relationships. The project requires the use of geographic information systems (GIS) software and SQL Data-

bases. Standard transportation principles are applied that can be used to evaluate transportation infrastructure and driver behavior within New Jersey.

Evaluation of archived probe vehicle data to determine costal evacuation due to Hurricane Sandy
Alba Bruna Cintra de Grandi
Lucas Abrantes Ladeira
Faculty Mentor: Dr. Thomas Brennan (Civil Engineering)

2015 MUSE Project

This project aims to analyze the impacts on traffic suffered in major evacuation routes from the coast of New Jersey during Hurricane Sandy in 2012. The purpose of this project is to also establish and analyze comparative data from a particular time interval. A database will be used to collect and store this data.

George Washington Bridge Scandal
Ana Carolina de Castro
Rodolfo Koch Wetter
Faculty Mentor: Dr. Thomas Brennan (Civil Engineering)

2015 MUSE Project

The goal of this project is to analyze the traffic data between September 9th, 2013 and September 13th, 2013 in Fort Lee, at the episode known as George Washington Bridge Closure Scandal. Between these days, two of three lanes from the main exit of the city were closed, causing big traffic jams inside Fort Lee. In this project the impact and full size of this closure will be analyzed.

Performance Analysis Applied to CR-541 from Probe Vehicle Data as TMC and XD
Aurelio de Rezende Teixeira
Joao Pedro de Alencar Costa
Faculty Mentor: Dr. Thomas Brennan (Civil Engineering)

2015 MUSE Project

The main objective of the project is the comparison between two different data sources: TMC and XD. The readings are mainly obtained on route 541 in Burlington County, New Jersey. After obtaining the same readings from these two categories, they are compared to determine which one brings more precise information for the traffic studies around this area.

Both procedures regarding data from TMCs and XDs were similar because the final step was comparison of the data. After the requested data arrived, the programs, changes and graphs by TMC worked under similar conditions as the XD program.

The data requested (between January 1st and June 15 under road 541 limits) were obtained from RITIS. It was posted on a SQL database and configured into the desired shaped. The remaining data was formulated into a table in Excel. This table contained rows for the hours of the day, the congestion hours, and the TMC code shown throughout the months.

Programmable Logic Controller Implementation of Multivariable Algebraic
Zachary Nelson
Faculty Mentor: Dr. Ambrose Adegbege (Electrical & Computer Engineering)

2015 MUSE Project

This research focuses on Programmable Logic Controllers (PLC's) and implementing different algorithms. These can be used to solve multivariable algebraic loops that arise from several optimal control problems. PLCs have the benefit of being able to withstand a variety of harsh environments while maintaining high reliability compared to computers and other controllers. Multiple algorithms will be investigated and compared based on ease of implementation, convergence properties and efficiencies.

Analog Computing for Real-time Model Predictive Control
Richard Levenson
Faculty Mentor: Dr. Ambrose Adegbege (Electrical & Computer Engineering)

2015 MUSE Project

This research focuses on the real-time optimization and implementation of model predictive control using analog electrical networks. Control algorithms modeled by electrical networks can be solved instantaneously and used to control real-time systems such as quadcopters that need to respond quickly to changing environments. The electrical circuit will be implemented on a field programmable analog array, which is a device that contains various circuit components and can be reprogrammed on the fly.

Richard Levenson-Personal Statement
Skills that I will learn over the course of this research are theoretical background on control systems, the design and implementation of electrical neural networks, and the use of AnadigmDesigner2 and LabVIEW software.

Neural-Inspired Analog Circuits for the Economic Dispatch of Power
Amanda Correia
Faculty Mentor: Dr. Ambrose Adegbege (Electrical & Computer Engineering)

2015 MUSE Project

This research focuses on the design of analog circuits for real-time implementation of economic dispatch problem for power system applications. The economic dispatch problem involves the minimization of the cost of power generation while balancing power demand with supply, and incorporating other constraints such as voltage and thermal limits on transmission lines. This is a classic example of a convex optimization problem that have received significant attention in mathematical programming. This research seeks an analog circuit implementation of the economic dispatch problem that emulates neural computing. The neural-inspired circuit will be implemented on a fast programmable analog processor generally referred to as Field Programmable Analog Array (FPAA) from Anadigm.

Wireless ZigBee Network for Home Automation
Julian Daum
Faculty Mentor: Anthony Deese (Electrical & Computer Engineering)

2015 MUSE Project

This research will involve testing and revising a wireless network of prototype sensor boards that communicate via the ZigBee protocol. Modules for sound, motion, and load current detection will also be designed in EAGLE and tested in the larger network. The ultimate goal of the larger project is to allow customers to automate their loads and cooperate with local power utilities in demand response.

Active Noise canceling system
Shubham Tandon
Julie Swift
Faculty Mentor: Larry Pearlstein (Electrical & Computer Engineering)

2015 MUSE Project

The proposed research will address the problem of selective cancellation of amplified environmental sound. An example of the scenario to be addressed is a concert venue or wedding reception where there is loud recorded (or otherwise electronically produced) music for entertainment, but where some of those in attendance desire, or need, to carry on conversation. As most would appreciate this type of scenario is not uncommon, and it is often difficult to hear normal conversational levels in the presence of loud ambient sound. The proposed research aims to apply and extend existing techniques for active noise cancellation, and to combine this with packet-switched wireless digital audio communication. The ultimate goal would be to allow people to conduct a conversation at normal speaking levels.

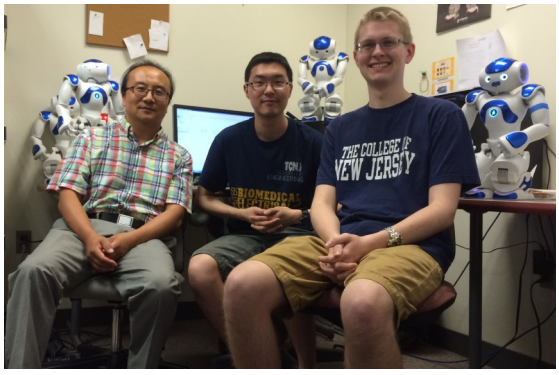
Toward Humanoid Robot Self Awareness Algorithms using Petri net Modeling and Simulation Analyses
Yilin Yang
Daniel Ponsini
Faculty Mentor: Dr. Seung-yun Kim (Electrical & Computer Engineering)

MUSE 2015 Project

Planning, modeling, and executing algorithms for humanoid robots are major challenges in both calculation and logistics. Petri nets (PNs) have been identified as an ideal means of mapping and simulating systems like the aforementioned, distinguished for their intuitive nature as a graphical and mathematical tool. A PN is a formal model of information flow and a weighted, bipartite-directed graph with two types of nodes: places and transitions. At any given time, a place may hold zero or more tokens, representing status of data or resources in a system. Transitions change the state of the PN according to a firing rule. Many researchers have recognized PN's effectiveness and have used it to support verification and simulation of system processes. Graphical representation and self-documented characteristics are the main advantages of using PNs. PN modeling programs HPSim, TINA, and YASPER, have been selected to design and simulate general PNs, TPNs, and FPNs respectively. The use of these programs allows for coordination and specialization among the different sub-types of PNs as various algorithms are graphed and tested. Additionally, the relative simplicity in their visual presentation serves as an aide in conveying the structure of the system to people who are unfamiliar with the internal workings of computers, robotics, artificial intelligence (AI) or Petri nets in general.

