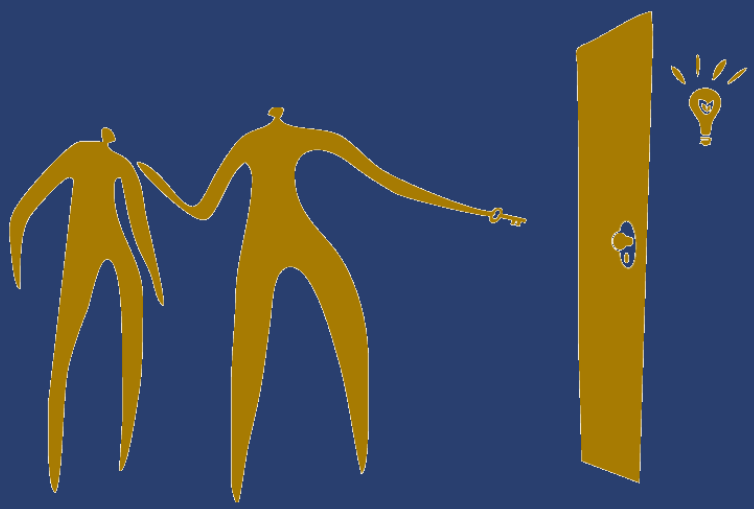
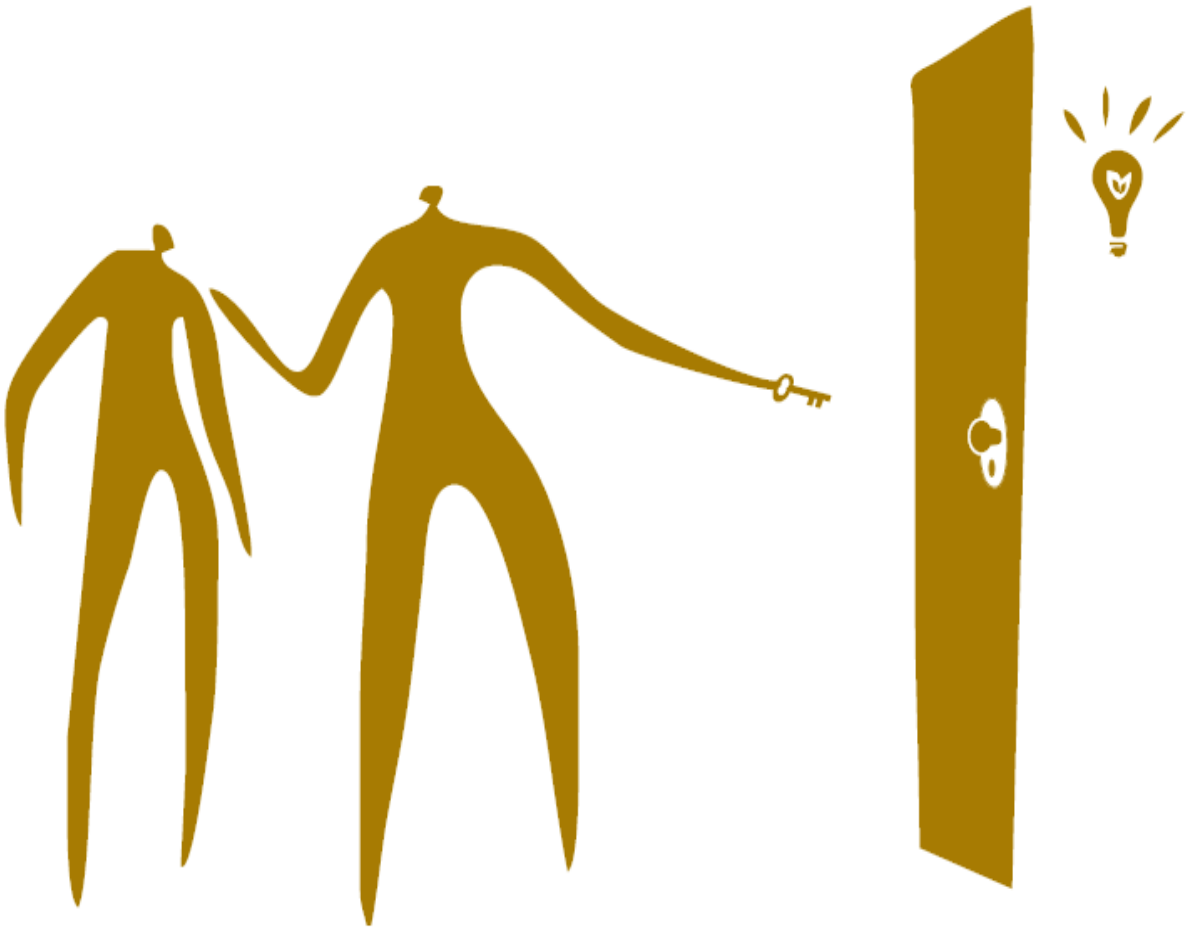
The College of New Jersey

Mentored Undergraduate Summer Experience



2012 Abstracts



MUSE 2012

The College of New Jersey

The College of New Jersey's

Mentored Undergraduate Summer Experience – 2012

TCNJ's MUSE (Mentored Undergraduate Summer Experience) created an interdisciplinary scholarly community for eight weeks over the summer. The program brought together 40 faculty members and 76 students from five schools and 17 Departments.

Students engaged in immersive scholarly or creative projects full time during the eight week program with intensive mentoring and interaction with a faculty mentor. They became junior collaborators to help further the scholarly aspirations of their advisor. We gathered during the summer for Monday lunches to develop student skills on networking and help them understand the graduate school process. Groups of faculty and students were provided weekly bagel breakfasts to allow our students and faculty to have a casual networking gathering with a wide variety of topics to discuss their projects, successes, problems, and discussions on presentation skills. Career Services ran an evening resume writing workshop and pizza party for students. Faculty and Students were involved in social activities together including softball, a bowling night, a trip to Grounds for Sculpture, and an end of MUSE picnic. The students helped to mentor international students from the ESLAS (English as a Second Language American Studies) summer program. Students created their own community through social activities including a beach trip, laser tag, movie discussion nights.

This program 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 Interim Provost Susan Bakewell-Sachs and Interim Vice Provost for Strategic Initiatives and Operations William Behre and invaluable administrative support from Janice Huang and student program assistant Sadia Tahir. 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: Jarret Crawford, James Taylor, Donka Mirtcheva, Dan Chandler, Carol Wells, Paul D'Angelo, Jerry Petroff, and Karen Yan. The program received major financial support from Academic Affairs with supplemental funding from the School of Humanities and Social Sciences (Dean Benjamin Rifkin), School of Engineering (Dean Steve Schreiner). We are thankful to our external funders, Bristol Meyers Squib, National Science Foundation, National Aeronautic and Space Administration, Marshall University School of Medicine, and Garden Club of America.

Finally, we would like to thank Dr. Janet Morrison, immediate past Director. Without her strong leadership to begin this program, we would not have this amazing program that we can continue to expand and to sustain.

Benny C Chan, Ph.D.

Director of Faculty-Student Scholarly and Creative Collaboration Activity and MUSE

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Interdisciplinary: Development of a Conducting Robot

(funded by National Science Foundation award number 0855973)

Laurence Agina, Computer Science
Michael Bauer, Mechanical Engineering
Faculty Mentor: Dr. Andrea Salgian

2012 MUSE Project

The goal of this project is to design, fabricate, and assemble a humanoid robot can conduct an orchestra with a large, varied, and non-predetermined repertoire.

The robot was designed using CAD (Computer Aided Design) software. Both of its arms have four degrees of freedom, each of which was obtained using a servo motor that can rotate 180 degrees and has the required torque. The arms are very modular and consist of pieces of thin aluminum sheets combined with L-brackets and bolts. The robot is controlled by an Arduino Mega and an Arduino Uno controller, which receive signals from a laptop computer and send signals to the servo motors located in the robot arms. Custom circuit boards were designed. The base of the robot has two large motors and four batteries allowing it to move freely on stage.

The musical score is provided in the form of a MIDI file. Information about tempo, dynamics, and cueing is extracted from the file and used to generate the trajectory of the conducting motion. This motion is based on the gestures of Dr. John Leonard from the Department of Music, who was recorded using a Microsoft Kinect camera. Shoulder, elbow and wrist coordinates recorded at 30 frames per second were converted into angles for servo motor rotation using inverse kinematics.

All the programming was done in the Processing programming language.

This robot is based on prototypes designed in the interdisciplinary special topics class on Conducting Robots, and we want to thank all the previous students and faculty that have contributed to this project. As an interdisciplinary project, this robot has allowed students from different backgrounds to work together to create something new and innovative.

Laurence Agina Personal Statement

MUSE has been a unique experience. For the first time in my life, I have had the opportunity to work on a single project during the entire time, allowing me to give it my undivided attention. Additionally, I opted to participate in this program due to my strong interest in the subject, making me more enthusiastic about the work. My time in the MUSE program has been quite enjoyable and also beneficial to me both in the short and long term. The off-campus excursions, social and practical alike, have been both entertaining and educational. The work I have done here this summer will serve as the foundation of my capstone project, allowing me to expand upon and supplement everything I have been working on these last few months. Also, this interdisciplinary project has opened my eyes to the power of combining sciences and arts, giving me a newfound sense of direction for my future career goals. Lastly, this research experience has given me great insight into the typical grad school experience, reinforcing my interest to pursue a PhD.

Michael Bauer Personal Statement

MUSE summer research has been a very challenging and enjoyable experience for me. As an engineer, I have learned a lot about stresses and strains on materials and good engineering practices, but have had little experience working on real projects. MUSE has allowed me to design and create something with my bare hands using the skills that I have learned. I have become more adept at using the school's machine shop, which will help me with my senior project this upcoming year. This project has also allowed me to learn electronic skills that are not normally taught to mechanical engineers, which is my field of study. Working with my partner has been a great experience as he is in the computer science field. In today's world, large projects require people of many different disciplines resulting in people working with others outside their fields. I have learned new things about computer software from my partner that will definitely help me in the future. I hope MUSE continues indefinitely as this experience cannot be taught be in a classroom.

One Dreams it Great

Nicole Thompson, Communications, RTF
Brad Heisler, Communications, RTF
Faculty Mentor: Diane Bates, PHD

2012 MUSE Project

Throughout the summer Dr. Diane Bates lead Brad Heisler and Nicole Thompson during research of the Nicaraguan people, culture, history and the U.S's involvement there. Nicaragua lies between the Pacific Ocean and the Caribbean Sea. With a population of 5,727,707 people it is the second poorest country in the western Hemisphere and the first poorest in Latin America. With the collaboration of social science and filmmaking we have been able to not only gather and analyze this data but capture it as well through the experience of seventeen TCNJ students abroad. These students, traveled to Nicaragua, stayed in homestays, and tackled the issues of homelessness, substandard education, poverty, and abandonment by doing community service for three weeks. Their experience was analyzed through pre-interviews and post surveys. With this film we hope to educate people on Nicaragua, the issues that affect it, and evaluate the Bonner's program, which hosted this community service experience.

Nicole Thompson Personal Statement

During the 2012 Mentored Undergraduate Summer Experience I have learned many essential lessons. Our project crossed two disciplines. With the collaboration of social science and communications we were able to use thorough research to create an original documentary focusing on the country Nicaragua and the impact seventeen students had while volunteering in Nicaragua. As the director of this documentary I learned the power of synergy, working side by side with my peer Brad Heisler and mentor, Dr. Diane Bates. I also learned the importance of research and organization to a project. It isn't very common for social science and filmmaking to cross, but it is without doubt that these two fields complimented each other towards the success of our project. MUSE has given my partner and I a wonderful opportunity to take our passion for filmmaking international with the help of the Bonner Center. I am very thankful for this experience and will use the lessons I learned this summer throughout my professional career.

Brad Heisler Personal Statement

Working with the MUSE project this year in collaboration with Professor Diane Bates and Nicole Thompson has been an exciting experience that forced me to work outside of my usual comfort zone, allowing me to grow both as a filmmaker and as a person. The project itself being a documentary presented its own unique challenges, as did working in conjunction with another documentarian and editor, but the differing viewpoints were often refreshing. This collection of people working together on the project brought about a finished product I wouldn't have been able to even imagine producing by myself.

Ortler Mountain Range: Paper, Pigment and Glacier Research

Bryan Borut, Art
Allison Tumminia, Art
Faculty Mentor: Elizabeth Mackie, MFA

2012 MUSE Project

Elizabeth Mackie and her student collaborators, Art Education majors Bryan Borut and Allison Tumminia, concentrated on three projects throughout the duration of MUSE. Initially, they completed *Ortler Mountain Range*, a large-scale paper and light-based installation began and brought near completion during MUSE 2011. Afterwards, they began work on two distinct projects: a site-specific installation project to be featured at Globe Dye Works of Philadelphia, and pigment formula research for improving papermaking methodology.

Ortler Mountain Range is an installation consisting of eighteen sheets of 4'x7' handmade paper, twelve of which were finished during MUSE 2011. The group completed the project by designing and cutting complex patterns into the final six paper sheets.

This summer's main paper-based project focused on pigmenting pulp for handmade paper. Specifically, the goals were to create a more effective pigment formula to result in the desired color of red, improve predictability of pigmentation, and to increase accuracy of color across multiple batches of pulp.

The group spent three days in Rosendale, NY, at Women's Studio Workshop, an art organization that provides facilities and opportunities for arts to pursue creative project. There, the goals were to beat pulp, experiment with pigmentation, and learn how to make sheets of paper with a mold and deckle. Upon returning, the group worked on improving papermaking methods for large-scale white and red paper. Sixteen sheets of white paper and eighteen sheets of red paper were produced for a sculpture.

Simultaneously, the group prepared for "Catagenesis", an exhibition of site-specific installations at Globe Dye Works, a former manufacturing facility in the Frankford section of Philadelphia that bleached and dyed textiles from 1865-2005. Components of the installation include a 13' wedding dress that serves as a projection screen for a video loop of farm animals, illustrating the Globe custom of sending off a bride with "prize" animals to accompany her to her new home. The installation also features a flowing veil that fills the floor of the space, and a sound work mixing wedding reception sounds with a cappella recordings of period wedding songs. Over the course of the summer, both the dress and veil were brought to completion.

Globe Wedding will be shown as part of "Catagenesis" starting in early September and continuing through October 2012.

Bryan Borut – Personal Statement

MUSE has presented a unique opportunity to develop research and experimentation skills. This summer, I explored non-traditional large-scale paper making methods. The project has helped to develop valuable problem solving skills: these are vital when grappling with the adverse circumstances and shortfalls that present themselves when working through a project of this scale. Most importantly, I have learned that process is equally important to the final product. In order to make sheets of paper out of sheets of pulp, hours are devoted to beating, dyeing, washing, spraying and drying. An investment of this nature was something I previously had not considered. Every part of every step is crucial to achieving a suitable final product.

Our stay at Women's Studio Workshop was a valuable experience that presented the options available in an artist community or residency program. Talks about graduate programs and internships provided me with ideas for tangible career paths in the arts. I truly have gained important skills and knowledge that I will take with me in my future endeavors.

Allison Tumminia – Personal Statement

As both an aspiring artist and art educator, being part of MUSE has been an invaluable experience. Through this collaboration, I have learned practical, conceptual, and pedagogical skills. This summer, we found that organizing a schedule and listing weekly goals were the most effective ways to complete each of our projects. During our trip to Women's Studio Workshop, I learned about residency programs and internships, which help artists prepare for graduate school. Within each project, we have tackled unexpected difficulties as a team, building our problem solving and critical thinking skills together.

The knowledge I have gained in papermaking and pigment research will certainly come into the classroom with me this fall. This MUSE project has prepared me for Asian and Western papermaking on both a small and large scale. I look forward to including the processes I have learned in my personal work and in my future lessons. These experiences undoubtedly will benefit my future as both a working artist and an art educator.

Exploring Contemporary Art in Art Education

Matthew Pembleton, Art Education
Gabe Randazzo, Art Education
Faculty Mentor: Dr. Lisa LaJevic

2012 MUSE Project

This project was designed to explore fresh curricular approaches in art education and promote an awareness of contemporary art. Personal experiences in the art classroom and current scholarship suggest many teachers are unfamiliar with contemporary art, and that art education lessons are often outdated and separate from student lives. Recent literature has suggested the importance of incorporating contemporary art in the classroom (Mayer, 2008; Walker, 2001). Often exploring conceptual and social issues, contemporary art investigates interdisciplinary themes that are prevalent in everyday life/culture, and challenges viewers/students to examine worldly issues and formulate their own beliefs. This qualitative research project explored past and current art education curricula, and focused on how contemporary art can be incorporated into the art classroom in order to update art education curriculum into the 21st century. It builds upon research about contemporary art and connects it to effective teaching practices that aim to push the traditional boundaries of art education by promoting student understandings of art, world, and self.

