The College of New Jersey

Mentored Undergraduate Summer Experience

2010 Abstracts

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2010

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Mentored Undergraduate Summer Experience – 2010

The TCNJ student and faculty participants in the Mentored Undergraduate Summer Experience (MUSE) created a vibrant scholarly community of faculty-student collaboration for eight weeks this summer. Our community was truly multi-disciplinary, with 73 students and 44 faculty members representing 17 Departments, Programs, or Centers, from all seven Schools.

The students engaged in authentic research or creative projects full-time, as junior collaborators with their faculty mentors. In addition, we gathered twice weekly as the MUSE community for food and conversation across the disciplines. Faculty mentors and staff led participatory workshops at Monday lunches on the research process, interdisciplinary, winning fellowships, diverse career paths, preparing for graduate school, and how to create research presentations. On Thursday afternoons we enjoyed refreshments while hearing from many students about their ongoing projects. Social activities like canoeing the Delaware River, ice cream socials, and the weekly soccer match also encouraged MUSE participants to build community outside of work. In addition, students enjoyed a series of coordinated, fun evening activities. Thirty-nine students were housed together, providing unlimited opportunity for making new friends and interacting informally with fellow scholars of widely varying interests.

This wonderful program was possible because of the generous support and dedication of many people and organizations. The Director and all of the students and faculty of MUSE extend our deepest thanks to the Office of Academic Affairs, with leadership from Provost Carol Bresnahan and Vice Provost Mark Kiselica and invaluable administrative support from Janice Huang; student program assistant Sadia Tahir; the Offices of Residential Education and Housing, Conference and Meeting Services, Catering Services, Finance and Business Services, and every School and Department office and Chair with MUSE students, for administrative support. We also thank the Faculty-Student Collaboration Committee for guiding the vision of MUSE, reviewing proposals, and selecting participants: Matthew Bender, Candice Feiring, David Hunt, Donka Mirtcheva, Jeff Osborn, Nick Ratamess, Ralph Reed, Jess Row, Greg Seaton, and Karen Yang. The program is possible due to major financial support from Academic Affairs, with supplemental funding from the School of Business (Dean William Keep), School of Science (Dean Jeffrey Osborn), School of Culture and Society (Dean Ben Rifkin), and the School of Nursing, Health and Exercise Science (Dean Susan Bakewell-Sachs).

We are very grateful to our generous external funders, the American Chemical Society Petroleum Research Fund, American Society of Plant Biologists, Bristol Myers Squibb, the National Science Foundation, and Research Corporation.

Janet Morrison

Director of Faculty-Student Collaborative Activity and MUSE

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From the "Burg to the Barrio

Nick Donnoli, Communication Studies
Faculty Mentor: Susan Ryan

2010 MUSE Project

During the past two months, Susan Ryan and her student collaborator Nick Donnoli have worked together to continue production of a video documentary about the changing characteristics of the Chambersburg area of Trenton. Together they have shot new footage of interviews with business owners, community members, former residents, and police officials as well as logged and organized more than 25 hours of previously shot footage. This period of collaboration has been extremely valuable for the editing process needed to complete the video.

Long recognized as the Little Italy of Trenton, famous for its Italian restaurants, bakeries, and groceries, the 'Burg is also a well-established working class neighborhood where Italian families lived in close proximity to local businesses and to each other. Today, the 'Burg still attracts immigrant families, but this time they are from Guatemala, Costa Rica Ecuador, and other Latin American countries. Italian bakeries continue to bake bread and pastries daily,, but they have been joined by bodegas and restaurants catering to the Latino population. 'From the Burg to the Barrio' shows an ethnic neighborhood in transition with all the pressures and contrasts as differing cultures meet. Entitled, "From The Burg to the Barrio," the video will show not only the differences, but also the many common issues and concerns of residents trying to live their lives during challenging economic times.

While Nick had previously produced his own documentary videos, this project gave him the opportunity to work with footage shot by others over different time periods. The intense period of collaboration enabled him to understand the challenges facing professional documentary editors who work with producers to create compelling stories and convey accurate information from large quantities of footage during the editing process.

The documentary will show some of those changes from the inside as the neighborhood struggles to survive; older inhabitants flee for the suburbs and current residents of different backgrounds try to live together. We see how residents action to improve their quality of life through the Chambersburg Civic Association and the efforts of community policing in the East Ward. In the face of growing economic pressures, tensions between the older Italian residents and their newer Latino and African American neighbors, between home owners and renters, between those that remember how it used to be, and those that have hope for what the neighborhood will become.

Nick Donnoli Personal Statement

Working with Dr. Ryan on "From the Burg to the Barrio" has certainly been one of the most challenging projects I have ever undertaken. I came into the documentary with an already overwhelming amount of video and information, and was nervous that, with everything that already existed, we were going to get even more. While challenging to manage and connect all of the story lines, the project was a great learning experience because I had to familiarize myself with the story and material, which was very different from working on a class project where I usually had a hand in its development. Working alongside Dr. Ryan was also like working in a professional atmosphere because she always wanted my honest opinion and would appreciate my comments. She trusted my decisions and had full confidence that I wouldn't steer the project in the wrong direction. Unfortunately, the project was not finished during the short two-month period, but I'm glad I was able to assist Dr. Ryan and meet some very kind people in Chambersburg along the way.

Statistical Analysis and Information Retrieval on Boston Symphony Orchestra Data Set

Timothy Song, Biology and Computer Science
Faculty Mentor: Dr. Teresa Nakra

2010 MUSE Project

In April 2006, Dr. Nakra led a collaborative effort between TCNJ, McGill University, and the Boston Symphony Orchestra to measure the emotional responses of musicians and audience members during a live concert. This resulted in a very large data set consisting of heart rate, muscle activations, galvanic skin responses, and movement data from accelerometers and sliders. Due to the large amount of data acquired, much in-depth analysis was needed. Our approach has been to first identify meaningful musical questions about the data, and then to develop quantitative methods to help us find answers.

One such example is to understand why a conductor's heart rate fluctuates and if that is a key factor in understanding

the relationship between emotion and music. Finding answers involves many steps combining computer science, physiology and music: filtering the raw data, analyzing data for coherence, and learning about heart rate variability. We hope to fully analyze the EKG of six musicians for a single composition and retrieve a significant correlation that would help us understand how music and emotion can be observed as physical phenomena.