Dr. Seung-yun Kim —Personal Statement

Students will gain invaluable skills and hone talents in a wide pool of applications. Use of PNs will exercise graphical modeling, management, and organization skills. These will be used to build algorithms which have great research and writing potential. Together, these will be applied to NAO humanoid robots, which require and foster proficiency in computer programming and electrical mechanics.



Alginate Electrospinning
Brandon Simon
Faculty Mentor: Matthew Cathell (Integrative STEM)

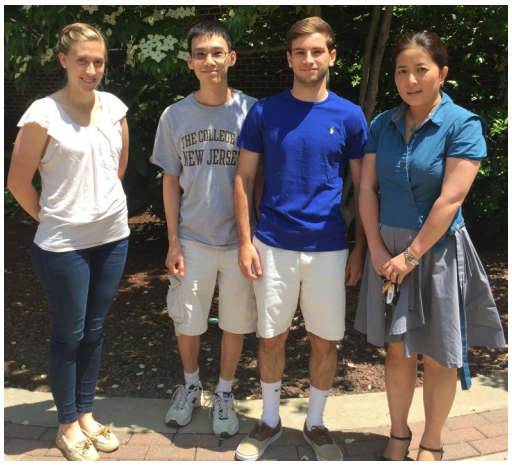
2015 MUSE Project
For several years, Dr. Matthew Cathell and his MUSE collaborators have been working with membranes made of nanofibers of the biopolymer alginate. The practical application of these membranes is the remediation of water that has been contaminated with toxic metals, like lead or mercury. The project bridges several disciplines; our primary focus is in the field of materials engineering, but we make extensive use of facilities and instrumentation in the departments of chemistry and biology.

The nanofiber membranes made in prior years were limited in a key way — they were capable of one-time use only. Once these membranes were used to remove toxic metal ions from water, it was impossible to cleanse those ions from the alginate nanofibers without destroying the nanofibrous structure. This summer, the project focuses on making the membranes more stable and durable by chemically linking the nanofibers together using citric acid. Because of these citric acid crosslinks, the nanofiber membranes can be rinsed and reused for multiple cycles of water purification.

Layered Construction of Microfluidic Devices Embedded with Electrospun Fibers
Chris Civitello
Alison McCarthy
Faculty Mentor: Dr. Karen Chang Yan (Mechanical Engineering)

2015 MUSE Project
This part of the project focuses on continuing to improve the electrospinning process. The current method for constructing a microfluidic device requires depositing agarose gel onto a PDMS polymer base by hand. Another aspect of this project is to automate this process so deposition of the gel can be done consistently with any shape desired. To accomplish this and more a new electrospinning apparatus is being designed and constructed. This apparatus will be a modular design, utilize Arduino and motors to allow for movement of a stage for deposition, and implement co-axial spinning with polymer melt material.

Characterizing Concentration of Macromolecules in Electrospun Fibers Using Image Analysis
Aren Moy
Faculty Mentor: Dr. Karen Chang Yan (Mechanical Engineering)



2015 MUSE Project
Electrospun fibers made of biocompatible material can have molecules incorporated in them. The molecules will diffuse out into the surrounding environment. We will develop a theoretical model of the diffusion in Mathematica and use samples from the new electrospinning apparatus to verify the experimental data. Samples from the apparatus will be imaged using a new confocal microscope and analyzed.

Interdisciplinary

Modeling Transcriptional Reprogramming by Markov Chain Monte Carlo Sampling
Matt Taylor
Prior Models for Statistical Inference from High-Throughput Biological Data
Paloma Hauser
Faculty Mentors: Dr. Michael Ochs (Biology & Mathematics and Statistics)

Matt Taylor- 2015 MUSE Project

Several molecular changes in biological processes and cell signaling pathways typically drive the emergence of cancer and complex diseases. The complexity of these biological processes favors a systems-level approach to the analysis of molecular data. Specifically, a Bayesian Markov Chain Monte Carlo approach has shown promise in terms of inference from high-throughput data; it addresses difficulties associated with underlying probability distributions as well as covariance that exists due to the complexity between signaling pathways and bio-molecules. This approach has been implemented as an algorithm into R/Bioconductor known as CoGAPS.

The project consists of gathering, processing, and analyzing breast cancer tumor sample data from The Cancer Genome Atlas (TCGA). Data from patient samples were collected based on the availability of follow-up clinical data including tumor status and vital status. The molecular data ranging from RNA sequence, methylation, copy number variant, and microRNA data were built into a comprehensive data set of molecular changes for patients with follow-up data. The data will be integrated with knowledge of signaling pathways in breast cancer to build a comprehensive model.

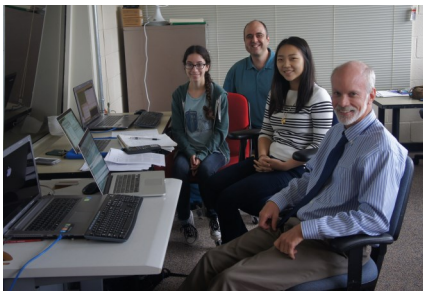
Initially, the gene expression data provided by RNA-sequencing will be run in CoGAPS to infer and detect patterns in the data. These patterns should map to breast cancer subtypes and determine genes expressed in these subtypes. After accounting for subtype, the findings will be linked to clinical follow-up data to determine if certain mutations or molecular changes provide markers of clinical status after removing known cancer subtype effects.

Paloma Hauser- 2015 MUSE Project

Complex diseases such as cancer arise only when multiple biological systems are impacted by molecular changes. These molecular changes lead to alterations in the cellular state, often including reprogramming of gene expression, which typically involves transcriptional regulation. Appropriate modeling of the system is required to recover knowledge of systems-level behavior in many cases because biological systems are inherently complex and nonlinear. CoGAPS is an algorithm that performs Markov chain Monte Carlo (MCMC) simulation on microarray data using knowledge of transcriptional regulation as additional information to refine identification of transcription factor activity. CoGAPS decomposes transcriptomic data matrices into two matrices of lower dimensionality, one which contains the nonorthogonal basis vectors that capture biologically meaningful directions in the data. The algorithm uses non-negativity and sparsity to identify the patterns and the distribution of genes into these patterns that provide the highest a posteriori probabilities.

This project focuses on integration of methylation and copy number change measurements of genes into the statistical inference process. This will contribute to a new MCMC algorithm that will provide a systems-level view of the cell behavior across the conditions or individuals measured and provide novel open-source tools for improved inference on and biomarker identification of transcriptional reprogramming of cells. It will also lay the foundation for full integration of all data types into a comprehensive, systems-level model of biomolecular behavior in cells.