Matthew focused on performance art and the role of the body as the medium in artmaking. He researched Robin Rhode's chalk-drawing street performances and Erwin Wurm's one-minute sculptures. Focusing on reverse graffiti, an ecological reductive artmaking process by removing dirt from a surface, Gabe integrated ecology with artmaking and devised interdisciplinary K-12 lesson ideas. He investigated Moose and related ecological themes. We engaged in historical and theoretical research and conducted an analysis of documents (e.g., journals, books, online databases, websites, artwork). Our research and ideas about updating art education and teaching with contemporary art will be presented at upcoming academic conferences and published as scholarly articles.

Matthew Pembleton-Personal Statement

I consider myself fortunate to be part of MUSE that focuses on a field I am most passionate about- contemporary art education. This research project concludes an ongoing collaboration with Dr. LaJevic on the benefits of incorporating contemporary art and artists into the classroom. Through multiple state and national conference presentations, we have investigated what it means to be a teaching artist in the 21st century. Throughout the summer, I have been able to consolidate my research, integrating performance art in the classroom, through academic writing.

This summer, I have gained a sense of what conducting professional research is like. The development of manuscripts for various art education magazines does not come easily; it requires an incredible amount of independent time management and motivation. With help, I established a means to procure accessible primary source data that can be used to create a relevant and meaningful essay. I hope to utilize these life skills as well as my developed editing and synthesizing abilities within graduate school and the K-12 classroom.

Gabe Randazzo- Personal Statement

The MUSE program has offered me a unique look into the art education curriculum. I've learned how to perform expansive research through multiple sources including books, magazines, and Internet sources. Additionally, I learned how to apply that research and write a literature review on a graduate level. My work with Dr. LaJevic, Matt, and Kelsey has taught me the importance of collaboration, sharing ideas, and constructive criticism. I now feel confident with my writing abilities in a professional setting. I have also learned how to adjust my writing style to fulfill specific publisher's guidelines. The MUSE program has provided me with ability to augment my resume in multiple ways thus allowing me to stand out to future foundations and employers.

The Reception and Rejection of Roman Imperial Portrait Models in the Eastern Provinces, 235-270 CE

Emily Conforto, Art History
Faculty Mentor: Dr. Lee Ann Riccardi

2012 MUSE Project

The focus of this MUSE project was to examine imperial portraiture on Roman provincial coins between the years of 235-270 CE. During this time, the empire faced political turmoil and had many rulers who led for short periods of time. New coins were minted each time a new ruler assumed the throne. Bronze coins were specifically chosen for the study because they were common, and many examples exist. Unlike precious metals, bronze coins were minted in local cities all over the empire. This allowed for thousands of samples to be available for study.

The imperial portrait was a means of propaganda for the empire. The portrait of the emperor in various media was displayed in public places. Therefore, there were strict guidelines to ensure the emperor was portrayed a certain way. The imperial portrait would have distinct characteristics making it immediately recognizable by all citizens. This project studied a variety of portraits on Roman provincial coins, and compared them to the official imperial portrait types. Traditional scholarship often assumes that the image of the emperor in the Roman provinces was highly regulated. However, by examining the portraiture on provincial coins, it becomes evident that most cities did not adhere to the official portrait image. This project therefore disproves the traditional theory by exposing the wide variety of imperial portraiture on provincial coins. Many of the portraits in the provinces barely resemble the official versions. After examining the results of this study, it becomes evident that the guidelines for the imperial portrait were only loosely followed in the many of the Roman provinces and there was far more local input than expected. Another interesting result of this study is that certain cities employed the same artisans to mint their coins, evident through the matching obverses of various coins from different cities.

Emily Conforto Personal Statement

Through my participation in the Mentored Undergraduate Summer Experience Program, I have learned what doing serious art historical research entails, and developed valuable research skills. I also gained valuable knowledge about numismatics, imperial portraiture, and the Roman provinces during the 3rd Century CE. This MUSE project has exposed me to a variety of publications and databases both in The College of New Jersey and the Princeton University Libraries which I would have otherwise not had access to. Working closely with my professor has allowed her to teach me about the process of publication through various art historical journals and publishing companies. Dr. Riccardi has been a mentor, and informed me of the various opportunities in the field of art history after the undergraduate level. Working with Dr. Riccardi on this project has prepared me for the type of research I will be required to do in graduate school, and in the future if I fulfill my goal of becoming a professor of art history.

Pains of Imprisonment With a Focus on LWOP Inmates

Michael Ryder, Criminology
Faculty Mentor: Dr. Margaret E. Leigey

2012 MUSE Project

Throughout this summer, Dr. Margaret E. Leigey and her student collaborator, Michael Ryder, a senior Criminology major, collaborated on an exploratory study examining the "pains of imprisonment" (Sykes, 1958) for life without parole inmates. Using qualitative and quantitative data, the purpose of the study was to determine if differences existed in the perceptions of the most and least difficult aspects of confinement of LWOP inmates as compared to long-term inmates.

Dr. Leigey began the research by sampling eighteen older male LWOP inmates in a Mid-Atlantic State prison. Each inmate was interviewed by Dr. Leigey and presented with twenty problems related to long-term imprisonment. Respondents were asked to rank the frequency, intensity, and dependency of each problem. A variety of non-parametric statistical tests were used to analyze the quantitative data. After Dr. Leigey transcribed all the interviews, she and Michael coded the data and identified common themes related to the difficulties associated with incarceration and the sources of support to cope with them.

The present research replicated two earlier studies by Richards (1978) and Flanagan (1980) using the same problem statement instrument and statistical measures to evaluate the pains of imprisonment. The objective was to discover whether the frustrations inmates experienced had remained similar over time or changed due to an evolving prison culture and/or length of time served by inmates. The findings yielded statistically significant results between the most severe and least severe problems facing inmates in all three studies, suggesting a universality of the pains of imprisonment.

The research paper will be submitted for publication in the *British Journal of Criminology*. The research is believed to contribute to the literature because of the limited knowledge related to the correctional experiences of LWOP inmates. Dr. Leigey and Michael will be presenting their findings at the American Society of Criminology Conference in Chicago this upcoming fall.

Michael Ryder Personal Statement

Working with Dr. Leigey this summer has been a tremendous experience. I will go forward from the MUSE program feeling more confident in my analytical, verbal and writing skills, which will serve me well in my graduate studies. Although my academic abilities have improved, I believe I have learned much more valuable lessons that exceed data input into an SPSS program or drafting a summary. There were many days when Dr. Leigey and I would discuss our next steps in our research via email or personally, and it was these times when I felt myself growing as a student and person. She has taught me a great deal about collaboration and work ethic, two aspects that will be invaluable for me in any challenge I encounter. I would like to thank Dr. Leigey and the MUSE program for helping me further my knowledge in the field of Criminology.

Borderline Citizens: The US, Puerto Rico, and the Politics of Colonial Law and Migration, 1898-1948

Eulogio Kyle Romero, History
Faculty Mentor: Dr. Robert McGreevey

2012 MUSE Abstract

During the summer of 2012, I worked under the direction of Dr. Robert McGreevey of the History department. Our MUSE project focused around revising Dr. McGreevey's book manuscript entitled, *Borderline Citizens: The United States, Puerto Rico, and the Politics of Colonial Law and Migration, 1898-1948*. Dr. McGreevey's book is one of the first to examine the historical relationship between U.S. foreign policy and immigration, two traditionally distinct fields of inquiry. Based on archival research in Puerto Rico and the United States, *Borderline Citizens* is intended to bridge the subfields of U.S. and Latin American history as well as contributing to emerging scholarship on the history of the United States in the World.

My day to day work consisted of locating, analyzing, and annotating relevant pieces of secondary material, including both books and articles. As Dr. McGreevey had already applied nearly all relevant secondary material on Puerto

Rico towards the construction of his manuscript, much of the material I analyzed focused on parallel narratives to the history of Puerto Rican immigration; including Native American, Mexican, and Caribbean histories, as well as more broad historical analyses of immigration policy, both foreign and domestic. Dr. McGreevey would then utilize my annotations as a means to decide which secondary sources could contribute to, or contradict, his arguments in *Borderline Citizens*. The majority of the secondary material was located online or at either the TCNJ or Princeton libraries.

In addition, I was also tasked with tracking down pertinent primary material. For the most part this type of primary research was conducted through Princeton University's massive collection of newspaper archives. Containing dozens of different publications, many dating back over 100 years, Princeton's newspaper archive was a vastly helpful source of material. Both the primary and secondary material I analyzed were an enormously helpful resource in contributing to the finalization of Dr. McGreevey's manuscript.

Eulogio Kyle Romero Personal Statement

The Mentored Undergraduate Summer Experience has given me incalculable benefits in regards to my future career, as I have aspirations of obtaining a PhD in History. Last summer I also participated in the MUSE program, under the direction of Dr. Fisher in the History department, both summers of MUSE work with Dr. McGreevey and Dr. Fisher have given me both valuable work experience to put on my resume as well as a unique insight into the daily workings of academic research.

I have been able to gain firsthand experience in the process of finalizing a manuscript. Whereas in last year's MUSE program I contributed to the initial theorization and construction of a book, with Dr. McGreevey I have been able to observe and contribute to the final step in the process of reviewing and publishing a book. There are few, if any, other programs from which I could have gotten this type of experience; I am truly grateful for the particular opportunities that TCNJ's MUSE program offers.

Political Stereotype Content Along Human Nature and Human Uniqueness Traits and Warmth and Competence Dimensions

Sean Modri, Psychology
Faculty Advisor: Dr. Jarret Crawford

2012 MUSE Project

Our objective was to explore the content of people's stereotypes of liberals and conservatives. Existing research on such political stereotype content lacked a theoretical focus. We therefore examined political stereotype content from the perspective of two recently developed theories of stereotype content: dehumanization theory (DT) and the stereotype content model (SCM). DT posits that groups may be perceived as emotional and open (human nature; HN) or organized and civil (human uniqueness; HU). The SCM states that all stereotypes fall along the dimensions of warmth (how much a group is liked) and competence (how agentic a group is perceived). Based on lay stereotypes of liberals and conservatives, we predicted that liberals would be perceived as possessing more HN than HU, and as more warm than competent, whereas conservatives would be perceived as possessing more HU than HN, and as more competent than warm. We tested these hypotheses using three online surveys of U.S. adults. In Studies 1 and 2, results largely supported the prediction that liberals are perceived as higher in HN than HU, but conservatives as higher in HU than HN. This did not vary by whether the participant was liberal or conservative. Moreover, this did not depend on the type of liberal (e.g., social liberal vs. big government liberal) or conservative (e.g., evangelical conservative vs. economic conservative) people evaluated. In Study 3, liberals evaluated conservatives for HN and HU traits, as well as warmth and competence. Liberals perceived conservatives as higher in HU traits and competence than HN traits and warmth. These results bring theoretical focus on people's beliefs about liberals and conservatives.

Sean Modri's Personal Statement

My work with Dr. Crawford has helped me to understand the realities of doing research. At the beginning of the program, my head was filled with unwavering hopes of finishing four studies and writing a paper – all in eight weeks. After diving head-first into our project, I soon realized the proper mindset for doing these kinds of investigations: hope for the best, but expect the worst. While some of our plans did not go as expected, Dr. Crawford helped me forge ahead with brain-storming sessions and positive criticism. Along with preparing my own research, I enjoyed conversing with other students and discussing our projects at length. I left the Mentored Undergraduate Summer Experience with a new

array of research-related skills, and a desire to pursue this line of work into graduate school.

Interactive Effects of Physical Disability Severity and Age of Onset on RIASEC Self-Efficacies
Rachel Tenenbaum, Psychology
Faculty Mentor: Dr. Jason Dahling

2012 MUSE Project

In this study, we examined the relationship between disability onset, disability severity, and participants' levels of vocational confidence. In particular, we looked at their degree of confidence in completing activities that were Realistic (such as making repairs), Investigative (such as solving math problems), Artistic (such as writing a poem), Social (such as helping others who are upset), Enterprising (such as managing a sales campaign), and Conventional (such as keeping records of sales). After collecting data from participants using Amazon Mechanical Turk, we found that age of disability onset moderated the relationship between disability severity and confidence in the Realistic, Artistic, Social, Enterprising, and Conventional vocational domains. Specifically, disability severity had a strong negative impact on the confidence of individuals whose disabilities manifested later in life, while the relationship between disability severity and confidence was not significant for participants who were disabled in early childhood. These results cause us to believe that individuals with a later age of onset may lose confidence in their abilities after becoming disabled. Individuals with early onset disabilities do not experience the same loss of confidence, because they have lived with their disabilities for most (if not all) of their lives.

Rachel Tenenbaum Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) allowed me to further my research abilities. I was able to work firsthand with data collected from participants and learn more about psychological concepts I was not as familiar with. I also learned how to put together surveys on Qualtrics and how to use Amazon Mechanical Turk. Since I studied abroad in the Spring, this Summer program provided me with a great opportunity to jump back in to reading scholarly articles, allowed me to improve my data analysis skills, and gave me a chance to refresh my memory on research processes before beginning my Senior Independent Study in the Fall.

Predictors of Intergroup Anxiety
Iris Chiu, Psychology
Faculty Mentor: Dr. Julie Milligan Hughes

2012 MUSE Project

U.S. society becomes more ethnically diverse every year, making individual experiences of interracial anxiety increasingly common. This summer Dr. Hughes and her student collaborator, Iris Chiu, have researched interracial anxiety and its antecedents. These antecedents of anxiety include: internal and external motivations to respond without prejudice (IMS and EMS; i.e., feeling personally motivated and socially motivated not to show prejudice) as well as ethnic perspective-taking ability (EPTA). According to Quintana's EPTA model (1994), from childhood into adulthood individuals develop through five levels of ethnic perspective-taking, at each level becoming more refined and fluid in intercultural understanding. Hughes and Chiu posited that at different levels of EPTA, people would perceive interethnic interactions with more or less anxiety. Hughes and Chiu also predicted that interethnic anxiety would be highest among those with lower IMS and higher EMS. Data collection was online with adult participants from across the U.S. Results indicated that EPTA was not associated with interethnic anxiety. Perhaps EPTA is less important than individuals' *perceptions* of their intercultural understanding. Hughes and Chiu also found that a combination of high EMS and low IMS predicted the highest level of anxiety. This project is an important venture for the Prejudice and Development Lab, as the lab is looking to conduct interviews with children and adolescents in the Princeton and Trenton area in the future regarding their experiences with interethnic anxiety. Hughes and Chiu plan to submit a research manuscript summarizing these findings to a peer-reviewed journal and to present the findings next spring at the Eastern Psychological Association conference.

Iris Chiu Personal Statement

Working alongside Dr. Hughes on this research on interracial anxiety was a great experience. I gained valuable practice and dispelled some common notions about research. First and foremost, the word "research" brings the adjectives

"boring and tedious" to mind to the masses but I was able to experience firsthand the exciting nature of research, as it comes down to whether or not you enjoy your topic of inquiry. Along with a curiosity for research, patience is another asset that I learned is important for research. As a mentor, Dr. Hughes was always encouraging and eager to hear my opinions and suggestions about our research so working alongside her, I felt the confidence and responsibility necessary of a researcher. Data analyses in SPSS and research-writing skills are additional skills that I have cultivated, which I am looking to keep honing in subsequent semesters. The MUSE Program, I feel, has given me an edge that will help in my application to graduate schools and only ensured me even more of my decision to go to graduate school.

Virtual Freedom Trail Project

Alyssa Fountain, Women & Gender Studies
Shannon Grooms, Women & Gender Studies
Faculty Mentor: Dr. Marla Jaksch

2012 MUSE Project

Throughout the Summer of 2012, Women's and Gender studies majors Alyssa Fountain and Shannon Grooms assisted Dr. Marla Jaksch on a transcontinental research project known as The Virtual Freedom Trail Project: Re-visioning Gender in African Liberation in Tanzania. The students used resources available to them in Tanzania and the United States to compile information that will be consolidated on an interactive website.

The Virtual Freedom Trail focuses on Tanzanian women's roles in liberation movements that span the entire continent of Africa, including Tanzania. The country of Tanzania, located on the east coast of Africa, played a critical role in supporting freedom fighters throughout the continent, yet the roles of women from all walks of life are often un-documented. Tanzania, which recently celebrated 50 years of liberation, is home to many powerful activist women and the Virtual Freedom Trail project intends to share their stories.