Personal Statement

This program was a great opportunity to do research that I could not normally do during the school year and it was also something that appealed to all of my disciplines. I did not really know what to expect when going into this project, but from it I learned much more about which computational programs to utilize when approaching each unique problem. I have also learned much more about the physiology of our heart and that there seems to be something intrinsically connected to music. I also have had the privilege of working with Dr. Nakra who was very encouraging and understanding through many of the obstacles encountered while working on the project. In addition, it is always amazing to see how diverse and talented the faculty of TCNJ, such as Dr. BuSha and Dr. Salgian, and that when I needed to approach solutions to problems that were out of my scope I could ask them for guidance.

William Grant Still's Suite for Violin and Piano and Folk Suite No. 4: A Blending of Classical Music and African American and Latin American Folk Traditions

Francesco Composto, Music Education
Rachel Smith, Music Education
Faculty Mentor: Dr. Ralph Russell

2010 MUSE Project

This summer we worked with Dr. Ralph Russell in the Mentored Undergraduate Summer Experience program to perform and research the life and works of William Grant Still, an African-American composer from the twentieth century. Still is one of the quintessential "American" composers because of his diverse musical background and unique compositional style. We started our research by analyzing *Suite for Violin and Piano* (1943) and exploring the various compositional styles utilized in this work. Our analysis focused on theme and thematic development, modulations to closely related and foreign keys, and harmonic progressions. We also examined how the piece was influenced by the ultramodern compositional style of Edgard Varese, the folk art of the Harlem Renaissance, and the melodies of American folk music.

The second part of our research focused on analyzing *Folk Suite No. 4* (1962) and the Latin American folk music influences on each short movement. This three-movement work consists of folk songs from Venezuela, Mexico, and Brazil. For example, in "El Monigote," Still used a melody and the *Joropo* form from Venezuelan to compose this lively and rhythmic first movement. We also compared this *Folk Suite* to *Folk Suites No. 2* and *No. 3*, which were influenced by the melodies and rhythms of America, Mexico, and Peru.

The primary goal of our research was to examine how Still's music is a product of the composer's musical training, performing experiences, and interest in American and Latin American cultures. In the future, we plan to present a lecture and concert at TCNJ, as well as present our findings at a music conference. We plan to continue our research on Still's life by looking at various writings and other primary sources to deepen our understanding of his style.

Rachel Smith Personal Statement

While participating in the MUSE summer research program with Francesco Composto and Dr. Ralph Russell, I improved my research skills and learned how to work collaboratively on a major project. I really enjoyed having the time to not only analyze various musical compositions by William Grant Still, but to also look at Still's background and the context surrounding the pieces. This project is the first time that I have been able to look in-depth at multiple aspects of a composition, and I have learned a lot about how to combine different pieces of the same composition to make a coherent whole. The MUSE programs and speakers have also been very beneficial and by helping me decide on my plans for after graduation, and given me more confidence and direction for the future.

Francesco Composto Personal Statement

Working with Rachel Smith and Dr. Ralph Russell this summer in the Mentored Undergraduate Summer Experience was both rewarding and revealing. The research process has taught me that you may begin research in one

direction but over time the process changes and you discover new and fascinating things you did not imagine you would find when you started. Understanding the compositional style of twentieth century composer William Grant Still has made me appreciate my work as a musician and has given me a new sense of awareness of the surrounding cultural and historical climate that is responsible for every musical composition. Still's Suite for Violin and Piano has made me utilize my collaborative skills in performance and has made me view the piece on a whole new level. Performing the piece helped me discover the composer's unique style and helped me see how one theme can cycle through the entire work in an innovative way. I hope that the work we did this summer contributes to future research of this unique composer.

Food Stamps and Obesity: An Economic Perspective

Andrea Ortu, Political Science
Meaghan Vitale, Economics
Faculty Mentor: Dr. Donka Mirtcheva

2010 MUSE Project

The original purpose of the Food Stamp Program (FSP) at its inception in the 1940s was to protect the lower income population from underconsumption of food and detrimental health implications resulting from hunger and malnutrition. However, in recent years, researchers have noted an unexpected pattern – the highest prevalence of overweight and obesity by income categories occurs among low income population. The number of program enrollees has also been on the rise. These simultaneous occurrences have policymakers examining whether food stamps have a causal relationship with the health and obesity of the recipients. Since the FSP is the largest federal food assistance program, examining whether the program helps or hurts its participants will allow for necessary changes to be instituted.

The first stage of the project was to review the literature already published on the subject. Patterns of obesity among low income men and women of all ages and demographics were examined. Most of the related studies focused on federal food assistance programs and the health and obesity of the program participants, but the relationships between hunger, food insecurity, and health were also indentified. By summarizing the articles, a greater understanding of the relationship between obesity and the FSP was gained. In addition, factors that may further affect this relationship, such as gender, mental health, dietary choices, and poverty limitations, were identified. Thus, we were able to gain an understanding of the problem and identify variables for the regression model.

Using the Panel Study of Income Dynamics (PSID), a nationally representative longitudinal study, with survey waves spanning from 1997 until 2007, body weight and obesity were analyzed as variables dependent on food stamp participation duration to determine if a relationship exists. The results from these models will produce recommendations and have policy implications for potential modifications of the FSP. The project will be continued in order to analyze the relationship between obesity and the Supplemental Nutrition Assistance Program (SNAP), which is the improved FSP recently implemented in 2008.

Meaghan Vitale's Personal Statement

The Mentored Undergraduate Summer Experience has provided me the opportunity to gain skills that will no doubt benefit me in any future endeavors I may undertake. Not only have I learned the life lesson that research always takes longer than one expects, but I have also learned useful researching techniques that can be applied to a variety of areas. Additionally, collaborating with others has allowed me to improve my communication skills; something that I am sure will prove to extremely important throughout my life. Furthermore, the MUSE program has given me other tools that will help me excel in life, such as information about graduate school, fellowships, and interdisciplinary communication. With so much competition today, I am extremely glad that I participated in the program and will forever value the experiences and the knowledge that I have taken from it.

Andrea Ortu's Personal Statement

Participating in the MUSE program has fostered my research and collaborative skills and encouraged interdisciplinary research. As a political science major with a minor in economics, it was enlightening to incorporate both fields within this project. While we initially analyzed the economic relationship between food stamp participation and health, the core of our attention was focused on the decisions made by and options available to low-income individuals, households, and communities. After compiling our data set, creating our own models, and running our regressions, the remainder of the project could focus on the effectiveness of the Food Stamp Program as a whole. Our research targeted which groups and individuals were most negatively affected by participating in the program. Using this data, policy recommendations could be made in order to make a more cohesive and beneficial program. Therefore, MUSE was an opportunity for me to combine both my economics and public policy background while simultaneously expanding my interests and gaining valuable research skills.