Detecting Calling Male Frogs above the Background Chorus Noise: A Simulation Study
Tiffany Yu
Elisa Idrobo
Faculty Mentors: Dr. Christopher G. Murphy (Biology) and Dr. Dimitris Papamichail (Computer science)



2015 MUSE Project

Using previously recorded data about communication in treefrogs, this research project aims to determine how many males a female from can distinguish. The focus of this project is to see how the number is affected by background noises, the size of the frog chorus, and the threshold for detecting males above the noise.

School of Nursing

Sustainable Elementary School-Based Interventions to Prevent Childhood Obesity- A Literature Review
Christine Castelluber
Brazil Scientific Mobility Program: Ana Clara Crepaldi Trindade
Eudijessica Melo De Oliveira
Larissa Dos Santos Brandeo
Nykolle Malone
Faculty Mentor: Dr. Elizabeth Teixeira (Nursing)

2015 MUSE Project

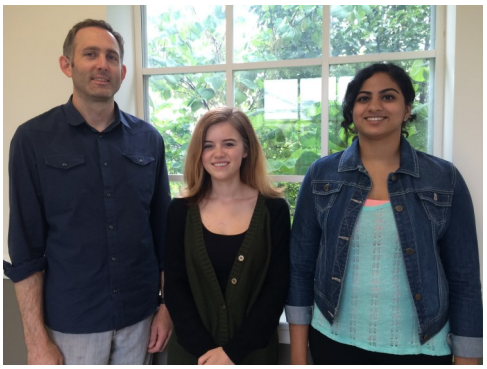
The goal of this project was to conduct and summarize a thorough literature review on school-based interventions in the prevention and management of childhood obesity in preparation for an integrative review for publication. A recent pilot study (SNACK) that involved second graders in the Trenton and Ewing school districts was the impetus for this project. The inclusion criteria for this review includes the following: experimental design or systematic review, school-based intervention that has a nutrition and/or fitness component, control or comparison group, children age 5-15 years, and published between 2010 and 2015.
Childhood obesity is an increasing global public health concern and although many interventional studies exist, there is a great need to explore the sustainability of these efforts in elementary schools.

SNACK (Smart Nutrition and Conditioning for Kids)
Allison Jones
Kevin Scott
Faculty Mentor: Dr. Tracy Perron (Nursing)

2015 MUSE Project

The purpose of the SNACK pilot study was to increase the fitness and health of Children 7-9 years of age in two Mercer County elementary schools. The original study, a collaborative effort between nursing and health and exercise science, provided treatment to an experimental group including Fundimental Integratibe Training (FIT) and health education lessons in fitness, healthy eating and diabetes prevention. The experimental group received these collaborative lessons during the academic year. The students were provided resources needed to live a healthier and more active lifestyle. After the lessons were finished the data was complied and analyzed for statistical significance.

School of Science



Fitness and Feather Quality in White-Throated Sparrows
Preethi Govindarajan
Cecilia Johnson
Faculty Mentor: Dr. Luke K. Butler (Biology)

2015 MUSE Project

Understanding the relationship between feather structure and feather function is central to understanding the lives of birds, and may help better explain the evolution of birds from their dinosaur ancestors. Relatively little is known about how the structure of individual feathers correlates with the health or social status of individual birds. This research project revolves around a lab-based study of relationships between feather quality and individual health and social status in a migratory songbird species. The main goal for this summer is to collect and analyze data from feather samples that were collected during the 2014-15 academic year. The samples were collected from wintering White-throated Sparrows in the field from December to March, along with several health measures (e.g., body mass, fat stores). During this project a spectrophotometer is being used to measure the light-reflecting properties of feathers collected from several positions on each bird. These indices will be compared using a microscope to the structural properties of the feathers themselves, such as the number and arrangement of the feather barbs. This comparison will relate the structural properties of the feathers to their functional properties as visual signals.

Pollen Analysis of the Breadfruits (Artocarpus, Moraceae)
Isabel Distefano,
Faculty Mentor: Dr. Wendy Clement (Biology)

2015 MUSE Project

Artocarpus, or the breadfruits, is a genus of about 60 species of trees and shrubs with a center of diversity in Southeast Asia. Some species of Artocarpus hold anthropological importance, as jackfruit (A. heterophyllus) and breadfruit (A. altillis) are cultivated throughout the tropics for their highly nutritious and sustainable fruit. Genetic and observational data throughout the genus has been limited throughout the years due to difficulties with both the locations and rather large sizes of these plants. Identification and study of Artocarpus pollination syndromes would have important evolutionary implications and economical applications; however, detailed studies of pollination across the genus are largely incomplete. Traditional field based studies are slow and challenging for tall rainforests trees and are currently not feasible to perform on all Artocarpus species within a short timeframe. The morphological characters of pollen can provide insight into pollination mechanism. This project focuses on characterizing the pollen morphology of Artocarpus through microscopy, digital measurement, and statistical analysis of more than ten pollen characters. The variation in Artocarpus pollen is analyzed using descriptive statistics and principle component analysis. This data is compared to empirical pollination studies of a few species to test the predictive power of these characters on pollination syndrome. Ongoing studies of additional Artocarpus species use targeted field studies to confirm predictions made by morphological analysis of the pollen grains.

An expanded species-level phylogeny for Viburnum (Adoxaceae) and its evolutionary implications
Patrick Gallagher
Evolution of Endocarp Morphology and Implications for Seed Dispersal in Viburnum (Adoxaceae)
Theodore Stammer
Faculty Mentor: Dr. Wendy Clement (Biology)

Patrick Gallagher-2015 MUSE Project

Viburnum is a group of woody flowering plants with approximately 165 species. These species primarily occur in temperate forests around the Northern Hemisphere, in tropical and montane regions of Southeast Asia, and in cloud forests in Latin America. Temperate eastern Asia and Latin America are modern centers of Viburnum species diversity,

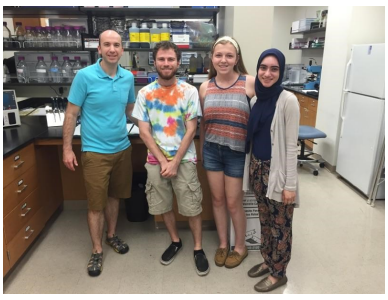
whereas Southeast Asia is the center of phylogenetic diversity. This project was centered around increasing the species sampling of the Viburnum phylogeny, while focusing on questions concerning classification and historical biogeography of the group. Complementing prior phylogenetic studies of Viburnum, species new to the phylogeny were sequenced by sampling nine chloroplast gene regions and the nuclear internal transcribed spacer region (ITS). A maximum likelihood analysis and Bayesian inference was used to reconstruct a phylogeny of Viburnum based on these newly acquired sequence data. It was also used to test hypotheses of taxonomy based on morphology rather than evolutionary history. In addition, analytical methods for studying the historical biogeography of this group were explored, with the intent that identifying the age, geographical origin, and subsequent dispersal patterns of Viburnum can be elucidated with a fully-sampled, species-level phylogeny.