Shannon and Alyssa explored the archives at the University of Dar es Salaam library, working with scholars in the East African archives, Gender Library, and International Development Studies department. The students gained access to primary sources and original documents found only in Tanzania and assisted Dr. Jaksch in sifting through the many resources she has collected on her own. They also composed a list of women to be interviewed in the future, often as the result of friendly conversations with local men and women. Their work with Dr. Jaksch will continue throughout the Summer of 2012, as all three women are eager to share the Virtual Freedom Trail Project with their peers worldwide.

Alyssa Fountain Personal Statement

The Mentored Undergraduate Summer Experience has provided me with a unique opportunity to hone my research skills both at home and abroad. My collaborative work with Dr. Marla Jaksch and Shannon Grooms introduced to me a broad range of critical research skills that were applied in Tanzania and the United States. Working with Dr. Jaksch and other professionals in Tanzania provided me with hands on application of participatory action research, encouraging me to respectfully embrace and understand many aspects of African history, Tanzanian culture, and women's roles in African liberation movements. The valuable mentor-mentee relationship I was able to form with Dr. Jaksch has been priceless, as we received the perfect amount of encouragement, guidance and independence. I am infinitely grateful for the opportunity to grow as a scholar and researcher with a diverse group of like-minded peers.

Shannon Grooms Personal Statement

The opportunity to participate in the MUSE Project alongside Dr. Marla Jaksch and Alyssa Fountain in Tanzania this summer was a once in a lifetime experience for me. It furthered my interest in pursuing a higher degree and provided me with the necessary research tools to do so. Not only was I able to gain a deeper understanding of various methods while researching the erasure of women's contributions in Tanzania's Liberation Movement, but I also gained hands on experience interacting with Tanzanian natives and scholars. Having the guidance from a mentor who I respect during this process was an invaluable bonus. Being a non-traditional TCNJ student, I often question my abilities and worthiness working alongside students who have had continuous guidance and who have been submersed in such rigorous academia. Ultimately, I was able to refine my research skills, while simultaneously strengthening my inner self and watching all of my collegiate desires unfold.

Applying Conversation Analysis to interviews with Japanese politicians about the Trans-Pacific Partnership

Russell Wolf,
Faculty Mentor: Holly Didi-Ogren

2012 MUSE Project

In our MUSE project we employed methods from Conversation Analysis (CA) in an analysis of verbal interactions in a 1.5-hour long panel discussion about Japan's participation in the Trans-Pacific Partnership (TPP). The TPP has been extremely controversial in Japan, and we selected the NHK panel discussion partly because of our interest in examining how panelists manage conflict in their verbal interactions. The television program that comprised our data aired on NHK, Japan's main national broadcasting channel, in fall 2011. The five-member panel was comprised of academic experts and members of Japanese Prime Minister Noda's cabinet.

Conversation Analysis (CA) is an approach to the study of natural conversation with a focus on turn-taking (e.g., how speaking turns shift from person to person), constructing sequences of utterances across turns (e.g., how a person's argument might change or develop over the course of several utterances in response to input from others in the interaction), and identifying and repairing linguistic/interactional problems (e.g., saying the wrong word). CA has been fruitfully applied to the study of interviews, including how participants in interviews create, maintain, and modify stances on a particular topic within an interview. Although most of this research has focused on English, there is a growing body of work on Japanese as well, including interactional patterns in Japanese interviews. Building on previous work done on broadcast interviews and panel discussions using methods from CA, we focused our analysis on turn-taking patterns at points of conflict or disagreement in the program.

As suggested by previous research on broadcast interviews, the moderator plays a key role in facilitating and at times overtly allocating turn-taking among the panelists. For example, at one point the moderator intervened in a discussion between two panelists in order to bring in the perspective of another panelist on a slightly different topic. The moderator thus used his role at times to both allocate turns and to channel the focus of the discussion.

We also examined turn-taking strategies among the panelists themselves, again focusing on points in the interaction where there was disagreement. This aspect of our analysis supported some findings from previous research on turn-taking in Japanese interviews, but added information about turn-taking in a panel discussion setting where there are more people responding to the moderator's questions than in a one-on-one interview.

Paired Peer Placements

Tara Farrell, Elementary Education and Psychology
Jacqueline DeNarie, Early Childhood Education and M/S/T
Faculty Mentors: Dr. Lauren Madden and Dr. Louise Ammentorp

2012 MUSE Project

In the education department at The College of New Jersey, students are partnered for their practicum placements during their sophomore and junior years. Our MUSE study sought to determine the various approaches used by faculty to create partnerships and examine their level of success as viewed by faculty and students.

We began the research process by conducting a literature review of studies that have been conducted in the United States and abroad involving paired peer placements. Our focus was compiling the various benefits and challenges that were discovered during these studies. Our data sources consisted of two surveys and two focus groups. The surveys were distributed online, one was geared toward the education departments' professors and the other was geared toward TCNJ education students. They provided us with both quantitative and qualitative data.

During the two peer lead focus groups, we each took a turn being the moderator and note taker. They ran between forty five minutes and an hour. We were able to gather a great deal of valuable data because the students were able to really elaborate on their thoughts and feelings. We transcribed the audio of the focus groups so we could more easily access the data. The Atlas.ti software allowed us to analyze the qualitative data by coding the main themes that were prevalent throughout the data.

Through our analysis we found many common factors that lead to the success or failure of a partnership. We compiled a list of suggestions for professors to take into consideration when pairing students in the future based off of the data we gathered. This information will help faculty to create and support more successful partnerships in the future. Towards the conclusion of our study, we created a cooperating teacher survey and pilot student questionnaire that can be utilized in future research.

Tara Farrell Personal Statement

The MUSE experience has allowed me to participate in a scholarly and creative program offered by TCNJ. As a junior collaborator assisting two professors on a research project, I was able to further my research skills. Through the process of gathering literature, sending out surveys and composing a research paper, I was able to strengthen my skills in these areas. At the same time, I was able to expand my knowledge and acquire new skills by being introduced to the program Atlas-ti. and conducting peer focus groups. Furthermore, by working closely with a peer and two professors, I was able to strengthen my collaboration, communication and leadership skills. Throughout this process, the four of us worked as a team providing each other with support and constructive feedback. At the same time, I was able to grow professionally in my field by acquiring new knowledge that will be beneficial to me as a future educator.

Jacqueline DeNarie Personal Statement

After participating in the MUSE program this summer, I feel more confident in my research and collaboration abilities. I worked with a partner and had the support of two professors. We truly worked as a team to accomplish everything we did in these last eight weeks. I benefited from receiving input from our professors and working side by side with a partner. In addition to developing my communication and organization skills, I gained valuable experience in running focus groups, transcribing audio tapes, and coding qualitative data. After working on this project I have garnered a larger interest in educational research that will stay with me throughout my career. I hope that the results of our study will help to create better experiences for future students in the School of Education at The College of New Jersey. I know that the knowledge I gained on pairing students will influence my actions as a future educator. Participating in the MUSE program was a meaningful experience that helped me grow as a student and as a person.

A Computational Stochastic Model of the Distributions of Physiological Processes

George E. Banis, Biomedical Engineering
Faculty Mentor: Dr. Brett BuSha

2012 MUSE Project

While conscious, there is a stochastic feature of cardiorespiratory control that is responsible for natural variability, which can be expressed as a distribution of breath-to-breath (BBI) or heartbeat-to-heartbeat intervals (RRI). The integrative nature of the brain imparts memory into this system, where any present BBI or RRI is related to past system behavior. The objective of this research was to design and implement a computer model (SIMOD) that simulates the natural stochastic and integrative behavior of cardiorespiratory activity. Breathing and heart rate data were recorded from 14 human subjects and model probability density functions with 32 bins from the BBI and RRI data were constructed. A sixth order polynomial curve was fit to each of the 28 distributions, and mean curves to describe the sample population-based BBI and RRI distributions were generated. Each distribution was used to generate random BBI and RRI sequences. Cardiorespiratory system memory was quantified for each data set using an autocorrelation function. Memory from two past values of BBI and RRI values were imprinted onto any present BBI or RRI value. Temporal scaling was used as a measure of system memory, and was quantified using detrended fluctuation analysis. After optimization with real data, the SIMOD artificially generated BBI or RRI sequences with a similar pattern in memory, variability, and distribution profile to that of healthy human breathing and heartbeat rhythm. This model would provide a non-invasive method for further understanding of the body's innate control over respiratory function, and can be utilized for other stochastic physiological processes as well.

George Banis Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) program has been a unique opportunity during my academic career. I learned valuable techniques in data analysis and computer programming, and was given new perspectives in systems physiology that I have integrated into my own outlook on the subject. My mentor helped me understand the vastness of the field I am pursuing and gave me great insights regarding how I should approach graduate school and any other type of work that I may become involved. This program has contributed significantly to my research experience while subsequently increasing my attraction to the field I chose to study. Furthermore, I have advanced my logical thinking skills, which I have been able to use As a result, I look forward to furthering my involvement in research in the future to share insight with professionals in the field, while also expanding my knowledge and understanding about the career I have only just begun to explore.

Remote Controlled Three Phase Relays

Tyler Wardlow, Computer Engineering
Faculty Mentor: Dr. Anthony Deese

2012 MUSE Project

The goal of the project was to design and build a wireless three phase relay controller for use in the new Smart Electric Power Systems Laboratory in Armstrong Hall. This device will be an addition to the lab and will provide an increase in capabilities for future experiments and testing. Conceptually this tool opens and closes four different switches, three for the phases and one for grounding, allowing current to flow. The unit is rated for use with the power equipment: 120VAC and 10A. The hardware for the project includes the Arduino UNO microcontroller and high powered relays. The voltage output of the digital pins on the Arduino triggers the relays on and off when desired to do so. Furthermore, a wireless module was added to connect to a wireless router through Wi-Fi (IEEE 802.11b standard) for remote control use. A LabVIEW virtual instrument, better known simply as a VI, was implemented as a user interface by establishing a TCP connection to the Arduino and passing commands to it wirelessly. Basic toggle switches control each of the phase relays and LED indicators provide response feedback from the controller regarding each status.

The device is working as per the original design specifications and has been completed as desired for the end of the MUSE program, but may be further developed to add more functionality which can increase its importance to the lab. Multiple of these units are planned to be built for use within a network. Ideally, smart sensors will be added to monitor power use for integration in a smart power network. A server will be able to control each remote relay and efficiently distribute power amongst the grid. Building the relay was the initial step leading towards future research in the Power

Systems Lab.

Tyler Wardlow Personal Statement

The MUSE program has given me the opportunity to perform research for an increasingly popular topic within my field. I have increased my engineering skills by taking a set list of project requirements and incorporating them into a functional design. Seeing the development of a device for use in the lab from start to finish was a rewarding feeling; the device accomplishes a practical need that can help design future tests and experiments. Through the mentorship of my accompanied professor, Dr. Deese, I was able to work independently while still learning from someone who is an expert in the field. Working with a faculty member also gave me the opportunity to work in a special lab, utilizing all the research resources TCNJ has to offer. I look forward to a career involving research and development and hope to be involved with the lab in future projects.

Effect of Inlet Flow Conditions on Flow Uniformity Within a Fuel Cell Manifold

Manthan Kothari, Mechanical Engineering
Andrew Specian, Mechanical Engineering
Faculty Mentor: Dr. Lisa Grega

2012 MUSE Project

Fuel cells have the potential to become the next leader of renewable energy and have been researched in many areas of science to maximize this potential. Over the summer our lab worked with a scaled up model of a PEM (Proton Exchange Membrane) fuel cell manifold, in which we used PIV (Particle Image Velocimetry) visualization to analyze and quantify the complex flow. This is important, as knowing and regulating flow inside of the manifold allows a stack to be used efficiently. An efficient stack allows the proper amount of fuel to be evenly distributed to each cell so as to avoid cells from starving or burning, which is destructive.

In real world applications the feed for a manifold may have bends, which results in asymmetric and or turbulent flow. Using PIV we recorded and analyzed three inlet pipe conditions; straight, 90 degree bend, and 180 degree bend in multiple planes along the manifold. This was done by seeding the air with tiny oil droplets entering the manifold and using a CCD camera to capture reflected light from a pulsed laser off of the seeded particles in different planar regions. The test section that was observed was 9.5" inches long and each photo capturing session was broken down into four 2.5" wide sections with an 1/8" overlap. Once the raw images were captured, software was used to convert the images into vector files that could be processed to view visual data. The velocity fields of each section were averaged and overlaid to create a full image of the manifold flow field. Additional comparisons of velocity values were created in Excel to provide a more quantitative model. The results revealed that the straight pipe had the most symmetric flow with the highest velocities, the 90-degree pipe bend lower velocities and asymmetric flow, and the 180-degree pipe bend generated the lowest velocities, but a more symmetric flow over the 90 degree scenario.

Andrew Specian Personal Statement

The work I have done at TCNJ through the MUSE program has helped me grow as an engineering student. I have expanded my knowledge of the engineering field, acquired unique technical skills, and gained valuable experience with teamwork and data analysis. Each day in the lab has challenged me to become more motivated, innovative, and organized. I can honestly say I have become more efficient in my work and mature in my approach.

The knowledge I have gained during my time with Dr. Grega and my partner will surely help me make the most of my engineering future. I look forward to using MUSE as a talking point in interviews as well as a highlight in my resume. Additionally, my out of lab interactions have opened new and exciting paths for me. I have talked with professors, my peers and professionals about not only engineering, but different fields of research, graduate school, and life. The connections I have made will surely lay a strong foundation for my personal and professional network.

Manthan Kothari Personal Statement

This summer Andrew Specian and I assisted Dr. Lisa Grega further progress her ongoing research on Flow Distribution in a Fuel Cell manifold. This experience provided a wealth of new knowledge as well as an opportunity to further enhance skills I have learned over the years as an engineering student. I can't say this was the first time I've worked in pairs but I can say that this time around the environment was completely different. There was twice the amount of knowledge gained and twice as many ideas were shared because I worked with a partner. The experience was a valu-

able experience in terms of what experimental research is like. The MUSE experience outside of the lab was just as valuable as I was introduced to new software in addition to new flow visualization equipment. This research experience will be a deciding factor in whether I will go to graduate school or work in the industry first.

Design criteria for preventing friction-induced squeak of Ceramic-on-Ceramic Hip Implants
Mark Sidebottom, Mechanical Engineering
Faculty Mentor: Dr. Manish Paliwal

2012 MUSE Project

Ceramic-on-Ceramic (CoC) bearings are an ideal choice for a total hip replacement because the ceramic bearings long wear life than Metal-on-Metal or Metal-on-Polyethylene bearings. Recently CoC hips have been reported to squeak in 1-10% of the patients. A study by Chevilotte et al. showed that in vitro testing of CoC hip implants material transfer (titanium wear particles as a result from impingement of the femoral stem on the acetabular liner) attributed to squeaking in lubricated conditions. This influences the coupling stiffness property of the hip implant and may cause instability which is a precursor to noise.

An explanted Stryker Trident® CoC hip bearing that had been removed due to squeaking was analyzed visually and by computer simulation. Grey marks on the femoral head of the implant showed material transfer of titanium alloy onto the alumina head. A 3-D computer model of the implant was developed using PRO-E (PTC, MA) and analyzed using ANSYS (ANSYS Inc.,PA). Using modal analysis, the natural frequencies of all the components of the implant were determined. The results from the modal analysis and calculated stiffness and damping coefficients were used in the mathematical two degree-of-freedom (DOF) model to calculate the velocity and position of the two masses in the system. To simulate material transfer, the contact stiffness between the two masses was varied and State-Space plots of the parametric analysis were used to evaluate the stability of the system.

Results from the plots show that a variation in contact stiffness has an influence on the behavior of the system. A complete hip implant, including femoral stem and acetabular cup would allow for more DOF and may allow for a better understanding of the stability of the system.

Mark Sidebottom Personal Statement

During my research in the MUSE program the past two summers, I realized that I was trying to solve a problem no one knows a definitive answer to. The realization that I was generating new knowledge surprised me because for most of my education before MUSE, I never had the opportunity to answer a question that you cannot look up in the back of a textbook or on online sources. The thought that the results from my research could be used to solve a problem in the field of orthopedics excites me and drives me to continue to do research on after I graduate from TCNJ. I hope that the work done over the past two summers from the model my professor and I created can be used by other scientists and engineers for the basis of their studies.