Changes in Microfinance after the Global Financial Meltdown: What Models Explain Fund Performance?
Stephen Gadda, Finance Major
Faculty Mentor: Professor Susan R. Hume

2010 MUSE Project

During the Mentored Undergraduate Summer Experience (MUSE), I have had the opportunity to collaborate with Professor Susan Hume, conducting research for the School of Business at The College of New Jersey. We set out to study the performance of public and private funds that invest in microlending. Our goal was to investigate how the global financial crisis has impacted Microfinance Institutions (MFIs) and their practices especially in the U.S. During our summer, we spent time interviewing different professionals in the field of microfinance, from those working with rating agencies that evaluate MFI's through traditional financial measures, and those working on the community impact side of it - seeking to maximize the social return of microfinance. By gaining insights from a broad range of professional opinions, we gathered a diverse and well rounded viewpoint about how the global recession has affected microfinance, in addition to its outlook looking forward. We also met and contacted representatives of well known domestic MFI's such as AccionUSA, Merrill Lynch, Justine Petersen Foundation and Grameen Bank and attended a plethora of microfinance panel discussions in NYC. These interactions and exposures further provided us with a wealth of knowledge regarding the effects of the recession upon different segments of the Microfinance industry.

Stephen Gadda Personal Statement

The MUSE program has helped me in understanding what is needed to conduct a proper academic research project. It has been a wonderful and intellectually immersing experience, and I look forward to working with Dr. Hume in the future continuing our work in an independent study class. Our research together has helped me learn of the true dedication to ones particular field of study that it takes to pursue academic research. Working in MUSE has helped me improve my research and analytical skills, and I hope to continue to develop them in research related studies in the near future.

Outward FDI from China to the United States: A historic comparison with Japan
Michael Okrend, International Studies
Faculty Mentor: Dr. Linghui Tang
(Funded by Dean Keep)

2010 MUSE Project

The goal of this project was to see what the motivations are for Chinese companies going abroad. A comparison was made between Chinese and Japanese outward foreign direct investment (OFDI) of present day China to that of mid 1960s Japan as both had similar economic trends during these respective periods. Under the direction of Dr. Tang I researched the Japanese companies Panasonic and Toshiba and the Chinese companies Haier and TCL. During the MUSE experience I researched the histories of these companies, their international beginnings, and significant oversees ventures. Motivations such as high domestic competition and China's entrance into the World Trade Organization (WTO) have propelled Chinese companies to expand internationally.
After this research was completed a comparison was then made between the Japanese and Chinese companies. Chinese companies tend to hire many more foreigners for executive and other positions. Japanese companies in contrast tend to exclude foreigners from top positions because they are considered to be "outsiders". The term "outsiders" also extends to people that are not part of one's family and not originally employed by the company. This fact has caused Japanese companies to be slower to develop. Chinese companies are more open with the company and want to advance as fast as possible, so not only do they hire foreigners, but they also take part in joint ventures to attain advanced technology. The research gathered during this project helps explain why and how Chinese companies are expanding internationally.

Michael Okrend Personal Statement

Under the MUSE program I have grown as a person. I have learned to schedule my life and focus on achieving set goals. Through the guidance of Dr. Tang, I have learned to work on my own time and manage time accordingly. She has helped me to take large projects and divide it into different steps. The process has helped me to able to read and synthesize much information. One valuable part of the experience was to be able to hear other people's projects and under-

stand what they are accomplishing. I am now more confident in using the school's online databases. I now know which databases to go to for certain information. The confidence I gained from this program will help me throughout the rest of my life, no matter how challenging the task.

An Options-Based Approach to Modeling Operational Flexibility
Joseph P. Gesualdo, Finance and International Business, Business School
Faculty Mentor: Dr. Andrew Carver

2010 MUSE Project

The purpose of this collaborative research paper is to examine the relationship between the stock price of gold-mining companies and the operational flexibility those companies have. This flexibility is evident in the option that gold-mining companies have to expand or abandon operations, depending on the market price of gold. If the price of gold is high, they will expand operations to profit from the demand, just as they would abandon operations if the cost of extracting and processing the gold were higher than the market price. Because of this operational flexibility, we believe that stock prices of gold-mining companies resemble option contracts. Our goal is to prove this by finding extraction costs that are implied by price observations of gold and gold mining stocks. This will give insight into the degree to which companies are exposed to gold price changes.

Joseph Gesualdo Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) has provided me with an educational experience different from any I have ever had. Over the course of the program, I have learned and accomplished things that leave me well prepared to excel in whatever path I choose to take after graduation, whether it be graduate school or the workforce. I was constantly challenged throughout this process, and there were times where I made mistakes, but something was learned from each mistake I made. Also, working independently forced me to think critically through difficult problems and instilled in me academic confidence. I am thankful that I was able to participate in this experience, and I value the intellectual growth I received as a result of this opportunity.

Utopia Online: Realizing the Potential of Social Networks
Nicholas Falcone, Economics
Matthew Turner, Finance
Faculty Mentor: Susanna Monseau

2010 MUSE Project

The goal of our research is to draw attention to a number of legal issues that exist on the internet which are not sufficiently addressed by current laws and are preventing online social networking from realizing its full potential. Social media does benefit society quite significantly, as it allows for freer, quicker and less expensive communication between individuals and allows people who previously may not have engaged in public discussions to do so. However, a relatively uninhibited flow of information is not a complete positive. Polls and surveys have consistently shown that internet users are concerned with the privacy of their personal information online, and these concerns have grown as the social networking industry continues to expand. Privacy concerns, as well as those regarding defamation, reputation, and employment, have manifested themselves; the growth of online social networking has outpaced the development of appropriate regulation, and has therefore placed these communities at the center of a number of legal battles both domestically and abroad. This project details the aforementioned concerns and their manifestations – including litigation, regulatory complaints, and a wave of strong public and academic opinions – and examines the gap between the unique legal issues provided by online social networking and the protection afforded by current law. It argues that online social networking is certainly valuable, but will likely benefit from the development of more adequate regulation.

Nicholas Falcone Personal Statement

Online communicative technology and the social networking industry have developed at a faster rate than cyberlaw, leaving hundreds of millions of users without adequate protection against a host of issues, including online defamation, personal information privacy, and social and professional reputation management. During the course of this project, it is our job to research these issues and user concerns, and their legal ramifications. In an effort to paint a clear picture of the

current legal framework governing online social media, I have learned how to perform a number of tasks, not the least valuable of which being the development of a detailed research plan. I am now more confident in my ability to perform and focus on the more specific aspects of academic research while also maintaining an eye for an overall line of argument that will convey our message in an effective and convincing manner.