Theodore Stammer– 2015 MUSE Project

Viburnum is a group of approximately 165 shrubs and small trees whose fleshy fruits are typically dispersed by birds. Throughout Viburnum the fruit is a drupe, which is fleshy, indehiscent, and contains a single seed. The endocarp (hard inner wall of the ovary) varies considerably in shape and size, and endocarp characteristics have long been used to identify major subgroups within Viburnum. In this project the variation in endocarps was quantified. The project also involved tracing the evolution of endocarp morphology using a robust Viburnum phylogeny. By comparing endocarp shape and size relative to the volume of the entire fruit, the evolutionary strategies of resource allocation in relation to potential dispersers can be identified. Endocarps from 129 species of Viburnum were sampled from herbarium (A, YU) and field collections. Whole endocarps and cross sections were scanned from camera lucida drawings or obtained using digital microscopy. Digital measurements, including endocarp length, width, height, and cross-sectional area were calculated using ImageJ. Scanned images were then binarized using Photoshop CS5.1 and volumes were calculated by multiplying average cross-sectional area by length. Additionally, Elliptical Fourier analysis was used as implemented in SHAPE and Momocs to study variation in Viburnum endocarp shape. Cases of parallel evolution were identified using the quantitative shape data and ancestral state reconstructions. Many Viburnum clades have endocarps with multiple grooves/undulations, and this appears to represent the ancestral condition for the majority of Viburnum. Two clear instances of parallel evolution was recovered. The Tinus and Oreinotinus subclades have converged on spherical endocarps, while the Lentago and Opulus subclades have converged on flattened endocarps with little grooving.

The Effects of Ocean Acidification and Salinity on the Mechanical and Biochemical Properties of Calcifying Marine Invertebrates

Taliah Khan
Kyle Siegel
Dana Tedesco
Faculty Mentor: Gary H. Dickinson, Ph.D (Biology)



2015 MUSE Project

This research project focuses on investigating the impact of ocean acidification. Ocean acidification is the decreasing pH in the ocean due to increased carbon dioxide concentration in the atmosphere. The project also involves investigating salinity on the adhesion and biomineralization of marine calcifying invertebrates, namely blue crabs and barnacles. Animals, raised in varying treatments of salinity and pH, will have their shells and glues tested for hardness, thickness, and overall growth.

The mechanisms of RNA synthesis and splicing coordination by the NuA4 complex in S. cerevisiae
Alexa Avitto
Faculty Mentor: Dr. Tracy Kress (Biology)

2015 MUSE Project

This project focuses on understanding how the steps of gene expression are coordinated within cells through the use of Saccharomyces cerevisiae (baker's yeast). Cells create RNA from DNA through the process of transcription, and this RNA copy goes on to code for proteins through "translation." Some extraneous chunks of the RNA sequence won't code for proteins. Before the RNA can go through the process of translation, it must first have these unnecessary chunks (called "introns") removed through the process of RNA splicing, which is thought to be coordinated by different protein complexes. RNA splicing is tightly linked to transcription, but the molecular mechanisms that coordinate these two processes are not well understood.

This research concentrates on the NuA4 histone modification complex, which has been shown to be involved in DNA binding and repair, as well as transcription. The hypothesis regarding NuA4's role in coordinating RNA synthesis and splicing will be tested. This work utilizes various biochemical and molecular biological techniques, including the creation and cloning of genetically mutated yeast, and data analysis.

Alexa Avitto— Personal Statement

In addition to laboratory techniques, I will gain experience in scientific collaboration, discussion, and presentation. Collaborative work will be done in the lab with other MUSE students through various experiments. Meanwhile, the Kress lab will hold joint lab meetings with other biology labs, where both our research and current scholarly papers will be discussed. Finally, I will spend time on my oral presentation skills through poster presentations.

Determining the mechanism by which Set2 coordinates RNA splicing with RNA synthesis
Margaret Kennedy
Faculty Mentor: Dr. Tracy Kress (Biology)

2015 MUSE Project

The Kress Lab studies coordination between transcription—which is the creation of mRNA from DNA—and splicing, where parts of the mRNA are removed. The spliced mRNA is then used to direct they synthesis of a protein. This project will involve using yeast as a model organism to determine the relationship between the Set2 protein, a transcription regulatory protein that has been found to promote splicing, and helicase proteins, which help direct the proper assembly of the proteins that carry out splicing. The project focuses on testing whether Set2 interacts with helicases using genetic techniques to measure how the health of the yeast changes when we remove Set2 alone or in combination with removal of the function a helicase. In addition, the changes in the amount of spliced RNA in these mutants will be measured. Changes in health or RNA splicing efficiency will indicate that Set2 works with the helicase to promote splicing.
Margaret Kennedy—Personal Statement

Throughout the MUSE program, I will be collaborating on some projects with another student in my lab. In addition, our lab will have bi-weekly lab meetings with another genetics lab, where we will discuss papers and present data. These experiences will allow me to learn important skills that are applicable in my future studies and the work place, such as collaborating on projects with others, data analysis, and presentation skills.

Response of Crab Gill ATPase Gene Expression and Activity to Salinity Change
Gia Pratta
Sam Platt
Michael Wolek
Faculty Mentor: Dr. Donald Lovett (Biology)

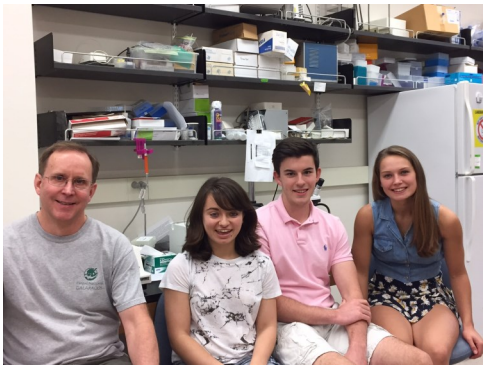
2015 MUSE Project

The green crab Carcinus maenas has adapted to tolerate the continual change in environmental salinity of its

estuarine environment. The crab is a strong osmoregulator that is able to maintain a somewhat constant salt level in its blood, even when faced with fluctuating seawater salinity. In response to exposure to low salinity sea water, the concentration of the putative hormone methyl farnesoate (MF) in the blood increases. MF is produced by the mandibular organs.

The biosynthesis of MF requires multiple enzymes. This project will examine differential expression of the genes of these enzymes in the crab in response to changes in salinity. The genes currently under examination are hydromethylglutaryl-CoA reductase (HMGR) and farnesoic acid O-methyltransferase (FAOMeT). The mRNA will be isolated from the mandibular organs, cDNA will be synthesized from the mRNA , and the relative amount of gene expression for HMGR and FAOMeT will be measured by quantitative real-time PCR.

The enzyme NA+,K+-ATPase (ATPase) functions in the gill tissues in transporting salt from the seawater into the blood stream as part of the osmoregulatory process. In this project, the activity of ATPase in gills will be measured in conjuction with changes in environmental salinity, with the goal of correlating ATPase activity with MF levels.



Group Personal Statement

We will learn the following skills during this project: maintenance of crabs in the laboratory, dissection of tissue, isolation of RNA from tissue specimen, measuring RNA concentration with a Nanodrop spectrophotometer, evaluating quality of RNA with Agilent Bioanalyzer, reverse transcription of mRNA, PCR analysis and gel electrophoresis to test gene-specific primers, quantitative real time PCR analysis to measure relative expression of specific genes, spectrophotometric assay of enzyme activity, measurement of osmotic concentration with a Wescor vapor pressure osmometer, maintenance of detailed laboratory notebook.