Development of a Damage Model for Fiber Reinforced Composite Materials
Daniel Christiansen, Mechanical Engineering
Faculty Mentor: Dr. Karen Chang Yan

2012 MUSE Project

A fiber reinforced composite (FRC) consists of two parts: high strength fibers and the resin that hold layers of these fibers together. The directional specific strength and relative lightweight nature of these materials are perfect for advanced applications such as aerospace and automotive engineering. While in most practical applications composite materials are treated as homogenous materials to simplify design and analyses, this approach has certain limitations in explaining failure phenomena and predicting failure since failures start at the microscopic level.

During the 2012 MUSE program, we generated a series of finite element models using a 9-fiber representative volume element (RVE) to better understand effects of microstructure failure. This model was first constructed in 3 dimensions but was later replaced by a simple 2 dimensional model due to its low computational time and fine meshing characteristics. After gathering a base line for comparison, defects of varying size were individually introduced in several locations around the center of the RVE. Qualitative and quantitative data on the area and magnitude of these stress concentrations was analyzed and graphed according to size and location. The combination of graphs and stress maps

give a detailed look into the behavior of the material under this transverse loading.

The data gathered in this research shows that, even with a large stress concentration, the homogenized material properties of a composite material can remain virtually unchanged, while such stress concentration could initiate failure locally. It also shows an indirect correlation between defect size and maximum stress concentration, but a direct correlation between defect size and region of elevated stress. These findings are important in predicting local defect interface and macroscopic failure. The effects of multiple defects and varying shapes will be the focus of this project going forward.

Daniel Christiansen Personal Statement

MUSE research is different from any other project I have undertaken due to the freedom and open-ended nature of the program. This project increased my academic independence and overall patience with problem solving. The first few weeks were frustrating due to the difficult and time consuming process of developing a feasible model, but the feeling of satisfaction once useful data was generated made it all worth it. Working with Dr. Yan and my student colleagues has been overwhelmingly positive and insightful on both a social and academic level.

Characterization of Tissue Damage via Dynamic Heart Phantom and MRI

Robert Seither, Mechanical Engineering
Faculty Mentor: Dr. Karen Yan

2012 MUSE Project

Heart disease is the primary cause of death in the United States. Cardiac Magnetic Resonance Imaging (MRI) technology has been used to diagnose and evaluate a number of diseases and conditions. Given the inherent difficulty in imaging the heart in motion, cardiac MRI studies often use heart phantoms made of rubber like materials with known material properties as a means of validation. This project focuses on tissue damage caused by myocardial infarction (heart attack). Understanding the underlying change of the damaged heart tissue will provide critical information for diagnosis and treatment.

The objective of this project is to develop a dynamic heart phantom (DHP) capable of simulating true physiological motion utilizing models of the heart at different stages of damage that can be used with MRI to compile a database correlating the stiffness changes to tissue damage. Sylgard 527 A&B dielectric silicone gel was selected as the base material due to its similarity to myocardium for MR imaging and ease of varying stiffness.

Throughout the MUSE program, in order to produce consistent samples, different molding methods were examined with focus placed on determining a viable release agent and making full size samples. An aluminum foil lining with Dry-Film Teflon release agent produced the best results. Compression testing was conducted on various gel samples and ANSYS hyperelastic material curve fitting was used to develop a model of the gel's material properties. A preliminary redesign of the phantom region was carried out.

For future work, the redesign will be finalized, manufactured and tested. The results will be compared with a computer model of the system made possible by the determined material property data. The molding techniques developed will be applied to the creation of heart models with varying stiffness. Finally, tests will be performed using the DHP apparatus in the MRI machine at the University of Pennsylvania.

Robert Seither Personal Statement

My time spent working this summer with the MUSE program has been impressive and enlightening. Having collaborated with Dr. Yan on the Dynamic Heart Phantom during the previous school year as well, it was an amazing experience to have two months to work solely on the project without having to divide my time between it, other academic responsibilities and extracurricular activities. Rather than putting in a few hours of DHP work into an already busy week, I was able to become fully immersed in my research. For each challenge that arose, I had ample time to find a solution, whether it was learning to operate a new computer program or completely redesigning a part of the apparatus. I am also impressed daily by the work produced by my MUSE peers. I have learned the value and power of collaborative research.

Fabrication of polymer and cellular composite constructs for tissue engineering applications

James Ferrie, Biomedical Engineering
Pamela Hitscherich, Biomedical Engineering
Faculty Member: Dr. Karen Yan

2012 MUSE Project

Tissue engineering is a promising aspect of regenerative medicine that is aimed at constructing functional tissues and organs. This requires the integration of living cells, biodegradable materials, and biologically active molecules to promote cell and tissue growth. Currently, challenges remain for more complex tissues/organs that require concerted efforts from multiple types of cells. One of the key issues in building replacements for complex tissues/organs is to mimic the organ's complex natural organization using a mixture of engineered materials and living cells. To this end, a system integrating polymer electrospinning techniques and pressure-driven cell deposition methods is currently under development for forming hybrid tissue constructs with living cells and natural and/or synthetic polymers. The objective of this MUSE 2012 project was to examine the effects of the process parameters on the form and structure. The effects of changing the working distance on the electrospun mat morphology were investigated using a 7% w/v polyethylene oxide solution. Three electrospun samples were obtained and analyzed at each working distance of 10cm, 15cm, and 20cm. Smooth fibers were obtained and found to have decreasing average fiber diameters with increasing working distance (averages decreased from 310nm to 196nm). Porosities were found to decrease as working distances increased (averages decreased from 1.20 mm^2 to 0.60 mm^2). Samples were analyzed using a Hitachi S510 scanning electron microscope (SEM). These findings illustrate that that the electrospinning process has the potential to produce a fibrous mat structure similar to the native ECM, and that properties, such as fiber diameter and porosity, can be tailored to a specific application. We hope to further our study and examine the changes in fiber morphology as the flow rate is varied as well as study fibers of different polymers and blends which would be more biocompatible and suitable for cell seeding.

Pamela Hitscherich Personal Statement

MUSE has offered me a very unique opportunity. I have been able to attain and master skills, such as electrospinning and SEM imaging, that I would have otherwise been unable to learn in the regular engineering curriculum. Furthermore, working on this research project, I have learned skills that will benefit me well into the future. The mentoring of Dr. Anderson and Dr. Yan has been a very positive experience in more ways than one. Not only have they shared their technical experience and expertise, but their advice on subjects like graduate school, career and family has been invaluable. MUSE has also given me the chance to develop new friendships with my lab partner James and with numerous students from across disciplines. I was afforded unique views into other disciplines and their research which only MUSE could have offered. Working in the MUSE program this summer has been a wonderful experience and I would recommend participation in the program to everyone.

James Ferrie Personal Statement

The MUSE program has provided me with the opportunity to gain valuable research experience. Throughout the summer, I have established protocols based on published articles, and gained experience using a scanning electron microscope, ImageJ software analysis, and MATLAB. This experience has given me practice in participating in a project and the ability to write and talk about it coherently. In, addition, I have gained a deep understanding of the electrospinning process for biomedical applications and current tissue engineering techniques. The MUSE program provided a great sense of community where I was able to meet students from other disciplines and learn about their projects as well. The knowledge and skills that I have gained will not only help in future courses but also in a research-based environment in graduate school.

Expanded Investigations into Remediation of Metal-Contaminated Water Through Electrospun Biopolymer Nanofibers

Melissa Bradley, Technological Studies
Faculty Mentor: Dr. Matthew Cathell

2012 MUSE Project

This project began during MUSE 2011 and is an expansion of ongoing research dealing with remediation of polluted wa-

ter. The goal of our research is to create biopolymer fiber mats that successfully filter toxic metals out of water. These mats were made from the biopolymer alginate, a water-soluble polymer known for its ability to bind to heavy metals. The production of these mats was achieved by electrospinning, a process in which nanoscale fibers are fabricated from polymer solutions in a high voltage electric field.

Fibers with diameter of about 200 nm were successfully electrospun and imaged using scanning electron microscopy (SEM). These fibers were then crosslinked, causing bonds to form within the polymer chains that strengthen the fibers and make them suitable for water filtration. This was achieved using calcium ions to create initial electrostatic crosslinks, followed by a glutaradehyde vapor treatment.

The final step in our research was to determine metal sorption capabilities of the fibers. Through colorimetric testing with a UV-visible spectrophotometer, it was determined that the fibers successfully biosorbed lead, mercury, and cadmium ions from water.

Melissa Bradley Personal Statement

The MUSE program has taught me a great deal about collaborative research. In the past two months, I have developed valuable research skills and laboratory techniques that I will take with me as I continue my education. This experience has also challenged me to think outside the box and problem solve. Much of our project was chemistry-based, so I was constantly challenged with new science concepts that I was otherwise unfamiliar with. Being fully immersed in a research project was an experience I fully enjoyed, and participating in the MUSE program has given me the confidence to pursue graduate research in the future. I also enjoyed the opportunity to meet other MUSE students and learn about academics disciplines and research projects vastly different from my own.

Effects of urbanization and extreme weather on the life cycle of a common songbird, the Carolina chickadee (*Poecile carolinensis*)

Sydney Hope, Biology
Frank Stabile, Biology
Faculty Mentor: Dr. Luke K. Butler

2012 MUSE Project

Urbanization has important effects on the biology of a wide variety of organisms. Likewise, global climate change has altered the timing of important steps in the life cycles of many organisms. In birds, the annual replacement of the plumage is a critical life stage and the timing and rate of plumage replacement may be sensitive to environmental perturbations such as urbanization and climatological extremes. We used a common songbird, the Carolina chickadee, as a model species to investigate the effects of urbanization and climate change on the timing and rate of plumage replacement in small birds. We compared plumage replacement in chickadee populations from urban and forest settings and across a three-year period with variable spring temperatures. We found that forest chickadees started molt later than urban chickadees and later in colder years than in warmer years. This study is the first to suggest that plumage replacement dynamics of songbirds may be altered in urban environments and in response to predicted global temperature increases.

Sydney Hope Personal Statement

The MUSE program has given me the opportunity to acquire skills pertaining to field biology, as well as gain experience in other aspects that will benefit me throughout my school and professional careers. While learning the technical skills of mist netting and measuring songbirds, I have gained experience with problem solving, working as part of a team, and maintaining the determination to accomplish a set goal. The techniques I have learned this summer will help me with my independent research next semester and the immersion into scientific thinking will help me in any future career that I pursue.

Frank Stabile Personal Statement

Although it is rather difficult to summarize all that I have learned in the past two months with just a few sentences, I can highlight the most important lesson. While collaboration and specialized skills are essential to any research endeavor, I have found that these ideas are certainly necessary but not sufficient. The need for mental flexibility struck me as the most prominent and novel concept. Laying the foundation with a hypothesis and data collection is one thing, but properly manipulating theories to suit facts is another task entirely. Above all, it is essential to avoid a fixation on the expected outcome and to instead create the best model possible. In my case, this flexibility has applied specifically to birds, but I believe it is an indispensible tool for whatever direction I choose in science.

The Effects of Prenatal Nicotine Exposure on Respiratory Behavior in the *Pet-1* Knockout Mouse

(Funded by the National Science Foundation through the *Gateway to Graduate School in Biology* Program)

Robert Myers, Biology
Faculty Mentor: Dr. Jeffery T. Erickson

2012 MUSE Project

Pet-1 gene deletion results in a significant loss of neurons that comprise the brainstem serotonin (5HT) system. This selective loss of 5HT neurons results in abnormal autonomic function, particularly during early postnatal development. *Pet-1* mutant (knockout) mice exhibit a lower resting breathing rate, a higher incidence of apneas, and an impaired autoresuscitation response to anoxia-induced apnea, compared to their wild-type littermates, and approximately 25% die within five days of birth. These findings have potential relevance to Sudden Infant Death Syndrome (SIDS) in humans, which has been linked to a deficiency in brainstem 5HT. Recent studies in our lab have focused on the effects of known risk factors for SIDS on cardiorespiratory function in *Pet-1* mutants. Currently, the major risk factor for SIDS is exposure to cigarette smoke during prenatal and/or postnatal development, and many believe that nicotine is the causative agent. We have shown through *in vivo* studies that the breathing abnormalities in the *Pet-1* mutants are reversed when the animals are exposed to nicotine prenatally. However, despite this improvement in breathing behavior, early mortality in the knockouts persists. The underlying mechanisms for these surprising results are not known.

This summer, we completed data collection for our initial *in vivo* study of the effects of prenatal nicotine exposure on *Pet-1* knockouts. To explore potential underlying mechanisms, we began to incorporate heart rate measurements into our standard protocol for measuring breathing behavior, since heart rate instability could be the basis for the continued high mortality in the knockouts. In addition, we made significant progress in developing an *in vitro* system for measuring fictive breathing in the isolated neonatal brainstem/spinal cord in anticipation of more controlled pharmacological studies aimed at defining the role of nicotine in reversing the abnormal breathing phenotype of the 5HT-deficient *Pet-1* mutant.

Robert Myers Personal Statement

The MUSE summer research program provided me the opportunity to fully engage myself in laboratory research. Working under the guidance and mentorship of Dr. Erickson, I learned a great deal about the importance of patience and perseverance in biological research. I mastered a variety of new lab techniques and developed skills in critical thinking and problem solving. My experience in MUSE has given me a unique insight into possible career paths as a scientist and has allowed me to grow increasingly independent in lab.

Exploring genetic variation in invasive and native populations as well as infected and uninfected populations of *Andropogon virginicus* using a population genetics approach

(Funded by the Garden Club of America)

Brian Giacopelli, Biology
Michael Readinger, Biology
Faculty Mentor: Dr. Janet Morrison

2012 MUSE Project

Andropogon virginicus is an important grass in old field succession that is native to the eastern regions of the United States and has also been introduced in California and Hawaii. In Hawaii it is considered invasive. In about half of the Eastern populations, *A. virginicus* is infected with the smut fungus *Sporisorium ellisii*, which is not seen in the California and Hawaii populations. We use *A. virginicus* to provide important insight into invasion ecology and plant pathogen interactions, by assessing its genetic diversity within and between these populations. Our research uses an analysis of ISSR molecular markers to generate DNA fingerprints for individual *A. virginicus*, which we will then use in the analysis. Over the course of MUSE, we extracted the DNA of 20 individuals from 16 populations (4 from Hawaii, 4 from California, 4 from east coast states infected with *S. ellisii,* and uninfected 4 eastern populations). We then began to generate the DNA fingerprints and did prelminary statistical analysis. So far, our data indicate that the non-native populations (from Hawaii and California) are less genetically diverse than their native counterparts from the eastern states, suggesting that introduction of this grass into a new territory causes a genetic bottleneck. Additionally, the populations infected with *S. ellisii* appear less genetically diverse than the uninfected populations, which supports our hypothesis that disease epidemics in nature should be expected where the host organism (here, the grass) is more genetically uniform. This would allow a pathogen to more easily evolve to overcome a commonly shared host defense.

Brian Giacopelli Personal Statement

The MUSE experience was an immensely positive one for me. I was able to dedicate much more time on my project that I have been working on for the past year, which enabled me to make a huge amount of progress. We have come a long way this summer and we are now very well set up to make even more progress over the course of next year. In addition to the progress we made, the MUSE experience showed me what it is like to work full time in research, which I thoroughly enjoyed. It has cemented my goal of continuing on to graduate school to further pursue research.

Michael Readinger Personal Statement

The MUSE program has provided me with an immersive and educational experience that has helped me grow as an aspiring research scientist. The intensive eight-week program has given me valuable time needed to make a large amount of progress on last semester's research that will continue into the following semester. The MUSE program has also provided me the time to develop my "lab hands" as well as other important skills needed for graduate school and for other continued endeavors in the field of genetics. I would like to thank Dr. Janet Morrison as for all of her support and guidance thus far and Brian Giacopelli for being such a pleasure to work with. I would also like to thank the professors of the TCNJ Biology department for being so welcoming during the time of the MUSE program. It has been a won-

derful eight weeks and I look forward to continuing research for my remainder of time at TCNJ.