Matthew Turner Personal Statement

One of the most prevalent themes in the world today is the social, legal, economic, political, and business impact of social media such as Facebook, Twitter, and MySpace. Never before has it been so easy to market ones product to such a large group of people. Conversely, never before has it been so easy for individual's voices to be heard and made public in an economic landscape dominated by large corporations. While the benefits of social networking are bountiful there are privacy implications of so much personal information being gathered by social networking sites. I set out with Nicholas Falcone and Business Law Professor Susanna Monseau to discover the vastly uncharted area of privacy in the world of social networking. We investigated a plethora of relevant cases and laws to find trends both nationally and internationally. The MUSE program developed my research skills as well as my communication/summarization skills in transmitting often long detailed legal articles/cases/statutes into concise summaries and conversations. Overall, the MUSE program prepared me greatly for my future career plans.

Tracing the Trope of Epiphanal Blackness

Adriana Botti, English
Faculty Mentor: Piper Kendrix Williams, PhD

2010 MUSE Project

This summer I worked collaboratively with Dr. Piper Kendrix Williams during the Mentored Summer Student Experience. The objective of our work this summer was to continue to develop her ideas on her original term "Epiphanal Blackness" and to gain a broader inventory of sources for Dr. William's initial article on the concept. Reaching this goal required research on the idea of "blackness" and what literary critics are saying on the matter. Throughout the summer experience I have read and dissected various texts in order to provide Dr. Williams with a detailed portfolio of quotations on her subject matter.

I began this experience by finding as many secondary texts I could find that related to our subject, and subsequently analyzing each one so that I could present her with the most important quotations. I also read a lot about contemporary race issues in America and discovered that Identity Politics dictate the consciousness and awareness each African American must face with regards to his/ her individual identity.

In addition to discovering the facts about many racial terms, I also began researching the ideas of "power" and "possession" and the interplay between the two with regards to African American identity dating back to the Slave era. The possession of a name, specifically, reflects an African American's grip on his/her own personal identity, and the denial of that name, in contrast, removes his/her grasp on selfhood and thus disempowers.

The work I did this summer helped to expose the static nature of the African American plight towards self-identity and consciousness. For, time is irrelevant when looking to expose the damaging effects society has had on the Black person, as one constant has remained; to be black, and thereby situated on the wrong side of the color line, means to be different in the eyes of American Society.

Adriana Botti Personal Statement

The Mentored Undergraduate Student Experience (MUSE) has benefited my academic career in more ways then I ever could have expected. I initially began research without much knowledge on the field I was studying, but have since developed a number of research abilities, and insight on the concept of "Epiphanal Blackness." I have expanded my researching techniques, my knowledge of the TCNJ library catalog and my experience using prestigious online databases. The connection I have made with my Mentor has provided me with much more academic confidence then I had prior to the experience and has inspired me to be much more invested in my future as an undergraduate, and possibly, in the future, as a graduate student. I am very grateful for the MUSE program and the many avenues it has opened for me as a result of its enriching and invaluable life lessons.

Approaches for Addressing Sexual Identity and Gender Variance in the Secondary English/Language Arts Classroom: An examination of English Journal, 1969-2010

Kate Ondrof, English
Faculty Mentor: Dr. Emily Meixner

2010 MUSE Project

The goal of this summer research project was to examine how *English Journal*, one of the most widely read publications of the National Council of Teachers of English – the national professional organization for K-12 English and Language Arts (ELA) teachers -- has addressed the needs of lesbian, gay, bisexual, transgendered, and questioning students. Beginning with articles published just after the Stonewall uprising in New York City on June 27, 1969 and ending with the journal's most recent volume, we sought to identify: (1) the number of articles on LGBTQ students, teachers, and pedagogy published during this forty year period, (2) the instructional strategies introduced and recommended to secondary (middle and high school) ELA teachers, and (3) the various LGBTQ texts recommended, cited, or incorporated into secondary ELA curricula.

After becoming familiar with current debates about LGBTQ students and pedagogy, Kate started to examine the selected volumes of *English Journal*, identifying, annotating, and coding relevant articles on a wiki where all of our data was housed. This work continued throughout the summer and as the articles accumulated, Kate began to identify trends in the ways in which LGBTQ issues were – and were not – arising in the journal. Specifically, Kate began to note how

and when it was that homosexuality was explicitly recognized, when *English Journal* officially acknowledged the existence of a gay rights movement, the public presence of gay teachers and students in the journal, and the moment when both NCTE and *English Journal* moved from a position of "neutrality" around LGBTQ issues to a position of advocacy for the incorporation of LGBTQ concerns in ELA classrooms.

To supplement her research, in early July, Kate also had the opportunity to view *Stonewall Uprising*, a recently released documentary on the Stonewall riots that was been screened in New York City.

Kate Ondrof Personal Statement

Working with Dr. Meixner on this MUSE project has surpassed all of my previous course experience at TCNJ. I have developed valuable methods of researching and synthesizing significant amounts of data. My findings have introduced me to many new texts, increasing my familiarity with Young Adult literature, particularly that with LGBTQ themes. Looking historically at pedagogical theories and practices—especially the ways in which they are politically and socio-culturally situated—has given me a better sense of the current state of education and my future role as an English teacher. Through MUSE, I have refined my skills in expressing opinions and advocating for my ideas, allowing me to become a significant contributor in my field. This project has enhanced not only my academic skills and pedagogical content knowledge, but it has also aided my professional development, providing me with instructional methods and materials that are both LGBTQ-specific and related to English in the broader sense. Most importantly, the research I have completed will help me develop a classroom that consistently challenges prejudices and embraces diversity.

Overwriting the Dictator: Innovations in Latina and Latin American Women's Autobiographical Literature
Stephanie Kraver, English
Faculty Mentor: Dr. Lisa Ortiz, English

2010 MUSE Project

Over the course of the summer, I have been contributing to Professor Ortiz' project, which explores five Latin American countries: Chile, Argentina, Nicaragua, the Dominican Republic and Cuba, along with the innovations of Latin American women writers under their respective dictators. My individual research focuses on Cuba and Cuban women's autobiographical literature and memoirs, and Cuban history under Fidel Castro. Although there are similarities between Cuba and the four other Latin American countries, my thesis argues that Cuba's exceptional qualities, particularly when studying women's literature, can be understood by Cuba's transformation following the 1959 revolution, and its mandated political and economic opposition to the United States into the twenty-first century.