The Effects of Deer Herbivory and Invasive Plants on Suburban Forest Community Structure

Ryan Goolic

Cindy Timko

Elizabeth Matthews

Mitch Vaughn

Jen Wells

Faculty Mentor: Janet Morrison (Biology)

2015 MUSE Project

Northeastern suburban forests are highly fragmented and under pressure from overabundant deer and multiple invasive species. Suburban forests are important since they are the repositories of most biodiversity across vast areas and are the main access people have to nature in highly populated areas.

However, this semi-natural matrix and the pressures that form its plant communities are not well understood. This project involves collecting extensive, diverse data from a highly replicated factorial experiment in six suburban forests, in order to investigate the interactive effects of deer and invasive plant species on suburban forest ecology. The treatments in the experiment are additions of Microstegium vimineum (an invasive grass) and Alliaria petiolata (an invasive herb) and deer exclosures. The percent cover of every plant speciesis measured in the plots, along with a range of other environmental variables. This data will be analyzed using structuring equational modeling to understand how the many ecological variables interact to form the forest understory and to determine the causes of the invasive abilities of Microstegium vimineum and Alliaria petiolata.

Localization of Protein May Affect Male Mating
Kate Badecker
Faculty Mentor: Dr. Peel (Biology)

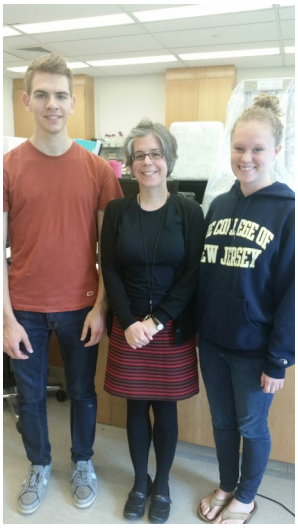
2015 MUSE Project

In this research the posttranslational modification known as glutamylation to microtubules in C. elegans is being studied. Previous research shows that worms lacking the three glutamylating enzymes—TTLL-4, TTLL-11, and TTLL-5—are male-mating defective. It was also found that worms with the protein PKD-2 mislocalized are male-mating defective. These discovers led to the hypothesis that lack of the three glutamylating enzymes may cause mislocalization of PKD-2. In order to test this hypothesis, this project involves creating a mutant strain of C. elegans that is missing three of its glutamylating enzymes (triple mutant) and also contains a GFP marker that tags the protein PKD-2. The purpose of creating this strain is to see whether or not PKD-2 is mislocalized in the triple mutant. If PKD-2 is mislocalized, then three GFP-tagged motor proteins will be crossed—OSM-3, KAP-1, and KLP-6—into the triple mutant to see how their localization and motility differ between that of wild type. Localization of PKD-2 is controlled by KLP-6, and seeing as hyperglutamylation has been shown to alter localization and motility of motor proteins, it is hypothesized that lack of glutamylation (found in the triple mutant) does the same.

Glutamylation May Regulate Microtubule Severing
Tim Salmon
Faculty Mentor: Dr. Peel (Biology)

2015 MUSE Project

This research project focuses on the post-translational modification of a cellular structural component called tubulin by addition of glutamate side chains. These types of modifications are highly conserved, so they likely perform an important role in regulation of cellular processes. This project seeks to answer how cells regulate enzyme and motor function at the substrate-level using glutamylation. During this project, mutant C. elegans will be developed and assays created to characterize them. Results of the project will identify how glutamylation regulates such events as meiosis, microtubule severing, and neuron function.



Tim Salmon—Personal Statement

I am most excited to look at male mating defects in new mutants with a neuronal dysfunction that makes males' tails too numb to recognize potential mates.

Adaptive Plasticity in Three-Spine Stickleback Fish
Nirmiti Borkhetaria
Farsha Rizwan
Faculty Mentor: Dr. Matthew Wund (Biology)

2015 MUSE Project

Adaptive plasticity is a phenomenon in which an individual develops different phenotypes (morphology, physiology, life history and/or behavior) based on the environment it experiences. Through plasticity, different individuals, even if they have the same genotype, will look or act differently if they live in different environments. This research focuses on determining whether or not the plastic, morphological changes, seen previously in three-spine stickleback fish are advantageous in the specific environment that caused the alterations relative to an alternative environment. If so, then phenotypic plasticity in oceanic stickleback may have facilitated their repeated colonization of various freshwater habitats. Furthermore, this research aims to understand whether morphological plasticity is so flexible that stickleback can alter their anatomy if they are switched into a different environment later in life. These developmental changes in

the stickleback population may influence the evolutionary processes of this particular model organism, and imply the presence of related processes in other organismal populations.

Over the course of this research project, marine stickleback fish were raised in two different environments, limnetic (deep lake) or benthic (shallow lake), with the appropriate diet. After several months of living in either one of the two environments, half of the fish were switched to the alternative environment so that they could compete with the fish that stayed at home. The growth rates of all fish will now be measured to understand whether the plastic changes that occurred where advantageous in only the home environment, or in both environments. In addition, to test the hypothesis that plasticity can occur late in development, fish morphologies at different stages of the experiment will be measured. Specific skills employed in this research include fish care, injecting fish with tags (labelling individual fish), euthanizing and preserving fish, staining fish, and analyzing morphological changes in fish body shape and mass.

Hand On The Mirror & Norm The Makishi Mask
Kendall Lee Ciriaco
Allison Zumwalde
Faculty Mentor: Dr. John Allison (Chemistry)

2015 MUSE Project 1:

Fingerprint Analysis is thought to be an important method in forensic science due to their uniqueness to every human. The whorls, arches, and loops on the fingertip of a hand are said to be unique to every individual. What many individuals do not analyze as a method of identifying someone is the uniqueness of a handprint. This project dealt with using a number of chemical techniques to replicate and identify handprints left on a mirror. Handprints are left behind because of the natural oils in the skin produced by glands. These glands interact with the salts produced by sweat glands to leave an oily-based substance on our hands that leaves a handprint with specific ridges when touching objects. When these handprints are exposed to an iodine chamber, superglue chamber which contains cyanoacrylates, or even fingerprint dust, chemicals bind to the oils producing the ridges thus creating an evident handprint. This project also dealt with a specific case which caused us to analyze chemical compounds that would leave a clear handprint and overtime or when exposed to steam will transform into a white powdery substance.