Characterization of mutations that change GLD-1 expression
(Funded by the National Science Foundation through the *Gateway to Graduate School in Biology Program*)
Jennifer Aleman, Biology
Faculty Mentor: Dr. Sudhir Nayak

2012 MUSE project

My project focused on discovering the mechanisms of *gld-1* regulation. In *C. elegans*, GLD-1 (defective in Germ Line Development) is an RNA-binding protein and acts as a translational repressor. The GLD-1 protein binds to mRNAs in order to block translation and prevent inappropriate expression of their gene products. Genetic analysis has indicated that *gld-1* acts as a tumor-suppressor in the germ line, which means it prevents cancer by regulation of the cell cycle. Mis-expression of GLD-1 can lead to incorrect progression through the cell cycle and germ line tumors. The expression of GLD-1 is tightly controlled in the germ line of hermaphrodites and regulates multiple processes such as oocyte development and cell proliferation. We are interested in discovering genes responsible for maintaining the correct expression pattern of GLD-1. To identify these genes, we were able to characterize mutations of *gld-1* by DAPI staining and using fluorescent microscopy to compare mutants to the wild type control. In order to see the difference in GLD-1 expression between the control and mutant, we took advantage of a transgenic strain which contained GLD-1 fused to GFP (green fluorescent protein). We were able to narrow down our total pool of mutant strains to two interesting mutant strains through the characterization of these mutations. Future directions include germ line dissection followed by DAPI staining and imaging to further characterize the two mutant strains. By imaging these mutations, we hope to identify novel genes that maintain GLD-1 protein at appropriate levels.

Personal Statement

The MUSE program has provided me with a unique opportunity that allowed me to fully immerse myself in research on a daily basis for an extended period of time. The time I was able to spend on my project was something that I don't normally get during the school year. During the course of the summer, I have gotten the opportunity to greatly improve my laboratory skills. I was also able to master new skill sets just introduced to me. I got the chance to properly process images in order to make figures and I got to apply basic concepts learned in genetics which helped me understand my project and the subject matter that much more. I've become more patient and understanding after having spent the first half of the summer troubleshooting a contamination problem. I learned that things in research don't always work the way you want. The MUSE experience has helped me become more independent and confident in my capability in the lab.

Extension of *C. elegans* lifespan through HIF-1 activation
(Funded by the Gateway to Graduate School in Biology program)
Emily Keppen, Biology
Faculty Mentor: Dr. Sudhir Nayak

2012 MUSE Project

Over the course of this project, we studied the life extension of *Caenohabditis elegans* (*C. elegans*) in response to the activation of the HIF-1 (Hypoxia Inducible Factor) pathway. The HIF-1 pathway is activated by low oxygen conditions, also known as hypoxia. When activated, HIF-1 upregulates the expression of telomerase. This is an important factor in aging since telomerase maintains telomere length and protects chromosomes from degradation. An increase in HIF-1 activity and telomerase expression is expected to increase chromosome stability and therefore contribute to an increase the lifespan of the worm. To induce hypoxia, wild type control (N2) and *hif-1* knockout (HIF-1) strains were treated with cobalt chloride and lifespan measures. Our preliminary suggests that wild type lifespan is extended with cobalt chloride treatment in a *hif-1* dependent manner. Although cobalt chloride appears to be increasing lifespan, these results may be a nonspecific effect of the treatment. To determine if the extension of lifespan is actually in response to the HIF-1 pathway and not the cobalt chloride we have initiated a second survival screen using sodium sulfite. In future research we will also plan on using other hypoxia inducing compounds such as deferoxamine to examine their effect on lifespan. By finding treatments to extend worm lifespan, we hope identify the key components of the pathway that govern lifespan in other animals.

Emily Keppen Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) has allowed me to greatly develop my lab skills and prepare me for future experiments. I had previously spent time shadowing a research student in the lab but could not fully engage myself in every aspect of the experiment due to time constraints in training. Through MUSE, I was able to become a full-fledged member of the project and quickly developed my skills for continuing the research. I learned to work independently and to reason through problems using my own critical thinking. I realized how much I have left to learn and look forward to my future in the lab and pursuing a career in biology.

Analysis of GLD-1 Post Translational Modification

John Fang, Biology
Faculty Mentor: Dr. Sudhir Nayak

2012 MUSE Project

The objective of this summer's project was to the study the regulation of GLD-1 (defective in Germ Line Development), a RNA binding protein that is important for normal germ-line development in the model organism *Caenorhabditis elegans* (*C. elegans)*. In mutant strains where GLD-1 is not expressed, hermaphroditic oogenesis ceases and the germline tumors form. Therefore, correct expression of GLD-1 in the germ-line of *C. elegans* is critical and is highly regulated by various cellular mechanisms. One suspected mechanism is the phosphorylation of the GLD-1 protein for the modulation of its functionality. In normal animals, GLD-1 protein levels gradually increase from the mitotic zone through the transition zone, and reach the highest levels of expression during the pachytene phase of meiosis. Prior to oocyte development, GLD-1 levels drop abruptly. By analyzing the phosphorylation levels of GLD-1 protein in germ-line, the relationship between phosphorylation and the levels of expression of GLD-1 may be explored. Western Blotting is common method used detect changes proteins according to mass, and may be used to analyze whether or not the phosphorylation of GLD-1 is actually utilized as a regulatory mechanism. This summer was focused on optimizing the detection protocol for phosphorylated GLD-1 versus non-phosphorylated GLD-1 isoforms. I plan on continuing this research in the future with more focus on the specific stage GLD-1 is phosphorylated as well as the specific effects of phosphorylation.

John Fang Personal Statement

The MUSE summer research program was a great experience that offered me hands on experience in a laboratory setting. I have shadowed other students in Dr. Nayak's laboratory before, but it was during the MUSE program that I actually experienced the in-depth work of actually performing research in a biology lab. The program offered a different view of biology that is seldom obtainable in a class room setting. Working in Dr. Nayak's laboratory during the MUSE program was a very invaluable experience because it provided an opportunity to fully focus on the practical aspect of biology and to contribute to the ever expanding study of genetics. Because of the particularly difficult time we had getting the project off the ground due to worm defects and bacterial contamination, the project proved to require more persistence and critical thinking than I had first expected. These two skills were greatly exercised during my time in MUSE and will be a valuable asset in my future studies and endeavors.

OpenShade: An Open-Source Multiple Sequence Alignment Shading and Editing Utility

Peter Swetits, Computer Science
Faculty Mentor: Dr. Sudhir Nayak

2012 MUSE Project

Protein sequence alignments allow researchers to quickly determine regions of similarity between different proteins. They also provide important clues about the nature of the proteins that may be important to their study. While working with sequence alignments, researchers often find that they need to quickly shade or edit their alignments. However, the most widely used shading program, BoxShade, is difficult to use, does not allow editing, and has a limited number of output options. OpenShade is being developed as an open source software application that solves these issues. It allows the user to input multiple sequence alignments in all popular formats, including FASTA, ALN, MSF, and Phylip. Once imported, the alignment can then be dynamically shaded for identities and similarities, with the consensus being either automatically calculated or defined by the user. The user is able to specify the criteria to form a consensus, change the

scoring matrix, and set the minimum score required for shading of either identical or conserved residues. After shading, the user has the ability to edit individual amino acids, entire columns of amino acids, or select and edit a single section of the entire alignment. The shaded sequences can be exported as a document in PDF, PNG, or RTF formats. OpenShade also contains the ability to conduct pattern matching using regular expressions. The user can input a string of amino acids and then the program will highlight all occurrences of that string in each of the protein sequences independent of position. The basic graphical interface and shading algorithms have been completed. We anticipate the completion of the project within the next year.

Peter Swetits Personal Statement

The MUSE program has provided me with a great opportunity to conduct research with my faculty mentor. I learned about different algorithms and procedures used in the field of bioinformatics, as well as developing my software engineering, troubleshooting, and programming skills. Conducting research with an interdisciplinary nature has also helped me practice explaining my work to colleagues who do not possess the same biology and computer science background I do. Most importantly, the MUSE program gave me a taste of what it is like to conduct research in an academic setting. I plan on pursuing a graduate degree in bioinformatics or computational biology after graduation.

Alternative Polyadenylation of *grk* mRNA of *Drosophila*

(Funded by the National Science Foundation through the *Gateway to Graduate School in Biology Program*)

Letitia Thompson, Biology
Faculty Mentor: Dr. Amanda Norvell

2012 MUSE Project

During *Drosophila* oogenesis, the TGF-alpha protein Gurken (Grk) is responsible for pattering the dorsal-ventral (D-V) axis of the egg and future embryo. Consequently, Grk distribution within the ovary is tightly controlled and the spatial and temporal regulation of Grk protein activity is, in part, achieved through post-transcriptional mechanisms. The goal of this project is to determine whether any aspects of Grk regulation are mediated through alterations in the polyadenylation of *grk* mRNA. Polyadenylation is the process of adding a poly(A) tail to the 3′ untranslated region (UTR) of the mRNA. Hex sites (AAUAAA) are required in order for polyadenylation to occur. We have found that *grk* mRNA is polyadenylated throughout oogenesis, and moreover that there are two major polyadenylated *grk* transcripts that differ by approximately 15 nucleotides in size. The *grk* 3′UTR does contain two Hex sites suggesting that alternative polyadenylation may occur. We have isolated and sequenced the two *grk* RNA transcripts in the ovary and found that these are indeed the result of alternative use of the two HEX sites. In future work we will investigate the functional consequences of the alternative polyadenylation and attempt to identify proteins that could play a role in this alternative processing event. We are in the process of making transgenes that delete the individual HEX sites and these flies will be analyzed for oogenesis defects. Finally, others have demonstrated that the *Drosophila* Sex-Lethal (Sxl) protein functions in the alternative polyadenylation of at least one transcript during oogenesis, so we will examine *grk* polyadenylation in these mutants.

Letitia Thompson Personal Statement

The MUSE research program has allowed me to develop confidence in my capability to do research. Being able to work in a close environment with my faculty mentor has allowed me to learn so much more than the average student. I have been taught information that I have not yet learned in class. This information is actually being put to use because you are the one using it to perform experiments and troubleshoot. There are times when you get results that you may not understand, but I feel as though that makes you more determined to find the answer. You may not know the answer to your question, but it is for that reason you must investigate. I appreciate the skills and knowledge that I received because of this hands-on experience. The MUSE program gave me a purpose and allowed me to accomplish more than I ever thought I could as a student researcher.

Maternal Regulation of Dorsal/Ventral Patterning in Zebrafish

William Cavallo
Faculty Mentor: Dr. Marcia O'Connell

2012 MUSE Project

In our lab we study the early development of the vertebrate species zebrafish. We are currently involved in studying a family of genes that are maternally inherited. My personal project is researching how the expression of a maternal mRNA called ElrA is regulated during development. ElrA codes for a CPEB (cytoplasmic polyadenylation element binding) protein which is responsible for activating polyadenylation of mRNAs which allows them to be translated. By following the expression of the ElrA mRNA, we can gain an insight into its expression and its potential regulation of other mRNAs. I have discovered that due to alternative splicing, there are two mRNA varients that are present in the zygote and I am now in the process of determining the quantitative presense of each of them in the developing organism and which, if not both, produces a functioning protein product. Future work wil involve quatitative analysis of the gene, as well as gel shift experiments with the Zorba protein that is believed to be involved in the regulation of th ElrA mRNA.

William Cavallo Personal Statement

Entering college, I never really saw myself getting involved in research. I thought that it was only for those who wanted to go on to get their PhD, and not for those looking to go to medical school. However, after spendning a year in Dr. O'Connell's lab I have gained not only an appreciation, but a true liking to what research helps me gain. Research has taught me a greater amount of discipline that I have been able to bring to my studies, as well as opening my eyes to a different way of thinking about concepts. MUSE has allowed me to be able to fully apply myself to my work without having to worry about other classes and the progress I have made this summer is outstanding. I am now hoping to gain entrance to an MD/PhD program so that I may continue researching after my undergrad.

Determination of the function of two genes, *hnrnpab* and *zgc:77052-201,* in early *Danio rerio* embryogenesis.
(funded by the National Science Foundation through the Gateway to Graduate School in Biology Program)
Daniel Ferrer, Biology
Faculty Mentor: Dr. Marcia O'Connell

2012 MUSE Project

This project's goal is to determine the function of two genes that are believed to function in the early stages of development of zebrafish embryos. The two genes of interest, *hnrnpab* and *zgc:77052-201,* are the two genes that are most homologous to the *squid* gene in *Drosophila melanogaster.* In *D. melanogaster*, *squid* codes for an RNA-binding protein that localizes the product of another gene to specific areas of the egg. The presence of the localized gene product influences the dorsal/ventral patterning of the egg. The functions of the genes in zebrafish were studied this summer through a series of microinjections. The embryos were injected with morpholinos specific to those genes between the one to two cell stages and the eight cell stage. Morpholinos are small antisense molecules that are designed to block the translation of a specific mRNA. The morpholinos were injected to prevent expression of the two genes under investigation. The embryos were fixed in methanol:DMSO and stained using immunohistochemistry to determine the effects of the injection on the expression of muscle-specific myosin, which is specifically expressed in somites in the embryo. Somites are embryonic structures that, in vertebrates, eventually develop into dermis, skeletal muscle, and vertebrae, and therefore are indicators of correct dorsal patterning of the embryo. The results of the injections suggest that blocking the expression of *hnrnpab* and *zgc:77052-201* disrupts the sharp, chevron patterning of the somites and the somite size. Therefore, these initial results indicate that the genes of interest in zebrafish may be involved in dorsal/ventral patterning and possibly homologous in function, as well as structure, to the gene in *D. melanogaster.*

Personal Statement

The MUSE program has given me the opportunity to work with other students and my faculty mentor in the lab as well as continue research I had been working on during the year in an environment without the stress of classes and other responsibilities. I have been able to place all of my attention on my project and develop critical reasoning and problem solving skills. I have also been able to come up with ideas for future projects that work off of the results of this one. I have learned valuable lab techniques and collaborative skills. Many of these skills will help me in the future regardless of what field I pursue. During the program I have had to troubleshoot issues, reason analytically and further my scientific knowledge beyond what I could have learned in the classroom.

Molecular Genetics and Biochemical Analysis of Cytochrome P450s in *A. thaliana*

Dylan McDivitt, Biology
Joseph Montes, Biology
Amanda Soler, Biology
Faculty Mentor: Dr. Leeann Thornton

2012 MUSE Project

In order grow enough food and plant products for the increasing human population, agriculture productivity must continue to improve. Currently, most plants only yield about 20 percent of their potential productivity when grown in the field. Much is unknown about how plants respond to stressful conditions. We aim to determine how a group of enzymes, called Cytochrome P450s (CYPs), influence plant metabolism in response to suboptimal growth conditions. We are studying these enzymes from *Arabidopsis thaliana* as a model for other plants. We took both a molecular genetics approach and a biochemical approach. For the molecular genetics approach, we isolated two plants with less enzyme activity for CYP72A11 and CYP72A13. We are examining these plants for growth deficiencies that will inform us about enzyme function. For the biochemical approach, CYP72A9 and CYP72A13 were expressed in yeast cells. Multiple yeast growth conditions were examined to obtain the optimal amount of plant enzyme. Under one condition, CYP72A13 produces a small amount of active enzyme while no functional CYP72A9 has been obtained. We will continue to optimize expression of both enzymes and work towards purifying functional enzyme samples. The goal is to perform this experiment to determine enzyme function. Our studies on *A. thaliana* will contribute to the better understanding of plant response to stressful conditions to improve crop plant productivity.

Dylan McDivitt Personal Statement

I knew coming into TCNJ as a freshman that I wanted experience with research to be a part of my undergraduate education as a biology major. The opportunity to not only learn lab techniques first-hand, but to also put them to practical use and solve real-problem questions was an opportunity I could not turn down. While I was fortunate enough to participate in independent research with Dr. Thornton as a junior, MUSE has allowed me to focus all of my time and energy on my project without having to divide my attention amongst other classes and outside activities. This summer I was given the chance to make more progress in my research project than I ever could have during the academic school year. My time in MUSE has pushed me towards becoming more independent and confident in the lab with both my skills and problem solving capabilities. My extended time in the lab over the past two months has enriched my academic experience in TCNJ's biology department more than I ever could have asked for.

Joseph Montes Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) summer research experience has developed and augmented my laboratory skills and given me the opportunity to learn about the importance of studying plant genetics. Techniques such as RNA extraction, cDNA synthesis, and performing PCR; all of which are vital skills involved in plant genetics research. Since this was my first time researching independently, there were some obstacles. Being able to troubleshoot difficulties enhanced my capability to critically analyze and solve problems. Although a large portion of research requires hands-on applications, learning about recent research that has already been performed is integral. Learning about the current knowledge allowed me to gain a further understanding of the genes studied this summer. Overall, this research opportunity permitted me to make progress with my project that I will continue for the rest of my career at TCNJ.