Primarily, I have studied the literary works of exiles in the United States, and elsewhere, in order to embrace a more inclusive understanding of Cuban women's narratives, and blur the dichotomy between what is 'Cuban,' and what is 'exilic' or 'Cuban American.'
In order to challenge the fixed binaries, which have defined mainland Cubans and exiles through cultural and national division, I concentrate on authors that introduce innovative and fresh perspectives, and reevaluate Cuban identity and culture.

I ground my analysis in postmodern critical theory and performance studies, which encourage experimentation, and criticize narratives that limit the methods of gathering and transferring knowledge. As a nation-state, Cuba is often misunderstood or prematurely defined in opposition to free market capitalism and democracy, without an understanding of Cuba's culture and rituals. Postmodernism and performance studies offer novel interpretations on how to reexamine misconceptions about Cuba through women's literature and identity.
My focus on Cuba will offer insight into Dr. Ortiz' final project -- Cuba in conjunction with, and distinguished from, the four remaining Latin American countries.

Stephanie Kraver Personal Statement

My work this summer has allowed me to expand my understanding of Cuban history and the significance of women's literature. One of the primary obstacles I experienced when addressing literature from Cuba is the availability of uncensored works. My project required creativity to identify women's literature that is considered Cuban, and how a literary approach can offer an innovative perspective when encountering artistic restrictions or limitations. My collaboration with Ivonne Gonzalez and Dr. Ortiz helped me to specify my area of study, and to develop my thoughts over the summer. Although Ivonne and I have been focusing on different Latin American countries, she has extensive back-

ground in Latin American women's literature, and the dictators that the female authors resisted. It has been helpful to share various resources and discuss our respective areas of inquiry in an open dialogue. Dr. Ortiz has been my primary collaborator over the summer, and has offered immense support and direction; she has also challenged me to further refine my thoughts independently, and to develop an organized and cogent argument.

Overwriting the Dictator: Innovations in Latina and Latin American Women's Autobiographical Literature
Ivonne Gonzalez, English
Faculty Mentor: Dr. Lisa Ortiz, English

2010 MUSE Project

My project for the summer of 2010 is a study on the autobiographical works emerging from the Dominican Republic after its 31 year dictatorial regime by Rafael Leonidas Trujillo. I have selected four books to analyze: Angela Trujillo's *Trujillo, Mi Padre En Mis Memorias,* Aida Trujillo's *A La Sombra de Mi Abuelo,* Flor de Oro Trujillo's *Trujillo En La Intimidad Segun Su Hija Flor* and Dede Mirabal's *Vivas En Su Jardin*. I am interested in looking at how these four women convey their memories of a time under the regime and whether there is a way in which the four use a similar method or a similar theme. I believe these stories will exhibit awareness of censorship and fear of offending the supporters of the regime or even those vehemently opposed to Trujillo. Michel Foucalt's theory of panopticon, his claim that our very persons are shaped by the knowledge that our actions are always under public scrutiny is useful in my analysis because it provides a frame through which I can read for evidence of lingering fear of censorship. For several of these authors, public scrutiny is not just a concept but a memory of a not too distant past in which few dared to speak against the Trujillo regime. In my analysis, I am looking into how the concept of panopticon may affect the memories revealed in these texts.

Ivonne Gonzalez Personal Statement

During my time in the Mentored Undergraduate Summer Experience I have had to learn time management, how to hone my research skills and what it truly means to work collaboratively. In most instances I am surrounded by others within the same major but this summer I have had the opportunity to meet and at times work with students from different disciplines whose fields allow them to see different ways to arrive at a solution. It has widened my own vision and tactics when attempting to resolve something. What I have gained from this experience is priceless and will aid in my future endeavors. At the same time I have had the chance to continue to work with Professor Ortiz in this project. Her advice and guidance have made me a better student and I will continue to practice them and strive for better. I truly enjoyed my experience this summer working with Professor Ortiz and Stephanie Kraver and know that it has led me to grow intellectually.

Attention and Memory Functioning in Younger and Older Adults
Hope C. Fine, Psychology
Faculty Mentor: Dr. Tamra Bireta

2010 MUSE Project

Working memory is a short-term memory system with several components responsible for attention, storage, and maintenance of information. The phonological loop component is responsible for maintaining verbal information, and is believed to be responsible for acoustic confusion, word length, and concurrent articulation effects. This summer, Hope Fine and Dr. Tamra Bireta examined these effects to determine if they remain stable with age.

Past research has shown that dissimilar sounding items (e.g., *F M N)* are recalled better than items that sound similar (e.g., B T V), or the acoustic confusion effect; shorter words (e.g., *ant, wrench, rose*) are better recalled than longer words (e.g., *butterfly, screwdriver, lavender),* coined the word length effect. When participants are asked to engage in concurrent articulation (repeating a phrase aloud during presentation of the list items), performance is impaired, and the acoustic confusion and word length effects are reduced. The working memory view predicts this pattern due to the manner in which the phonological loop operates, and this prediction has been confirmed among younger adults. No studies have examined whether these interactions occur among older adults. Across two experiments, participants viewed lists of similar/dissimilar letters or short/long words, sometimes with concurrent articulation. As expected, younger and older adults demonstrated the basic effects. Further, concurrent articulation reduced the effects of acoustic confusion and word length similarly for younger and older adults, suggesting a quantitative, rather than qualitative, difference in the functioning of the phonological loop. This research is important because it can possibly lead to more discoveries about

memory for healthy aging adults and can help people understand what to expect about in their later years.
This summer, Hope Fine and Dr. Bireta analyzed the results of the study and wrote up a manuscript that will be submitted for publication.

Hope Fine Personal Statement

Being involved in the MUSE summer research program has been a valuable learning experience for me. It has provided me with the opportunity to develop a better understanding of the psychological research processes. By being in the MUSE program, I also had the opportunity to be the lab manager for the Memory and Aging Lab this summer, helping to strengthen my leadership skills. I have also gained invaluable knowledge about various databases and software tools, which will be beneficial with my future research experiences at TCNJ and at graduate school. Working alongside Dr. Bireta to write a manuscript for publication has helped to improve my writing skills. Not only did MUSE provide me with the chance to do undergraduate research, it also provided the opportunity to learn about my peers' research experience and to acquire knowledge about other fields of research in which I have no previous knowledge. I look forward to continuing to do research with Dr. Bireta by completing my Senior Honors Thesis next year.

Exploring neighborhood influences on the mental health of emerging adults in Trenton, NJ
Meagan Docherty, Psychology and Sociology
Faculty Mentor: He Len Chung, Ph.D.