2015 Muse Project 2:

In regions located in the southwest of Africa, rite of passage ceremonies are pivotal in the upbringing of young boys. These ceremonies are traditionally known as Mukanda and occur in the regions of Congo, Angola, and Zambia. Throughout this traditional ceremony, young boys from the ages of 9-13 leave their homes for about 3-5 months to undergo certain processes that will allow them to transform from boys to men. During this time these boys are circumcised, taught discipline, and taught hunting and survival skills necessary to be considered a man. They also took time creating spirit masks known as Makishi masks. These specific masks are considered sacred and are thus burned at the end of the ceremony in which they are used. This project dealt with analyzing an authentic Makishi mask using Infrared Spectroscopy (IR) and Ultraviolet & Visible Spectroscopy (UV/VIS) to analyze the components that make up the mask. After analyzing the components, the instruments were used to analyze the spectra of the best possible matches. From those spectra, we were able to deduce what components made up the sample being analyzed. Thus, we were able to find other products, analyze them using IR and UV/VIS, and find all the products that made up the authentic Makishi masks. As of today, these ceremonies and rituals are slowly disappearing from their culture and the construction of these masks has not yet been defined. With the help of several chemical analysis techniques, we will define the construction of these masks as they will soon be gone.

Computational Modeling and Simulation of the PilT Motor

Aleena Andrews
Faculty Mentor: Dr. Joseph Baker (Chemistry)

2015 MUSE Project

Type IV Pili (T4P) are long protein filaments used by Gram-negative and Gram-positive bacteria in order to adhere to various surfaces. A string of monomer subunits called pilin are combined to make up these long biopolymers. T4P is "sticky", and therefore are used by bacteria to adhere to other surfaces such as host cells during the infection process. The fibers themselves are retracted and extended through membrane proteins in the bacterial cell membrane through the removal or addition of pilin subunits to the fiber. Two different motor proteins in the bacterial cell help assemble and disassemble the fiber by adding or removing the pilin subunits. They are the PilB motor for assembly, and the PilT motor for disassembly. We are currently studying the PilT motor from the organism Pseudomonas aeruginosa.

The PilT motor is an extremely powerful biological motor. The force exerted by the motor during the retraction of a single T4P filament has been measured experimentally to be about 100 picoNewtons. A static structure of the PilT motor protein complex has been solved by x-ray crystallography, however the dynamic structural changes that occur during the exertion of mechanical force and therefore the mechanism of the motor itself is vastly unclear. The goal is to carry out computer simulations of the crystal structure of the PilT motor using a molecular dynamics program called Amber which runs on high-performance graphical processing units. Using this software simulations can be run that use Newton's laws to calculate the motion of hundreds of thousands of atoms over time. Once the the motor is simulated, the data is analyzed using various programs to understand the details of the protein motion and function, providing a deeper insight into the structure/function relationship for PilT than can be obtained from static structures alone.

Modelling and Simulation of Bacterial Membranes in the Presence of Ionic Liquids

Rebeca Saldanha Castro
Faculty Mentor: Dr. Joseph Baker (Chemistry)

2015 MUSE Project:

A significant number of infections are related to the presence of bacterial biofilms. These are "communities" of bacteria that cluster together, offering extra protections to the bacteria that are greater than the defenses of an individual bacterial organism. For example, the formation of bacterial biofilms can lead to enhanced resistance to conventional antibiotics treatments. Therefore, methods to disrupt bacterial biofilm formation are of great importance for human health. One such approach, which recent experiments have demonstrated to be effective against bacterial biofilms in model systems, is the use of ionic liquids.

This project focuses on studying how ionic liquids interact with cell membranes by building computer models of membranes in the presence of ionic liquid molecules. These simulations are being run on high-performance graphical processing units which can be used to simulate systems with hundreds of thousands of atoms very quickly. From the simulation results the project revolves around understanding how ionic liquids disturb the bacterial cell membrane and allow antibiotics to penetrate this membrane at a molecular level of detail. The objective of this research is to understand the fundamental physical processes at play when ionic liquids diffuse into lipid bilayers, and eventually to be able to use molecular models to predict novel ionic liquids that would be most effective at combating bacterial biofilms.

Stabilizing Effect of a Lipid Membrane on Bacterial Pilin

Troy Brier
Faculty Mentor: Dr. Joseph Baker (Chemistry)

2015 MUSE Project:

The project focuses on studying the stabilizing effect of a lipid membrane on various Type IV bacterial pilins. Pilin are small (about 150 amino acids), ladle-shaped proteins that are stored in the bacterial cell membrane before they are assembled into very long (micrometer scale) protein fibers called Type IV pili. These long protein filaments extend from the surface of bacterial cells, and are important to the movement of the bacteria. Additionally, they provide the bacteria with the ability to attach to other surfaces since the filaments are "sticky", including the surface of an infected host organism. Therefore, learning more about these proteins can help in the development of novel ways to combat against bacterial infection.

In order to obtain a molecular scale understanding of the dynamics of pilin proteins in a bacterial membrane, the research will involve using computer modeling and simulation to investigate three separate types of bacterial pilin: the PAK pilin (from Pseudomonas aeurginosa), the GC pilin (from Neisseria gonorrhoeae) and the Type IV pilin from the organism Geobacter sulfurreducens. As tracking the motion and dynamics of an individual pilin subunit in a cell membrane would be extremely challenging experimentally, the project involves using computer models and molecular dynamics simulation to study these biological systems. MD is a technique used to study the motion of systems through the use of computers by perform complicated calculations of the forces between thousands of atoms based on Newton's laws of motion. By knowing the forces on the atoms the resultant motion of the system can be calculated and produce simulations that display how the system changes over time. These simulations are then studied to determine different aspects about the system. The project will look at how often the pilins move around in the membrane, how flexible they are in the membrane compared to in water, how deep the various pilin seep into the membrane bilayer, and what specific interactions pilin subunits make with the lipids that compose the membrane which allow them to remain anchored within the membrane before filament assembly.

Characterizing Novel Peptides as Anti-Thrombosis Agents

Sara Martin
Faculty Mentor: Dr. Danielle Guarracino (Chemistry)

2015 MUSE Project:

This research involves developing a way to synthesize cyclic peptides that would inhibit thrombosis, or blood clot, formation. A thrombus in the body can lead to fatal conditions such as stroke and heart attack. Medications presently used to prevent thrombus formation prevent the liver from making adequate clotting proteins, but do not differentiate between beneficial clots that are formed during wound healing and dangerous clots that can block blood vessels. The peptide being creating would target a mechanism specific to thrombus formation and not significantly influence the body's ability to heal wounds. The Von Willebrand Factor (VWF) is a blood protein that plays a major role in thrombus formation. When it binds to collagen which is in the linings of blood vessels, it induces an aggregation of blood platelets to form a clot in the area. The peptide should compete with VWF for binding collagen, thus preventing the binding of collagen to VWF and a formation of a thrombus. There has already been some success in synthesizing cyclic peptides that competitively bind collagen, but they would not be stable in the body due to a weak bond. The method being using allows for the peptide to be cyclized with a stronger bond. There have been some minor changes made in the amino acids (building blocks of peptides) used to help the compound better dissolve in the body. There are now three variations of the peptide that have been synthesized, purified, and confirmed by mass spectrometry. The peptides will soon be tested with a competition assay to determine to what extent they can competitively bind collagen.