Amanda Soler Personal Statement

The MUSE 2012 program has provided me the opportunity to learn many different aspects of working in a lab and what full time biological research entails. Throughout the summer, I have learned how to work with others while improving my lab techniques that are associated with my project. There has been a notable difference between the person I was the first day of MUSE compared to the person I am now. I am now confident to run immunoblot and microsomal extraction protocols on my own without the aid of my mentor being in the lab. Also, I am able to think on my own, plan out the week's agenda, and analyze data and make sense of what the next steps need to be. Overall, MUSE allowed me to make headway in my project and made me realize that I am capable of things I did not think I could do on my own, thanks to my mentor, Dr. Thornton, and my lab citizens, Dylan and Joe.

Using Fluorescence Correlation Spectroscopy to Investigate the Unfolding of Human Serum Albumin

Andrew Apicello, Chemistry
Priya Gupta, Chemistry
Mentor: Dr. Michelle Bunagan, Chemistry

2012 MUSE Project

The focus of our project is on human serum albumin (HSA), which is a protein that can bind to many ligands (ions or molecules that form a certain type of bond with the molecule in question) and is therefore important in the study of interactions between proteins and drugs. The goal is to determine the important intermediate conformations that are accessed by HSA during the folding and unfolding process and thereby determine the specific folding pathway and folding energy landscape. To accomplish this, FCS (fluorescence correlation spectroscopy) will be used to measure the radius of single protein molecules. These experiments will be done in various concentrations of chemical denaturants, such as urea and guanidine hydrochloride, which will cause the protein to unfold and likely access these intermediate states. Dyes (like Alexa Fluor 488) will be used to label domains on the protein so that it may be detected by the FCS equipment.

Andrew Apicello Personal Statement

MUSE transformed the way I think about science. Hours spent in labs and in classes were rarely interesting at best. However, those hours were crucial. All the while, whether I knew it or not, (I didn't) I was learning the foundations of the scientific discipline. At first, science to me was a vehicle to accomplish some other goal; a roadblock that would soon be far behind me. Now, I understand the creative force that drives scientific endeavors. This summer was a turning point in my path. I found something I actually love doing, and it was in the least likely of places. My confidence in math has never been high, but physical chemistry demands those skills. I am more than happy to dedicate my time to further my understanding of those principles and push the boundaries of what I am able to do. With these ideas and through MUSE, I was able to contribute my first verse to the powerful play that is science.

Priya Gupta Personal Statement

During the last two months of this summer, I have learned a lot. With the guidance of my mentor, I have acquired a valuable set of skills working with certain instrumentation in the lab. I have learned new methods of analysis, as is pertinent to my research. Furthermore, working with Andrew – my research partner – has allowed me to better my ability to do work in a group setting.

My most favorite part of this summer experience was getting to know my advisor, other faculty members, and my peers - both in my department as well as in others. Our weekly breakfasts and regular seminars were helpful in allowing me to gain skills in networking and understanding how various disciplines in the sciences come together to make progress in doing research. Overall, being around people who are interested in pursuing careers in the sciences was an enjoyable experience. Going forward, these invaluable skills will prove to be very helpful.

Testing hormone mimic function against biological protein targets implied in human health

Jessica Gruskos, Chemistry
Ari Goldwaser, Chemistry
Faculty Mentor: Dr. Danielle Guarracino

2012 MUSE Project

Vasopressin and Oxytocin are two naturally occurring hormones with biological importance. Vasopressin helps regulate water levels in the body, and lack of vasopressin is associated with Neurogenic Diabetes Insipidus (DI). Oxytocin has many biologically important functions such as initiating uterine contraction, cell signaling, and regulating certain behaviors (autism, anxiety, etc). Cyclized peptides that imitate these hormones have been designed. Our peptides incorporate small, but significant, changes thought to improve stability in comparison with the natural hormones. Vasopressin "mimics" could rescues Vasopressin function in DI while Oxytocin "mimics" could be applicable to a range of disorders.

This summer we continued the research that the Guarracino research group had been previously conducting during the past semesters. One Oxytocin mimic and two Vasopressin mimics were synthesized, purified, and their sta-

bilities were tested against three different peptide-degrading factors that emulate the cellular condition: pepsin, pronase, and α-chymotrypsin. All the hormone mimics proved to be more stable than the natural hormones and a linear control peptide. Additionally, during MUSE a method was developed to test the binding affinity of the hormone mimics to their appropriate cell receptor. The V2 vasopressin receptor is fundamental in bodily maintenance of water homeostasis. The binding affinities of natural Vasopressin and Vasopressin mimic 1 for the V2 cell receptor were tested. We showed that Vasopressin mimic 1 binds to the V2 receptor and competes with natural Vasopressin for binding. While Vasopressin mimic 1 has a 1-fold weaker binding affinity compared to natural Vasopressin, this supports the potential for these mimics as first generation pharmaceutical models. Further optimization of the Vasopressin and Oxytocin mimic design and determination of other mimic binding affinities will be tested in the future.

Jessica Gruskos Personal Statement

The MUSE program has allowed me to continue our research project, learn new laboratory skills, and meet new friends. I started working with Dr. Guarracino on this project in the beginning of the Spring 2011 semester, and I would not have been able to see the project to completion without the opportunity to do MUSE. Additionally, during MUSE I learned new laboratory skills and techniques that will help me in my future studies and have made me more comfortable in the lab. My interest in this project has led me to want to pursue a career in biochemistry. Throughout the summer I made new friends and enjoyed the opportunity to participate in the MUSE research program.

Ari Goldwaser Personal Statement

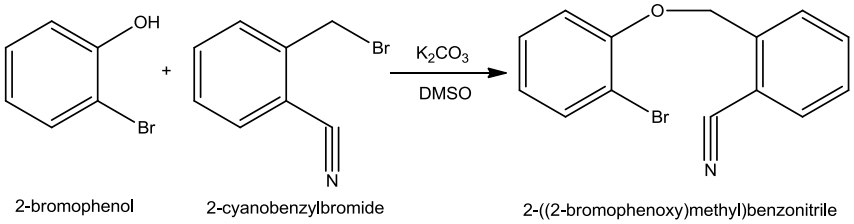
The Mentored Undergraduate Summer Experience has felt like an oasis of discovery amidst the routineness of classes. As my first research experience, it felt incredible to be a part of the discovery of completely novel information. I will be continuing to work on this project throughout the coming academic year, so being able to begin the research over the summer with no distractions has been very valuable. I have developed great laboratory skills and knowledge of various instruments which I have never used before. On top of everything, I have made some great friends and bonded with many of the other MUSE participants.

Development of a Novel Ring Forming Reaction

John Farrokh, Chemistry
Faculty Mentor: Dr. David Hunt

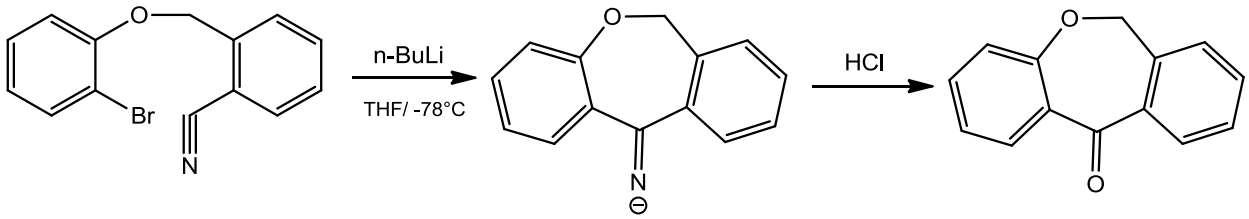
2012 MUSE Project

Benzo-fused 7-membered heterocyclic ketones have been shown to possess pharmacological activity. The goal of our project is to develop a new method of synthesizing these compounds. Starting materials were typically prepared by reacting a compound unique to each reaction with 2-cyanobenzylbromide.



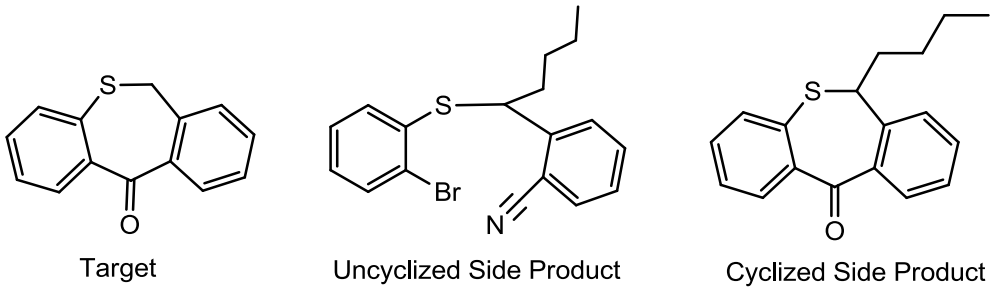
2-bromophenol 2-cyanobenzylbromide 2-((2-bromophenoxy)methyl)benzonitrile

The reaction utilized to prepare these products entailed the formation of a N-lithioimine salt by reacting the starting material with n-butyllithium at -78 ^{o}C followed by an acidic work-up and extraction.



Using this methodology, the compound above and several analogous compounds have been successfully prepared, iso-

lated and characterized. Of particular interest is the thioether formed by using sulfur as the heteroatom instead of oxygen as it behaves differently than the other analogues. When treated with 2.0 equivalents of n-BuLi or greater, the reaction favors the formation of the butylated side products shown below. Preparing the reaction with 1.0 equivalents of n-BuLi forms the desired product exclusively, but does not lead to a complete reaction (~40%). The effects of using t-BuLi as a substitute for n-BuLi to eliminate alkylation have yet to be determined.



John Farrokh Personal Statement

Over the past two months, The Mentored Undergraduate Summer Experience has enabled me to gain invaluable experience in the laboratory. It has allowed me to continue my work from the past year and expand my knowledge of and proficiency at performing various chemical synthesis techniques. In addition to improving my lab abilities, MUSE has given me the opportunity to work alongside my peers with a variety of different projects. I have expanded my appreciation of the work done in other disciplines, as well as the projects under-taken by my fellow scientists. Thanks, to MUSE, I have been given an excellent opportunity to develop both as a student and as a researcher. The skills I have gained in these past two months will be priceless assets during my academic and professional careers.

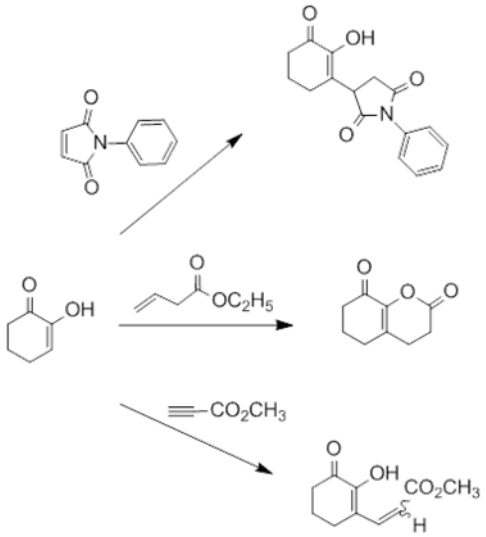
Michael Additions of Unsaturated Ketones and Alkynes to 1,2-cyclohexanedione

Tyler Higgins, Chemistry and Applied Mathematics
Faculty Mentor: Dr. David Hunt

2012 MUSE Project

Through previous research, it has become known that 1,2-cyclohexanedione can be used in Michael addition reactions. The use of 1,2-cyclohexanedione in Michael additions was previously restricted to reactions involving β-nitrostyrenes; this current project sought to expand the amount of Michael additions that 1,2-cyclohexanedione could undergo by examining reactions with different α,β-unsaturated ketones and alkynes.

After determining whether or not there exists a Michael addition reaction between 1,2-cyclohexanedione and these substrates, the next step is to condense the Michael adduct into a new heterocyclic ring structure. These heterocyclic ring structures are known to possess pharmacological activity as anti-cancers and anti-tumors.



Tyler Higgins Personal Statement

My MUSE experience this summer has been incredibly fulfilling. I was able to completely submerge myself in a research laboratory setting, and in the process learn many significant laboratory techniques. Having many other chemistry students around my laboratory was also very beneficial, as they were often instructing me on specific laboratory methods. Discussing the various projects that my fellow researchers were conducting was an illuminating experience as well, as it taught me how to describe my research clearly and concisely. The experience as a whole has shown me that a career in organic or medicinal chemistry is something that I look forward to with much excitement.

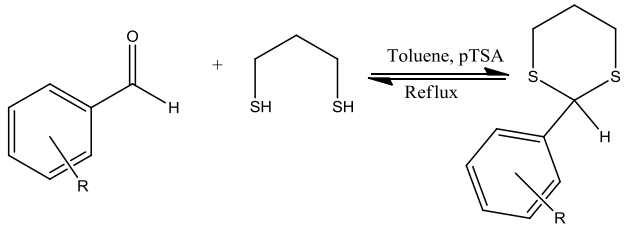
A Study for Strategies for the Synthesis of Aromatic Silyl Ketones

Katrina Wunderlich
Faculty Mentor: David Hunt

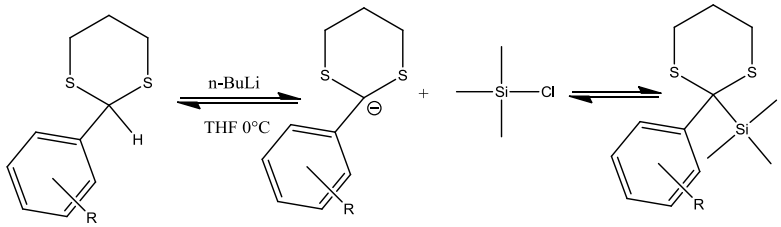
2012 MUSE Project

In our lab we wish to study the Brook Rearrangement on a series of aromatic silyl ketones. However, aromatic silyl ketones are not readily available commercially. Therefore, they must be synthesized. The current literature for the synthesis of silyl ketones tends to follow three basic steps:

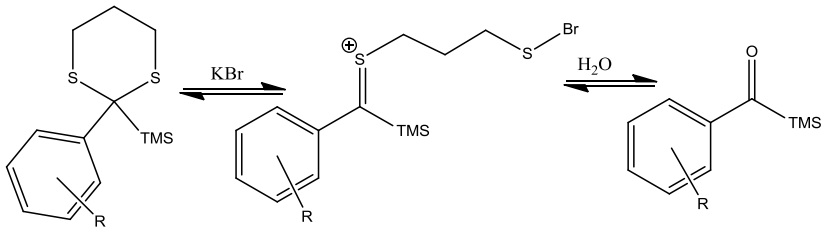
1. Protection of aldehyde



2. Addition of TMS



3. Deprotection of ketone.



Though the first two steps are largely straightforward, the deprotection in the third has proven more challenging. To date, literature suggests that the strategy most useful for the deprotection step largely relies on the use of mercury chloride which is toxic and expensive. In our lab, we've developed a synthesis to deprotect the ketone using an inexpensive and safe reagent known as oxone. The third step of this synthesis, the optimization of the conversion of the protected ketone to the deprotected ketone has been the focus of this study. Results indicate that heat hinders this conversion and increasing the molar ratio of oxone to starting material to 4:1 decreases the time necessary for deprotection. To date in our lab, we have been able to increase the GCMS percent yield of starting material to desired product from 20% to >99%. We have analyzed this synthesis strategy on F, Cl, Br, and OMe substituted benzaldehydes as well as trans-

cinnamaldehyde and a heterocyclic derivative. Further characterization and purification of these compounds are necessary before they are used to study the Brook Rearrangement.

Katrina Wunderlich Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) has allowed me to further develop my organic laboratory techniques and better familiarize myself with different instrumentation used for purification and instrumentation. I have had the opportunity to further develop my ability to work through problems independently and creatively. I have thoroughly enjoyed the struggles and successes I've experienced in my laboratory this summer and hope that I will have the opportunity to work on similar challenging and rewarding projects in the future.