2010 MUSE Project

This summer, Psychology and Sociology major Meagan Docherty and faculty mentor, Dr. He Len Chung, analyzed recently collected data to write a manuscript for publication in a scientific journal. Data came from the REACH (Research on Emerging Adulthood and Community Health) project, and data collection occurred over the previous two years (March 2008 – May 2010). The sample for the current project was composed of 127 African-American emerging adults (ages 18 to 25) from Trenton, NJ. Data collection methods included community-based face-to-face interviews that lasted approximately 60 minutes. Examples of analyses included descriptive statistics, bivariate correlations, and path analyses, all done with the help of two data analysis software programs: SPSS and MPlus.
Previous research indicates that both the structure (e.g., socioeconomic conditions) and processes (e.g., social functioning) of neighborhoods can have important impacts on the residents living within them. The purpose of this MUSE project was to investigate the effects of neighborhood influences, specifically neighborhood disorder and social cohesion, on the mental health – depressive symptoms and aggressive behavior – of young adults living in urban communities like Trenton, NJ. We found that, after controlling for important covariates (age, gender, education, and the amount of time spent in one's neighborhood), young adults who lived in neighborhoods with high levels of physical disorder (e.g., garbage in the streets, abandoned buildings) reported higher rates of depressive symptoms and aggressive behavior. We also found that social cohesion moderated the association between neighborhood disorder and aggressive behavior, such that neighborhood disorder was associated with aggression only in communities with low levels of social cohesion. In other words, social cohesion appeared to buffer the adverse effects of neighborhood disorder on aggressive behavior. Our results confirm the importance of studying contextual factors for understanding risk and protective mechanisms regarding mental health in urban communities.

Meagan Docherty Personal Statement

Although I had already worked in the REACH lab with Dr. Chung for two semesters, and served as Lab Manager for one, I felt that this summer's MUSE project allowed me to become more familiar with the data and the analyses we used, more invested in the project, and more comfortable with writing scientific papers. Although I have tried to take advantage of many of the opportunities and experiences available to me at TCNJ, I feel that MUSE has been instrumental in allowing me to become an active participant in a research team and has given me the opportunity to communicate with students and faculty from various fields about scientific projects and findings. I am very excited to be a part of this program, and I know the experience it has given me will benefit not only my TCNJ career, but also my life after graduation, when I hope to continue studying psychology in graduate school. I wish to thank Dr. Chung and the MUSE program for allowing me to have this experience.

A Comparison of Environmental Emigration between Nicaragua & Ecuador

Stephanie Torres, Sociology/Anthropology
Faculty Mentor: Dr. Diane Bates

2010 MUSE Project

In the 1960s and 1970s, international agencies and Amazonian governments funded colonization programs in Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela. In 1968, the US Peace Corps, along with funding from the Inter -American Development Bank and an Ecuadorian state agency (CREA) helped to identify appropriate colonists in the relatively poor Andean highland provinces of Azuay and Cañar to settle Amazonian lowlands in the adjacent province of Morona Santiago, founding a community called Sinaí. This research project is a continuation of a manuscript based on research completed in Sinai, Ecuador. The purpose of this project is to conduct a comparative study of environmental emigration, with a focus on natural disasters in Ecuador and Nicaragua. Sinai, Ecuador has been experiencing environmental deterioration due to farming practices. Nicaragua also has been experiencing environmental deterioration and is greatly susceptible to natural disasters. In 1998, Hurricane Mitch was the second deadliest hurricane to hit the Atlantic. During the hurricane, tremendous amounts of rain triggered mudslides and landslides that washed away crops, animals, buildings, roads, and bridges. Natural disasters, that strike developing countries, can cause people to migrate in order to find economic work. *Environmental Refugees* includes people who migrate from their usual residence due to changes in their ambient non-human environment (Bates 2002). Preliminary steps have been taken for research in Nicaragua. Dr. Diane Bates has taken a field visit to Nicaragua and I have completed a review of national statistics and journal articles which have discussed the topics of Hurricane Mitch and environmental emigration.

Stephanie Torres Personal Statement

Every summer since the 7th grade, I have participated in various educational and internship programs. MUSE has been the first of my summer experiences where I have dedicated my time to environmental sociology. I have learned the importance of society's role in protecting and cultivating the environment. I had the privilege to read and comment a portion of the manuscript Dr. Bates has been working on. I have enjoyed learning about the research conducted by Dr. Bates in Sinai, Ecuador. I also was able to work on a project that could be added into the manuscript. This program has stretched me academically, professionally, and personally. All in all, MUSE has allowed me to see what I can expect in a career in research.

Exploring the ambiguities associated with collaborative teaching experiences of educators in New Jersey: A pilot study

Gabrielle Minervini, Elementary Education & Mathematics
Faculty Mentor: Dr. Nadya Pancsofar

2010 MUSE Project

This summer I worked under the direction of Dr. Nadya Pancsofar in the Mentored Undergraduate Summer Experience. The goal of our work was to research the topic of collaborative teaching in New Jersey. Co-teaching, commonly regarded as collaboration teaching between special education and general education teachers in a shared classroom space, has become highly recommended in the field of Education for supporting inclusive practices and the full integration of children with disabilities in general education settings (Friend & Cook, 2009). However, very little is known about the effectiveness of training or the actual experiences of educators in collaborative teaching situations.

The research process began with an extensive literature review of co-teaching, its practices and models. I continued investigating by transcribing an hour and a half focus group with teachers currently in co-teaching positions. To date, I have conducted ten interviews with general and special education teachers in district throughout New Jersey. I transcribed most of the interviews and coded for themes, sub-themes, and nuances. Through the coding process, the issue of ambiguity in collaborative teaching situations became obvious.

Through the literature review and synthesis of interview data, it was concluded that teachers, generally, seek guidance in understanding co-teaching in four areas of their professional workplace including: district and supervisors, pre-service training, in-service training, and professional experience. There is a need for clarification of expectations and evaluations among the co-teaching professionals within districts, schools, and classrooms in order to ensure the success of all students.

The research this summer will support a manuscript to a leading professional journal, *Teaching of Exceptional Children*. In addition, the data collected will support the creation of a questionnaire that will be administered widely to a large pool of graduates from The College of New Jersey in the Fall 2010 semester.