Preparation of Resveratrol Derivatives to Cross the Blood-Brain Barrier
Andrew Glass
Faculty Mentor: Dr. David Hunt (Chemistry)

2015 MUSE Project:
Resveratrol, a compound obtained from the skin of grapes, has been shown to have anti-oxidant properties. This gives it potential to have a wide variety of therapeutic effects for certain diseases. If resveratrol were able to get into the brain, it could potentially be used to treat diseases such as Alzheimer's. However, resveratrol alone cannot pass the blood-brain barrier. In this study, various conjugates of resveratrol will be prepared. These compounds will be submitted for testing to determine their ability to be absorbed and held in the brain.

The Synthesis, Characterization, and Transfer Hydrogenation of Cp*Ir(III)pyridinesulfonamide Cl Complexes
Andrew Ruff
Faculty Mentor: Dr. Abby O'Connor (Chemistry)

2015 MUSE Project:
Although examples of iridium complexes containing diamine ligands that catalyze transfer hydrogenation are known, few examples exist of iridium complexes that contain pyridinesulfonamide ligands, and the catalytic activity of such complexes is limited. Therefore, the O'Connor group is interested in exploring new catalysts for transfer hydrogenation using air and moisture tolerant complexes possessing pyridinesulfonamide ligand scaffolds. The synthesis, characterization, and catalysis of Cp*Ir(III)Cl complexes (Cp* = pentamethylcyclopentadienyl) containing pyridinesulfonamide ligands have been achieved. These complexes are active in hydrogen transfer catalysis, as aryl ketones with electron withdrawing and electron donating substituents are effectively reduced to an alcohol at 85°C (80-90% conversion) with 1 mol% of the iridium precatalyst. The electronic nature of the catalyst plays a role in product yield. This portion of the project includes an expanded substrate scope to include aliphatic ketones and diones, activated and unactivated alkenes, aliphatic and aromatic alkynes, and esters. In addition, the investigation of alternative and more sustainable hydrogen sources will be completed. Lastly, mechanistic studies will be performed to help determine the catalyst resting state and other reaction intermediates to build a catalytic cycle in order to improve catalyst design in a rational manner.

Mechanistic Insights into Catalytic Transfer Hydrogenation using Cp*Ir(III)pyridinesulfonamide Cl Complexes
Tanya Townsend
Faculty Mentor: Dr. Abby O'Connor (Chemistry)

2015 MUSE Project:
Previous work in the O'Connor lab has focused on the development of (Cp*)iridium pyridinesulfonamide chloride complexes (Cp*=pentamethylcyclopentadienyl) to catalyze transfer hydrogenation of a wide variety of substrates containing polarized or activated double bonds. Transfer hydrogenation avoids the use of hydrogen gas under high pressure and the chemoselectivity can be controlled by the type of catalyst. This project focuses on the elucidation of the reaction mechanism via the synthesis and characterization of catalytically competent intermediates. Understanding the mechanism, will allow for the rational design of improved catalysts that yield more product under milder reaction conditions. Additionally, the chemoselectivity can be tailored through catalyst design. In the literature, most active species for transfer hydrogenation involve metal-hydrides. In order to access the reactive metal hydride, a complex with a weakly coordinating anion, such as triflate needs to be prepared. Specifically, Cp*Ir(pyridinesulfonamide)(OTf)

complexes, where OTf = triflate, have been synthesized under inert atmosphere using air-free glovebox and Schlenk techniques. The complex was characterized by 1H and 19F NMR spectroscopy and crystallization of the complex is underway. This precursor will be used to prepare hydride analogs and both sets of complexes will be evaluated for transfer hydrogenation catalysis. Further mechanistic studies to evaluate the need for ligand flexibility will also be conducted by synthesizing complexes with more structurally rigid ligands to study the impact on catalytic conversion.

Maximum Parsimony Advances for Native Phylogenetic Stemmatics
Nathan Gould
Andrew Miller
Faculty Mentor: Dr. Dimitris Papamichail (Computer Science)

2015 MUSE Project:
The goal of textual criticism is to compare different versions of a document and reconstruct the archetype (original), or the document most closely resembling the original version of the work. By comparing differences and similarities among multiple versions of the work it can be determined whether one version is derived from another, and whether two or more versions descend from a hypothetical version that is now lost. The interrelations among the existing versions and the hypothetical versions can be naturally presented as a tree in which a branch represents derivation of a new version. The scholars of textual criticism perform the reconstruction of this tree, called a stemma, based on the historical information of the manuscripts at hand and their insights on how errors and changes are introduced during the process of scribing; i.e., the process of copying a manuscript by hand.

This project involves investigating efficient computational algorithms to find the most compact tree with the maximum parsimonious score, where documents can be placed on leaves as well as internal nodes of the stemma. In doing the phylogenetic tree enumeration and the small Parsimony problem solutions of Fitch and Hartigan are being extended. The placement of restrictions on document relations based on external evidence will be examined and the most parsimonious tree generation under these restrictions investegated.

Synthetic gene library design algorithms and software
Vitor Machado
Faculty Mentor: Dr. Dimitris Papamichail (Computer Science)
2015 MUSE Project:
The goal of this project is to create efficient algorithms and tools that will enable the design of optimized synthetic genes and gene libraries. This research involves designing and implementing algorithms for the construction of protein coding gene variants, controlling for codon utilization, codon pair bias, and mRNA folding energy. The project also involves trying to construct a web-based utility that will allow access to the algorithm and enable life scientists to create their own synthetic gene libraries based on a variety of criteria that affect gene expression and degradation.

Fabrication of birefringent organic thin films
Benjamin Campos
Faculty Mentor: Prof. David McGee (Physics)
2015 MUSE Project:
This project involved working with Erin Cain and Ed Witkowski to study the fabrication of organic thin films consisting of an organic dye molecule in a polymeric host. These films have optical properties advantageous for many applications in image storage and telecommunications. This research involved learning how to properly combine the components, prepare substrates, spin coat, and measure film thickness. Over the course of three days a solution of the organic dye molecule and polymeric host is prepared. On the third day glass substrates are cut, cleaned, and dried overnight for immediate use the next day. The solution is then filtered and added to the substrates in the spin coater where it is distributed across the substrates. The films are baked overnight and their thicknesses and indexes of refraction are

measured the next day using a prism coupler. Films are then sent to the optics lab where their birefringence is measured.

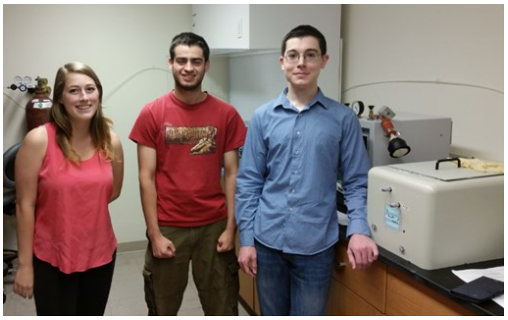
In addition to the fabrication, the project involved working on a new technique to measure their thickness by using the Beer-Lambert law. The prism coupler is a useful and accurate way to measure the thicknesses of films but has some setbacks. Measuring the thickness of films with the prism coupler requires the surface of films to have a good contact with a prism. Acquiring a good contact with the prism may result in damaging the films. Also the process of measuring the thickness of a single film takes a good amount of time. Using the Beer-Lambert law and films of similar concentration and known thickness we generated curves to measure the thickness of films of specific concentrations based off of the transmittance of a low power green laser through the films. Using this method to measure the thickness of films should result in a smaller chance of damaging films in measurement and a shorter measurement time.