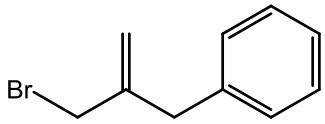
Progress Towards the Synthesis of Nickel Complexes Containing Hemilabile Arene Groups for Applications in Catalysis

Christopher Bregna, Chemistry
Faculty Mentor: Dr. Abby R. O'Connor

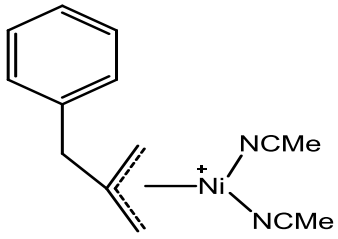
2012 MUSE Project

One of the driving forces in the field of organometallic chemistry is catalysis, where a catalyst is defined as an additive substance that allows a chemical reaction to occur by lowering its barrier to activation. Nickel, a relatively inexpensive metal found in high abundance in the Earth's crust, has been shown to catalyze many chemical reactions. An area where nickel complexes have not been utilized effectively is for hydrogenation reactions. Typically hydrogenation reactions are catalyzed by noble metals such as platinum, rhodium, and ruthenium, however due to the high cost and rarity of these noble metals, nickel is a cheaper alternative. Nickel has been used as a heterogeneous catalyst in hydrogenation reactions, where a heterogeneous catalyst is not found in the same phase as the reactants. On the other hand, homogenous catalysis is the process where the catalyst is found in the same phase as the reactants. A benefit of homogeneous catalysis is that the mechanism can be studied using basic spectroscopic techniques to gain insight into the reaction and aid in future catalytic design. This field is of broad interest as chemists search for new ways to design more sustainable processes as well as increase specificity in chemical reactions. The purpose of this work is to gain a deeper understanding of nickel complexes for use as homogenous hydrogenation catalysts through the synthesis and characterization of new nickel complexes containing a pendent hemilabile arene group to aid in stabilization during catalysis. This moderate coordination strength of the hemilabile group is extremely important due to the reversible binding of different species to the catalyst during the course of the reaction. Progress towards the synthesis of the allyl bromide ligand (1) and preliminary results focused on reactions of the ligand with nickel are described. Future work will focus on isolation of the new nickel complex (2) and to study its behavior in hydrogenation reactions.

1) Allyl Bromide ligand



2) Nickel complex with hemilabile group



Chris Bregna Personal Statement

During the 2012 Mentored Undergraduate Summer Experience, I had the opportunity to become immersed in the research environment, which was something I have never done before. I learned many techniques in the laboratory, began to "get my feet wet" with a branch of chemistry that is fairly young and a prime target for research and understanding, and ultimately began to work independently. One of the biggest stepping stones of this summer was taking what I have learned in the classroom and applying it to everyday work. I learned that not everything is black and white like the textbook, where the answers are crystal clear. Rather, every day was a learning experience and a challenge that

was brought upon me. Because of this, the MUSE program helped me to grow intellectually as both a student and as a person.

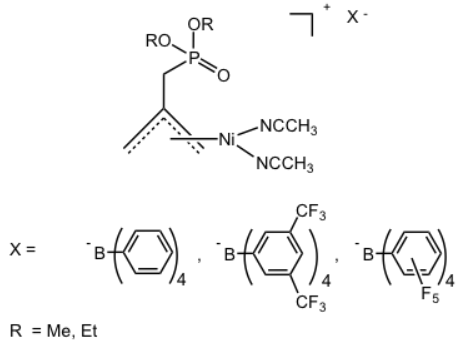
Synthesis and Reactivity Studies of Ni(II) Complexes Containing Hemilabile Groups

Jacob L. Levene, Chemistry
Faculty Mentor: Dr. Abby R. O'Connor

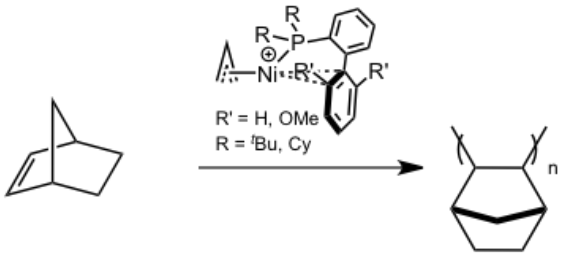
2012 MUSE Project:

Nickel is a transition metal found in the d-block of the Periodic Table. Transition metals can be reactive, making them valuable for use in catalysis. One place nickel is utilized in nature is in the hydrogenase enzyme, a biologically relevant catalyst. As organometallic chemists, we are interested in identifying new nickel complexes for use in catalytic applications. Our work focuses on the rational design of nickel complexes for use in different avenues of catalysis. Nickel complexes catalyze a number of different reactions, including the formation of carbon-carbon bonds. However, an area in which nickel complexes have not been utilized effectively is in the hydrogenation of alkenes. This poster highlights our progress towards the synthesis and reactivity of new nickel complexes containing hemilabile groups. A hemilabile group has the ability to coordinate to a metal to stabilize open sites but is readily dissociated to allow for substrate coordination and further reaction. One focus of this work is towards the synthesis of nickel complexes containing a hemilabile pendent phosphonate arm and weakly coordinating ligands. Ideally, the compound will be stable, yet reactive enough to act as a catalyst. Another area of study is the use of nickel and palladium complexes to polymerize alkenes and dienes. This work also highlights our progress towards studying the reactivity of nickel complexes containing phosphine ligands with hemilabile arene groups to polymerize norbornene.

Complexes for use in hydrogenation:



Polymerization of norbornene



Jacob Levene Personal Statement

The Mentored Undergraduate Summer Experience has provided me with an invaluable experience I shall not soon forget. The opportunity to work side by side with a professor in the laboratory was an ingenious way to learn about the intricacies of chemistry research. The projects I worked on were interesting and practical, but the equipment and instruments I had the privilege of using made the laboratory time even more fascinating. I mean, what twenty year old college student doesn't love playing with liquid nitrogen?

Perhaps the best part of MUSE was the chance I had to bond with some of the Chemistry professors. The weekly lunch gatherings and bagel breakfasts allowed me to see the more personal side of the instructors that take such giddy pleasure in torturing their students. I feel as though I have developed a wonderful rapport with the professors that will last long after my graduation from TCNJ.

Integrating Cloud Services in Application Development

Alexa Cain, Computer Science
Lindsey Nice, Computer Science
Faculty Mentor: Dr. Peter DePasquale

2012 MUSE Project

This project's goal was to develop a web-based application for the TCNJ Admissions Office. The students gained

experience in both theory and implementation of technologies such as Enterprise-level Java, HTML, CSS, Java Server Pages, and MySQL databases. A combination of a Tomcat server and cloud computing via Amazon Web Services was also used to host the project and ensure scalability.

Currently, the admissions counselors at TCNJ collect contact information from prospective students at college fairs using pen and paper. The information is then typed manually into a computer in a process that can take weeks. The application streamlines this process and minimizes human error by offering a web-based form that can be accessed on any tablet, laptop, or smartphone for students to fill out. Data entered into the form is then securely stored in a database, and students receive an immediate email response confirming their interest. Students can also be sent reminder emails about important application dates.

Furthermore, the data collected in the database can be used by the Admissions Department to analyze attended events and students reached. Counselors can track which events reach the highest number of students and plan next year's events accordingly. Eventually, graphs and charts will be integrated to further ease this analysis.

Development on this application will continue in the future in the Computer Science Department. The goal is for the Admissions Department to have a testable prototype to bring to college fairs for testing this coming fall.

Alexa Cain's Personal Statement

Through the MUSE program I have been able to further develop my Computer Science skill set, both covering topics that I would not get to see during normal class sessions and going into more depth in others than the academic year allows for. I now have experience designing an application based on the needs of a real client as well as working with a small team to accomplish this goal. Playing off each other's strengths while maintaining personal responsibility was important for the team dynamic and provided me with motivation to keep working.

When considering our project's audience, I wanted to ensure the applications were as user-friendly as possible while maintaining the security of the data and database. In addition, maintaining accessibility of the product for all users was important to me. When designing I try very much to keep people in mind, and I am grateful that MUSE gave me opportunity to work on such a practical project, especially since it is for the benefit of the TCNJ community.

Lindsey Nice's Personal Statement

My experience in the MUSE program has been invaluable. I have been afforded the opportunity to learn and use many new languages and technologies in a short period of time. I would not have been able to learn many of these things in the classroom; so working with them while being supervised and guided by Dr. DePasquale has been a wonderful opportunity. Working with another student helped me develop my collaboration and communication skills, and my lab partner and I were able to help each other learn and grow throughout the summer. I also learned to be more independent and confident in my work, and sometimes had to teach myself something that I wanted or needed to learn. The knowledge, skills, and confidence that I have gained from this experience will, without a doubt, prove to be incredibly beneficial to my career.

Balancing Open Information Access With Maintaining Privacy, Security And Reliability In The Age Of Social Computing

Francisco Estevez, Computer Science
Shahzore Qureshi, Computer Science
Faculty Mentor: Dr. Monisha Pulimood

2012 MUSE Project

Advances in technology have made it easier to collect and store massive amounts of data. However, it has become increasingly challenging for users to find pertinent, reliable, and current information, particularly for data related to social issues of concern to local communities, for example, environmental justice. SOAP (Students Organizing Against Pollution) is an initiative aimed at empowering citizens of New Jersey to learn, share, and contribute data about brownfields in the Trenton / Ewing area and encouraging them to become participants in advocacy and public policy deliberations on these issues. The main goal of this summer's project is to investigate how crowdsourcing can be leveraged to make this data more reliable while maintaining the privacy and security of users' personal information.

The web-based SOAP system is powered by a database that gets its data from the EPA and other official government websites. The system manages data concerning the location and status of brownfields, chemicals found at these

sites, legislation related to the environment, and politicians who sponsor/vote on such bills. The system is integrated with social networks, such as Facebook and Twitter, and the intuitive user interface includes an interactive map that allows the user to pinpoint locations of brownfields. Users can contribute their own findings to the website, which can be seen by other members as a newsfeed. SOAP embraces the latest trends in modern technology, such as mobile computing, cloud computing and HTML5, and has been designed to store as little information about users as possible to protect their privacy. Upon initial deployment of the system, it will be utilized by journalism students for reporting on environment-related issues. However, the long-term goal is for SOAP to be used by all citizens of New Jersey.

Francisco Estevez Personal Statement

This summer I have been working on developing the web-based SOAP system with Shahzore Qureshi under the guidance of Dr. Pulimood. Since the beginning of the project, I have learned so much about my field, from both the technical aspect and the business aspect. Thanks to the many field trips the Computer Science faculty mentors organized for us, I've been given a first hand look at how websites like Tumblr work, how large data centers operate, and what it takes to work in a corporate research lab. Besides learning about the industry, I've learned a whole new set of programming skills and knowledge concerning dynamic websites, social networking, and database management. The MUSE experience has truly been both educationally rewarding and fun, and has definitely given me a competitive edge as an aspiring software developer.

Shahzore Qureshi Personal Statement

I remember the first meeting I had with my faculty mentor Dr. Pulimood and my research partner Francisco Estevez. My partner and I were quickly overwhelmed by the amount of work that needed to be done and the amount of knowledge that we needed to learn in order to get that work done. The first two weeks were spent researching the technologies and learning the languages we needed, while the rest of the summer was spent applying what we learned to the project. The work we had to do soon became less overwhelming and more enjoyable as we made progress. We also visited companies that are implementing technologies my partner and I are studying on an industrial scale. These visits made us realize how significant and relevant our research is to the real world. All of this work can help us become major competitors in the tech industry. MUSE has given me so much in terms of knowledge and experience, and I hope that my research and contributions will give just as much in return.

Mathematical Model of Tumor-Immune System Interactions

Warren Jagger, Applied Mathematics
Faculty Mentor: Dr. Jana Gevertz

2012 MUSE Project

Cancer is a complex disease characterized by several major "hallmarks" that disrupt the normal state of a cell. My project focused on developing a mathematical model of tumor progression while concentrating on one cancer hallmark: the interaction between a tumor and the immune system.

I developed a 2D system of differential equations that models the rate of change in the number of cancer and immune cells (combination of innate and active). I analyzed the steady state values of the equations, and performed a linear stability analysis to identify how the immune system affects the size of a tumor: does the tumor die out, remain at a benign size, or become malignant? Since there were a large number of unknown parameters in the model, I used MATLAB (a mathematics computer software package) to help explore these and other features of the system of differential equations.

In MATLAB, I wrote scripts to automate the processes of exploring many parameter scenarios that correspond to different characteristics of a patient's tumor and immune system. Data retrieved from the *scripts* allowed me to categorize the number of equilibria and their stability. Next, graphs were made using *pplane8*, a MATLAB function that makes direction fields, to visualize how the number of tumor and immune cells change as a function of one another. Additionally, I used *ode45*, a numerical ordinary differential equations solver, to study how tumor and immune cells grew over time in order to determine how the behavior of a tumor is dependent on the parameter values of an individual "patient".

Expanding our research, we have developed a 4D system of differential equations that incorporates more biological details than our original system. In the future, we hope to analyze this system and implement an immunotherapy term to further our knowledge of tumor-immune interactions.

Warren Jagger Personal Statement

During MUSE, I have worked with Kayla Spector and Dr. Gevertz studying many subjects including cancer, the immune system, and mathematical modeling using ordinary differential equations while also enhancing my collaborative skills and interdisciplinary knowledge. Researching an interdisciplinary topic has allowed me to see how my mathematical training can be utilized to better understand complex biological events. My work this summer has taught me how to analyze primary literature, convert that knowledge into a mathematical model, perform analysis on the model, use computer software to better understand mathematical equations, dissect data, and interpret the mathematical results in a biological context. Additionally, MUSE has allowed me to explore cutting edge ideas and live as a researcher. From my experience, I believe I have an increased ability to approach an unsolved problem, and communicate my findings to individuals of various backgrounds, including biologists and mathematicians. All told, I believe I have gained valuable tools that will help me as a student and a future employee.

A Mathematical Model of Cancer: Tumor Growth & Invasion

Kayla Spector, Physics
Faculty Mentor: Dr. Jana Gevertz

2012 MUSE Project

The focus of this project was cancer cell invasion, the process by which cancerous cells leave the primary tumor site and enter healthy tissue. Invasion is the first step of metastasis, the formation of secondary cancer colonies. My goal was to build a mathematical model which accurately describes how the tumor microenvironment impacts cancer cell proliferation and invasion.

Using MATLAB, I developed a computational algorithm based on biological knowledge of how cancer cells grow and invade. It involves several components: proliferating, invasive, hypoxic (low oxygen), and necrotic (dead) cancer cells as well as the extracellular matrix (ECM) which surrounds them. The algorithm is initialized by introducing a small tumor in a simulated tissue region containing an ECM of uniform density. A novel feature of our biologically-based algorithm is how cancer cells interact with the microenvironment: the probability of division and invasion depend on pressure imposed by the ECM, and if a cell divides, the location of the daughter cell is determined using physical and geometric constraints of the microenvironment. Further, physically-motivated functions are introduced for "pushing" the ECM as a tumor grows.

Using these rules we can study the dependence of tumor growth on ECM density. Tumors that develop in higher density environments are characterized by a small necrotic and hypoxic core with large amounts of branching and a higher probability of invasion, while low-density environments foster tumors that are more circular and isotropic with less invasion. These findings are consistent with biological studies. While we currently determine the probability that a daughter cell becomes invasive, our simulation of invasion is incomplete. Once this aspect of the algorithm is developed, we would compare our output with experimental data and possibly calibrate parameters. Eventually, a more complex microenvironment could be implemented to include blood vessels, non-uniform ECM density, and drug therapy.

Kayla Spector Personal Statement

This summer I learned about the biological and physical aspects of tumor growth and invasion. After immersing myself in biological literature, I was challenged with transforming experimental observations into an algorithm that could produce life-like results. After studying published algorithms, I determined what aspects of biology were most important and yet unaccounted for and began designing our model. In order to accomplish this, I began by expanding and imitating existing models, which taught me how to put modeling techniques into practice. In doing so, I built upon programming knowledge that I had acquired in my courses while developing new skills in debugging, coding cellular automaton models, and recursive coding. Finally, I learned how to translate a biological phenomenon that was largely influenced by physical constraints into a program. I found it both interesting and challenging to develop the dynamic relationship between different aspects of this algorithm, but also highly rewarding when the results were in agreement with published biological research. I am grateful for the chance to approach a biological problem from a new angle.

Eastern United States Crust Characterization

Melanie Crampton, Physics Secondary Education
Faculty Mentor: Dr. Maggie Benoit

2012 MUSE Project

The lithosphere of east coast of the United States has been modified dramatically by two different supercontinent cycles over the past 1.2 billion years. A supercontinent cycle involves continental collision and subduction as tectonic plates converge, as well as rifting as the continental plates break apart and diverge. The Northeast of the United States has been a site of numerous collisions and rifts during these supercontinent cycles. In order to learn more about the structure of the Earth in the past as well as the process of rifting, we can examine the crust of the Earth in the Northeast to determine exactly where rifting occurred and why it occurred. This summer, we analyzed gravity data collected by the United States Geologic Survey to help understand the crustal structure. Gravity can enact a different amount of force on certain areas on the surface of the Earth based on the density of the materials under the Earth's surface. The thinner the crust, the shallower the high-density mantle is to the surface, creating a stronger gravity force in that particular area. In order to analyze the gravity data, we used two different techniques: inverse modeling to estimate crustal thickness values and analysis of the gravity gradient, which shows finer scale variations in the gravity data. To inverse model the gravitational data, we used a Matlab program, 3DINVER.m. This program inverse models the data in the frequency domain and then Fourier transforms the results to calculate crustal thickness values. The inverse model results correlated very well with crustal thickness values found using seismic analysis, except in the area of the Scranton gravity high. Here, 3DINVER.m estimated a thin crustal thickness based on the high gravity values, while seismic analysis predicted a much thicker crust. This discrepancy confirmed our hypothesis that the Scranton Gravity High is the location of a failed rift basin from ~ 1 billion years ago. Analysis of the gradient of the gravity data along with known fault lines suggests that there are likely small scale variations in crustal thickness that are unexplored along the margin. More detailed seismic studies are needed to confirm these results, but these studies would help elucidate the location and scale of known and unknown rift basins along the eastern margin of the US.