Gabrielle Minervini Personal Statement

M.U.S.E. has been my first research experience and it has been an eye-opening and enjoyable summer. My collaboration on this project with Dr. Pancsofar has been truly amazing. She gave me the freedom to succeed and fail on my own; yet, still giving the perfect amount of guidance. Through all the interviews and focus groups, I was able to meet wonderful people and listen to their first-hand accounts. Additionally, I was able to bring my general education knowledge into a special education topic; something that is rare at the undergraduate level. I am so dedicated to furthering the knowledge of collaborative teaching to general education majors. I hope to continue with this project in the upcoming year. I will certainly take all the methods and knowledge gained through this program into my last two semesters as an undergraduate elementary education major and far beyond.

A computational stochastic model of breathing embedded with fractal-like scaling

Sagar Sutaria, Biomedical Engineering
Faculty Mentor: Dr. Brett BuSha

2010 MUSE Project

The brain-level integration and non-linear summation of feedback signals from systems operating on multiple physiological (cell, tissue, organ) and temporal (sec, min) scales results in fractal-like breathing patterns that exhibit stochastic (random) and deterministic behavior. The objective of this study was to design and build a computational model that accurately reproduces the pattern of human breathing. Breath-to-breath interval (BBI) was recorded for 256 breaths from 10 female and 10 male subjects. Prior to analysis, data were normalized and detrended to limit inter-subject variability, and a distribution function was fit to the data. Autocorrelation was used to quantify the memory within the breathing pattern. Model breathing sequences were constructed by generating simulated breath sequences from the distribution function, and passing these data through a memory filter. Detrended fluctuation analysis will be used to compare the scaling and memory components within real human breathing sequences and the model data. Distribution analysis indicated that the human data fit a Gaussian-like distribution, slightly skewed to the right, and the autocorrelation analysis indicated there is decrementing memory component of 3-4 breaths in a BBI sequence. A difference between the autocorrelation of males and females was observed. Ultimately, the model data will produce patterns seen in human breathing patterns. With this model, breathing patterns, illustrated with BBI sequences, will be generated without human data, allowing the rapid computational testing of new hypothesis. Future directions include optimizing and testing the model. The model allows for a non-invasive method for studying feedback integration and breathing patterns involved in human breathing.

Sagar Sutaria Personal Statement

The MUSE program has been a very intriguing, enriching and enjoyable learning experience. I had a great opportunity to continue my work in the cardio respiratory control lab under Dr. Brett BuSha. This experience was particularly exciting and rewarding because I worked with experimental data that I had collected during the previous summer MUSE program. Also, this summer I worked extensively with computational software that I will be using heavily for my senior design project and advance coursework next semester, therefore it was a great experience to be able to learn and utilize this software. Working with the same mentor was a great experience because we had already formed a strong mentor-mentee relationship that was further reinforced. Also, I enjoyed the MUSE program presentations during which I learned a great deal about other ongoing projects at TCNJ, and received advice for my career and future. Overall, I truly value my experiences in the MUSE program and thankful for having such a great opportunity.

Dispersion of Saccate Pollen: Wind Tunnel Experiments of Pollen Dispersion in Turbulent Flows

Winston Moy & David Talarico, Mechanical Engineering
Faculty Mentor: Dr. Lisa Grega

2010 MUSE Project

The objective of this study was to determine the effects of the geometry and surface textures on the aerodynamic characteristics of pine pollen. Pine pollen is different from other typical forms of pollen because it possesses one to three air-filled sacci. Previous studies of different pollen geometries have mathematically shown that sacci reduce settling velocities of the pollen grains, which in turn, increase dispersal distance. The settling speeds were to be further validated by dropping scaled-up pollen grain models in glycerin. The 3D models were weighted such that the main body to sacci mass ratio matched that of pollen grains in nature to insure that models would fall in natural orientation. It was found that in general, pine pollen's geometry resulted in a higher drag coefficient than that of a sphere.

In order to study the effects of wind movement and turbulence on pollen dispersal, wind tunnel studies were conducted. Natural pine and corn pollen were released in uniform and turbulent flows with the goal of measuring the ability of the pollen to move with the flow. The velocities of the pollen and surrounding flow were measured using a technique called Particle Image Velocimetry. This technique involves taking two images separated by a small time interval and using software to calculate the motion of detected particles. A particle disperser was created to inject the pollen into the wind tunnel. An atomizer was used to create micron-sized droplets of oil that were used to illustrate the motion of the air. A laser was placed at the top of the tunnel facing down to illuminate the particles while a camera was posi-

tioned on the side of the tunnel to capture successive images.

Challenges specific to this project included developing an algorithm to separate the two media (pollen and oil) into separate images so each velocity field could be processed separately. Preliminary results suggest that the two media can be successfully distinguished. A low-cost particle disperser was also successfully developed which did not alter the flow characteristics in the wind tunnel.

David Talarico Personal Statement

The Mentored Undergrauate Summer Experience 2010 allowed me to further my knowledge of fluid mechanics. It also allowed me to better understand how research in this field is properly conducted. My collaboration with Dr. Grega and Winston developed my teamwork skills. We worked quite efficiently at tackling the problems that arose. After working on this project through the MUSE program last year, I had much mor experience than Winston at the beginning of the program. We reeated the tests that were conducted last year to prove that our results were repeatable. Then we moved onto the windtunnel tests of actual pollen. This was new to all three of us, therefore many problems needed to be addressed. Winston and I built different apparatuses to aid our research. I definitely feel that this experience will facilitate the skills I will need in the future.

Winston Moy Personal Statement

I want to begin by saying that this summer has been wonderfully filled with setbacks and failures. And under any other circumstance I would probably mourn and regret opportunities lost, but my MUSE project has been too rewarding for me to write off these experiences.

What started out as a simple and straight-forward problem in June became fraught with difficulties and obstacles that exemplified what research is all about: not knowing exactly what you're getting into because it hasn't been done before. Close to 5 weeks have been spent developing various particle dispersion processes, pollen separation methods, and image manipulation programs and we are still nowhere near ready to collect data. Despite being off to a better start than last year's group, a conclusion to our work is almost certainly not forthcoming this year. But, for me, none of that matters. The black hole (a.k.a. our project) that consumed our solutions, confounded our creativity, and spat out ever more problems has been the most intellectually stimulating thing to hit me in quite awhile. And the experiences, lessons, and memories I've made will last me for a long time to come.