Investigating Synchronization in Neuronal Networks

Kelly O'Connor
Krishna Sheth
Faculty Mentor: Tuan Nguyen (Physics)

2015 MUSE Project:

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. The question is - How do oscillators synchronize themselves without following a central conductor? While numerous models have been successful, they have often oversimplify or ignore how the oscillators are connected to each other. Only recently has the issue of connectivity been explored using network science. One significant result is that synchronization emerges when a network begins to display "small-world" network properties, i.e. when the distance between any two nodes is small compared to the size of the network.



Neurons, grown in culture, also exhibit synchronous oscillations known as network bursting and are ideal testing grounds for theories of network synchronization. Initially, embryonic cortical neurons are placed on coverslips completely unconnected. After a few days of wiring themselves, they begin to spontaneously fire action potentials. Bursting begins around day in vitro (DIV) 5-10 and is characterized by nearly all neurons firing together. The size of and time (20–120 seconds) between bursting events depends upon the age, density, and composition of the neuronal culture. Presumably, these parameters play key roles in determining the connectivity of the network. The large uncertainties in connectivity associated with these methods make it difficult to test specific network models with corresponding bursting data.

This project focuses on studying network synchronization in bursting cultured neurons by mapping the connectivity of growing neuronal cultures before and after the onset of network bursting. To obtain an adequate sampling size, many networks will be mapped. Before each mapping experiment, spontaneous activity will be recorded for about ten minutes. After this a neuron located near the center of the FOV will be photostimulated. Images will be taken before and after photostimulation. Neurons that show Ca responses are considered connected to the photostimulated neuron and added to a queue of neurons to be stimulated. In addition, the strength of the connection can also be found by integrating the response. The process continues for each neuron in the queue. In this way, full connectivity maps can be obtained for networks that lie within the FOV.

Neuronal networks, however, consist of connections that are unidirectional and weighted by their synaptic strengths. Network parameters such as degree distribution, path length, and clustering coefficient will all be affected by these modifications.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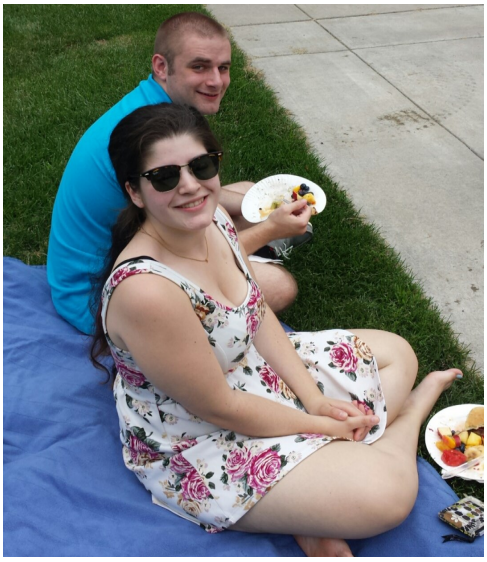

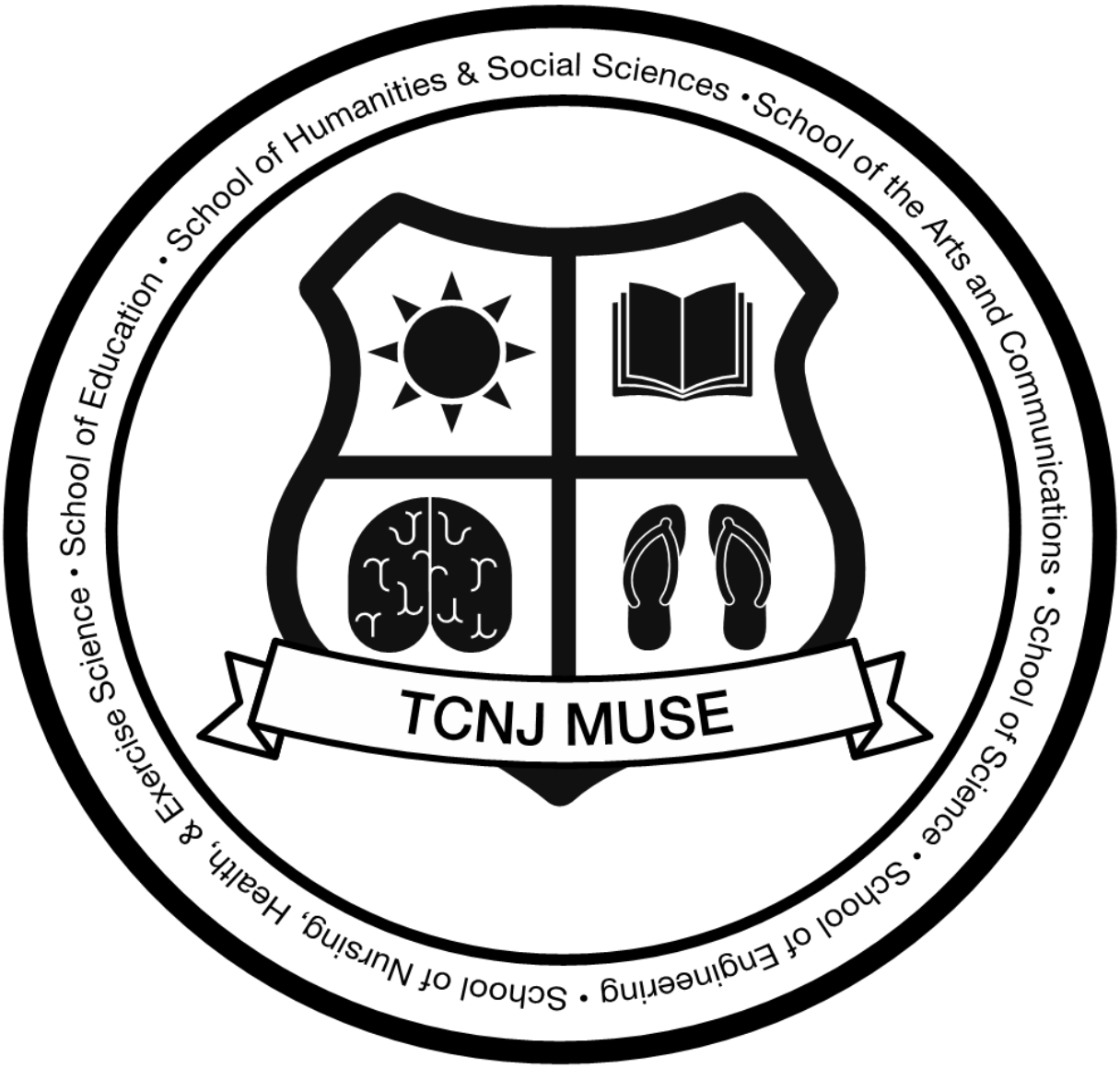
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