Melanie Crampton Personal Statement

This summer I not only learned a lot about geology, but I learned about collaboration and research. Science is not something that is discovered in one day by one person, but is rather a learning process, leading to dead-ends, but also to moments of great accomplishment. Dr. Benoit helped me to understand this, as well as personal responsibility and perseverance, while still working as a team with her. I learned to question, to problem solve, and the value of patience and dedication. Overall, this was such a rewarding experience and I am so happy that I was able to be a part of it. In the future, I would love to work on more geophysics research and to bring what I learn about the scientific process into the classroom to share with future students.

Mesoscopic surface structures of ice crystals more prevalent than thought

Andrew Miller, Physics
Faculty Mentor: Dr. Nathan Magee

2012 MUSE Project

We studied the optical properties of ice crystals using environmental scanning electron microscopy (ESEM). The ESEM allowed us to image the mesoscopic surface of ice crystals, and rough surface topography (including linear strands, crevasses, islands, and steps) was discovered at an unprecedented level of magnification: 10,000x. We used an ESEM because light microscopy – a competing way to study ice crystals surface structure and shape — has proved to be a limiting factor in studying the mesoscopic surface of ice crystals, for the light prevents any visible roughness to be seen. Other scientists have seen surface architecture using an ESEM, but they either limited their observations to a certain face of the ice crystals, or confined their observations to a narrow range of morphologies, substrate selections, temperature s, and nucleation and growth rates. We believe that these scientists misinterpreted their data due, in part, to the effects of the angle from which the ice is viewed, as well as the brightness and contrast setting on the ESEM. A better understanding of the mesoscopic surface of ice crystals could lead to improved light scattering models of ice crystals – currently a chief problem in atmospheric science – and a more thorough account of thunderstorm electrification: how ice crystals collide and interact to become charged and create lightning, essentially. Additionally, our results represent the beginning of a quantitative catalog for the prevalence, scale, shapes, and symmetry of these surface features. This cata-

log is absolutely necessary for climate change science due to a long history of conflicting satellite observations, aircraft measurements, and modeling of cirrus and mixed-phase clouds.

Andrew Miller Personal Statement:

Working with Dr. Magee has been worthwhile. I was able to work intently on our project each day, which allowed me to develop a sense of ownership of the project. When I did research for Dr. Magee during the spring semester, I felt I was helping out with his project, for I watched him build all of the equipment necessary, and I waited for him to give his opinion on something before I offered mine. However, participating in MUSE ignited a passion for our project, as in, I wanted to go to Princeton to image the growing ice crystals, I wanted to play an instrumental role in writing our paper, and I wanted to start using the heavy machinery that I was too afraid to use during the semester. During MUSE, I finally learned how to speak the language of ice crystal science, which allowed me to do more than just ask questions as I did during the semester: I was able to actually have an opinion in our discussions.

Tornadogenesis

Megan Hartline, Early Childhood Education and M/S/T
Faculty Mentor: Dr. Nate Magee

2012 MUSE Project

This summer Melanie Crampton, Walter Ingram, and I worked with Impress-Ed, a program funded by NASA that gives future science educators the opportunity to learn more about earth science by participating in focused research in either astrophysics, geophysics, or atmospheric physics. During the first two weeks of the program, we were engaged in the "common module", where we learned content involved with those fields of earth science from Dr. Magee, Dr. Benoit, Dr. Wiita, and Dr. Kavic. In addition to content, we learned science pedagogy by discovering helpful resources available in the science community.

Following the two weeks, we were each paired with a mentor based on the field in earth science we were interested in. I worked with Dr. Magee in atmospheric physics. More specifically, I focused on tornadogenesis, which is our current understanding of how tornadoes form. Using NASA's A-Train satellites, particularly CloudSat, as well as records of tornados from the past six years available through the National Weather Service, I was able to find times when the satellite passed over a thunderstorm that produced a tornado. A computer program, originally written in MatLab by Rachel Goldberg with Dr. Magee in the spring, was designed to scan every day since 2006 and formulate a list of these matches with respect to close latitude, longitude, and time. The CloudSat satellite gives us more information about the reflectivity and altitude of the clouds in its path, which helps to understand the formation of tornados. After the lists were devised, I narrowed down the matches in more detail by using the images from Calispo and MODIS, two more satellites in the A-Train, to find thunderstorms with not only a close match between the time of the tornado touchdown and the satellite overpass, but also significant reflectivity and altitude. I focused in on one F3 tornado from May 2nd, 2010, which touched down on the border of Mississippi and Tennessee. Using the National Weather Service's Weather and Climate Toolkit, I was able to look at the base reflectivity, storm relative velocity, base velocity, and enhanced echo tops of the section in the thunderstorm where the tornado was formed. From there, I compared the current understandings of tornadogenesis with the results I found through these satellite images.

Megan Hartline Personal Statement

The Impress-Ed Program has given me the opportunity to further my knowledge in the field of science education. I was able to engage myself in research that furthered, not only my knowledge of atmospheric physics, but also earth science as a whole. The tools I learned from being apart of this program have helped me grow as a future educator even more. By providing the right tools and direction, Dr. Magee helped guide me towards independent research in tornadogenesis. I had the opportunity to fully immerse myself into my project and was rewarded with promising results and a new knowledge for the subject material.

Two-dimensional surface mapping of second harmonic generation in nonlinear optical materials

(Funded by National Science Foundation DMR-RUI award #1138146)

Jan Brauburger, Physics
Dacoda Nelson, Physics
Faculty Mentor: David J. McGee, Physics

2012 MUSE Project

Nonlinear optical materials are integral to applications in spectroscopy, medical diagnostics, and telecommunications. Novel high performance materials generate nonlinear optical effects through controlled alignment of highly conjugated dipolar molecules. Spatially probing this alignment on a material surface is critical to the development of these materials, yet is possible only through techniques such as second harmonic generation (SHG). In this project, physics students Jan Brauberger and Dacoda Nelson worked with faculty mentor David McGee to develop a scanning optical imaging system to map the SHG generated by a nonlinear optical material pumped by a high intensity pulsed laser beam. The system was controlled by computer and preliminary results using calibrated nonlinear optical crystals indicate that the SHG over a 1 cm^2 area can be mapped with a resolution of 1 mm^2. Future work will involve the addition of imaging optics to increase the resolution and total mapped area.

Jan Brauburger Personal Statement

This research opportunity gave me the chance to get a feel for what I would do with my degree in physics, and it confirmed my choice in major. I also gained considerable experience in optics, materials chemistry, and how to work in a lab. I learned Labview, a programming language commonly used in professional labs. This job was my first step towards becoming a professional physicist and will hopefully help me get accepted into an NSF-REU (Research Experience for Undergraduates) program next summer, as well as bolster my resume for graduate school. I was able to work quite independently, and I feel like the work I did was significant to the scientific community. I received great guidance and help from my research professor, Dr. David McGee, and my coworkers, Michael Erickson, Mina Shenouda, and Dacoda Nelson, but throughout the summer I still had the freedom to be able to grow in my field and learn much about applied and theoretical physics.

Dacoda Nelson Personal Statement

Being in the MUSE program has been an ideal opportunity to hone my professional skills. I strongly believe it's made me a more viable candidate for further research programs and graduate school. MUSE has given me an inside look at how research is done in the real world, as opposed to the broader methods learned in the classroom. In addition, working with a professional in the field and with peers of my own was a great opportunity. Being in a lab isn't just about flipping the switch, it's also about communicating, meeting deadlines, and staying organized. I'd assumed there would be a certain amount of this, but getting acclimated to it in the sort of nurturing environment that MUSE provides is much less stressful than simply walking into a lab that expects these skills are already honed. In short, MUSE has given me a very competitive edge over other applicants in my field and it's also given me a new appreciation for aspects of research I'd never have considered had I not experienced them firsthand.

Optical control of birefringence in chromophore-functionalized nanotube films

(Funded by National Science Foundation DMR-RUI award #1138146)

Mina Shenouda, Physics
Faculty Mentor: David J. McGee, Physics

2012 MUSE Project

Carbon nanotubes constitute a relatively new class of nanostructures with unique mechanical, electronic, and optical properties. They find applications in multiple technologies such as microelectronics, image display, and optical sensing. One particularly promising architecture is functionalized carbon nanotubes, in which an optically active azobenzene chromophore is bound to the nanotube surface. The chromophore can switch between *trans* and *cis* configurations in the presence of light, a property which can then be used to optically modulate the electronic properties of the nanotube. In this research, Mina Shenouda worked under the mentorship of Dr. David McGee to build an experiment to measure the photoswitching properties of single-walled carbon nanotubes functionalized with the commercially avail-

able azo dye Disperse Red 1. The experiments focused on measuring subtle changes in refractive index while the nanotube-chromophore samples were irradiated with an Argon laser. Preliminary results using modest laser powers of 1 mW revealed refractive index changes of 0.01 for nanometer-thick samples, which is sufficient for many proposed applications.

Mina Shenouda Personal Statement

This is my second summer participating in the MUSE program. Last summer's work set the stage for my research throughout the past two school semesters and this summer I was able to collect data worthy of publication. Under the constant guidance of faculty mentor Dr. McGee and with the aid of my fellow lab members, I was able to complete an efficient, reliable experiment and perfect a program to operate its devices using the programming language LabVIEW. I learned how to read and analyze dozens of articles and sources, and compiled a literature survey which served as a guide for our research and data collection. I learned how necessary it was to document and keep backups of all my data. The MUSE program has been one of the most influential and beneficial experiences I ever had. I am currently applying to MD/PhD programs, and the skills and knowledge I will be taking from this experience will help me throughout the rest of my academic and professional career.

Blazar Research Using the Kepler Satellite: A Search for Periodic Variations

Paolo Di Lorenzo, Physics
Mitchell Revalski, Physics
Daniel Sprague, Physics
Faculty Mentor: Dr. Paul Wiita

2012 MUSE Project

During the summer of 2012 Paolo Di Lorenzo, Daniel Sprague, and Mitchell Revalski conducted research in the field of active galactic nuclei under the advisement of Dr. Paul Wiita. The purpose of this research project was to search for periodic luminosity variations in a class of active galactic nuclei known as "Blazars" using the Kepler space satellite. The Kepler satellite is used to search for exoplanets (planets outside of our solar system); however, it has the advantage of nearly uninterrupted viewing over long time scales since it is a satellite in an earth trailing orbit. We can use this nearly continuous and high precision photometric data to carefully study how galaxies with active cores vary in brightness over time. In particular, we hope to learn more about the physics of accretion disks (material encircling the central supermassive black hole) as well as relativistic jets beamed outward from these central sources. These relativistic jets emanating from the core are pointed close to our line of sight (similar to staring right into a flashlight), and gives rise to the term "Blazar". Evidence of quasi-periodic variations would help to better support certain models of relativistic jet physics and accretion disk theory.

In the past evidence has surfaced that these periodic variations exist, however for the targets which we researched during MUSE, we found little evidence of this behavior. Our group work consisted primarily of correcting the data for instrumental effects so it could be processed properly. In addition we created our own programs using a variety of languages to evaluate the data. The primary tools used to evaluate the corrected and uncorrected data were power spectral densities, structure functions, and periodograms. Future work in this area includes processing data which is not yet available for the same target objects, as well as looking at data available for other objects of the same type.

Mitchell Revalski Personal Statement:

Working through MUSE with my collaborators Paolo Di Lorenzo and Daniel Sprague has been a rewarding experience. We gained a great deal of knowledge in programming, data analysis, mathematical techniques, as well as having a lot of fun along the way! In addition to our work on active galactic nuclei we also worked at fixing up the fluid dynamics lab including construction of a self-designed x-y axis camera platform. Our adviser, Dr. Wiita was always helpful and taught us a great deal throughout the course of the summer. Being able to focus solely on a project such as this, with helpful and patient teachers both faculty and student alike, allowed me to learn what would otherwise take many months to acquire were it attempted alone. I strongly believe MUSE is one of the most worthwhile programs available at TCNJ, and hope to participate again in the future!

Paolo Di Lorenzo Personal Statement:

(Funded by NASA Grant Kepler GO NNX11AB90G)

My summer research under Dr. Wiita and in collaboration with Daniel Sprague and Mitchell Revalski has provided me with a wealth of information and data processing techniques in the field of galactic astrophysics. After data was downloaded from the Kepler database, it underwent a series of rigorous adjustments and manipulations in order to fix the various nuances in the data caused by the satellite. In doing this, I was required to write several programs in Mathematica, C++, and FORTRAN. Once the data was corrected, periodic analysis was performed on the data using structure functions and power spectral densities. The knowledge learned in doing this is applicable to a very wide range of physics, including electronics, geophysics, and everything in between. As a side project for the summer, we also collaborated in constructing an XYZ stage with which to mount the camera in Dr. Wiita's fluid dynamics lab to allow a full range of motion for the camera in precise increments. Building the stage allowed me to gain valuable experience in machine shop safety and techniques. My plan is to pursue a graduate degree in computational astrophysics so the experience gained this summer through MUSE will be greatly beneficial.

Daniel Sprague Personal Statement:

This summer I worked with Dr. Wiita, Paolo Di Lorenzo, and Mitchell Revalski on a combined project involving Blazar periodicity and Dr. Wiita's fluid dynamics lab. Computational methods were used to analyze data from the Kepler satellite telescope and the results were analyzed to see if there were any underlying periodicities in the data taken from the telescope. In the fluid dynamics lab, the prior setup was changed to include a significantly larger tank and a hand-machined camera stand built to allow for accurate leveling for future experiments.

Density of Active Galactic Nuclei at Various Redshifts

Walter Ingram, Physics
Faculty Mentor: Dr. Paul Wiita

2012 MUSE Project

The goal of this project is to determine the density and fraction of Active Galactic Nuclei (AGN) in different redshift bins: we chose .01-.03 (close distance); .4-.5 (medium distance); and .7-.9 (far distance). By looking at random parts of the sky using the NASA Extragalactic Database (NED) we were able to obtain a survey of about 500 close objects, 250 medium objects and 150 far objects. By entering right ascension and declination coordinates into NED the search returns all objects within a 20-arc minute circle that have been found by various satellites and telescopes around the world. Each search can return anywhere from 0-10,000 results. However, most of these objects have not been thoroughly researched and do not have redshift determinations. By adding redshift to the search criteria we get results that are almost all previously studied objects that have been defined as Galaxies, Quasars, UV Excess, or Radio Excess. We found that at the smallest redshift it is easiest to find objects; however, the odds of finding an AGN are very low. At the medium and large redshifts finding objects takes more trials, but we find greater fractions of AGN. There are two main reasons for this: (1) there are more AGN's in the past and the bigger the redshift the farther back in time we are looking; (2) AGN's are much more luminous and outshine other galaxies around them, so at farther distances we cannot see the dimmer galaxies but we can still see Quasars and Seyfert Galaxies. Our survey of randomly selected patches on the sky included less then 1% of the entire sky. To do this project more thoroughly one would expand the survey and look at more patches of the sky and make corrections for the selection effects that favor the detection of Quasars.

Walter Ingram Personal Statement

The MUSE and IMPRESS research programs have provided me with a unique opportunity to experience research firsthand and integrate it into the classroom. In the first two weeks I picked up valuable teaching skills during the common module. I'm excited to use these skills during my junior professional experience this upcoming fall. During my mentored research I got a chance to learn the processes and procedures behind research. In a short few weeks I learned more about Astronomy and Cosmology then most learn in a semester. Since I will be going into the secondary education field research is something that not many others will have on their resume. After my experience with the MUSE program this summer I am excited to become involved in other research programs in the future. I am grateful for the opportunity to be part of MUSE and I know that the skills acquired during the past 8 weeks will help me in the future as both a scientist and a teacher.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