The Impact of Physical Forces in Flowing Blood on Hemostasis and Thrombosis

Bhumi Shah, Mechanical Engineering
Faculty Mentor: Dr. Constance Hall, Mechanical Engineering

2010 MUSE Project

Understanding the effects of blood flow on thrombi formation will lead to a better understanding of thrombotic risk in health and disease. In the normal vasculature at bifurcations and branches, blood flow is disturbed and may recirculate. In the case of cardiovascular disease arteries may narrow significantly and lead to disturbed and recirculating blood flow. If arterial walls are damaged, collagen is exposed to flowing blood and induces platelet adhesion and leads to thrombi formation. In order to investigate the impact of physical forces produced by disturbed flow, an in vitro flow chamber was constructed with a vertical step created by cutting rectangular channels of different lengths in two gaskets of equal thickness and laying them on top of one another on a glass coverslip. These were then placed between a polycarbonate base and an aluminum coverplate and secured by screws. A disturbed flow pattern was produced downstream of the step. The optimum gasket thickness, channel width, and compression force that minimized blood volume and produced a range of physiological wall shear rates were determined. It was concluded that a gasket thickness of 254 μm and channel width of 0.2 cm were ideal to run experiments. Fluorescent particles were perfused in real time on an inverted microscope in order to confirm the recirculation zone downstream of the step. In order to promote thrombi formation as blood flowed through the chamber, cover slips were spray coated with fibrillar collagen. A syringe pump was used to withdraw a fixed volume of anticoagulated blood through the chamber at varying shear rates. Thrombi were visualized by fluorescently staining the platelets using mepacrine. Future studies include quantitative analysis of thrombi height and volume as a function of flow conditions.

Bhumi Shah Personal Statement

My participation in the Mentored Undergraduate Summer Experience allowed me to fully develop my research abilities. As part of my research, I was able to train at the Illinois Institute of Technology, in Chicago, and experience graduate level research by working with a postgraduate and graduate student. Furthermore, I learned a variety of new techniques which I can now implement in my research work at TCNJ. The knowledge I gained from working with the MatLab and Computational Fluid Dynamics software will prove to be very useful when I begin working on my senior project and all other future endeavors. Through the duration of the summer, I became a more independent worker and was able to solve problems logically. The skills and knowledge I have gained from my research experience in MUSE will help me in further research during the semester and also in graduate school.

Investigation of the effect of cement viscosity on functional loading micromechanics at the stem-cement and cement-bone interface in Total Knee Replacement using Digital Image Correlation

Kevin Abbruzzese, Richard O'Laughlin, Daniel Lee, Mechanical Engineering
Faculty Mentor: Manish Paliwal, Mechanical Engineering

2010 MUSE Project

One of the most prevalent reasons for failure in Total Knee Arthroplasty (TKA) is aseptic loosening of the tibial implant. Aseptic loosening is primarily a function of the type of prosthesis and integrity of the mechanical interlock between the cement and bone. The cement viscosity at the time of application to the bone is vital to the cement penetration and the stability of the construct. High viscosity cements significantly reduce operating time, however, these cements may result in a decreased penetration into the bone which could reduce the stability of the prosthesis.

Twelve surrogate sawbone constructs were instrumented with Zimmer NexGen-LPS tibial plates and stabilized with four cements of different viscosities- Simplex-P, Endurance, DePuy II, and Palacos. Simplex and Endurance are low viscosity cements, while Depuy-2 and Palacos are high viscosity cements. The constructs were subjected to cyclic loading (600 N) in sagittal plane of cemented tibial implants using MTS 810 Universal Testing Machine (MTS, Eden Prairie, MN). A CCD camera (JAI Pulnix TM1327 GE) was used to sequentially image the speckled tibial plate. Commercial Digital Imaging Correlation (DIC) software (RapidCorrelator v1.0) was used to determine displacements between image frames. Combining this loading method with Digital DIC technique allowed quantifying the tibial plate transverse- and sagittal-plane micro-motions. A comparative assessment was done.

Simplex exhibited the smallest micromotion of all cements in sagittal plane with a strong statistical significance when compared with Palacos and Endurance ($P = 0.002$). The correlation was not significant when compared with Depuy-2 ($P = 0.2794$). In transverse plane Simplex had the lowest micromotion (0.0234mm±0.0175mm) with a strong statistically significance when compared with Endurance ($P = 0.011$). There was no significant correlation with Depuy-2 and Palacos ($P > 0.2$).

The outcomes of the study have direct clinical relevance for the patients treated for total knee replacement surgery by reduction in revision surgeries due to aseptic loosening.

Kevin Abbruzzese Personal Statement

Research in the engineering department has granted me a wonderful opportunity to obtain pragmatic skills and collaborate closely with an innovator in the field. Over the course of 8 weeks, I learned how to use machinery and certain software to perform pivotal engineering tasks, in order to collect and analyze data, furthering my knowledge in Biomedical Engineering. The opportunity to work closely with an advisor was truly astounding, allowing me to develop connections and plan for future events, like graduate school and presentations. In the fall, our group will have the chance to present our findings at the Biomedical Engineering Conference in Austin Texas. Without MUSE, these auspicious events would not have been possible.

Ricky O'laughlin Personal Statement

The research that I conducted this summer during MUSE has undoubtedly been a valuable experience that has allowed me to pursue my interests in biomechanics as well as help me prepare myself for graduate school. The significant research responsibilities that I had in designing, modeling, and testing our experiment exposed me to new knowledge and ideas, allowing me to mature intellectually as an aspiring engineer as well as cultivate strong relationships academic advisor and fellow researchers.

A novel method for measuring the effect of fiberglass reinforcement on SYLGARD using digital image correlation

Daniel Lee and Mary Kate McDonough, Mechanical Engineering
Faculty Advisor: Dr. Manish Paliwal and Dr. Karen Yan

2010 MUSE Project

Digital image correlation provides a non-interfering technique for measuring strain/deformation which is preferable for measurements on soft tissue because contact methods could affect the soft tissue's structural integrity. Gel molds (SYLGARD® 527) were used to simulate healthy heart tissue. The gel is known to be a neo-Hookean incompressible solid where the stress-strain curve's slope is linear in the low load range. Scar tissues form from heart attacks, or myocardial infarction, and increase the stiffness of the soft tissue. The scar tissue is simulated using SYLGARD 527 reinforced with a layer of fiberglass. The samples (19x19x28mm, n=7) from the two sample groups (healthy tissue and scarred tissue) were uniformly loaded in compression in a custom designed experimental setup. A CCD camera (JAI Pulnix TM1327 GE) was used to sequentially image the speckled samples during loading. Commercial Digital Imaging Correlation (DIC) software (RapidCorrelator v1.0) was used to calculate strains. The results of the DIC were validated by calculating the modulus of the gel representing healthy tissue, and mechanical properties of the scarred tissue were determined.

Daniel Lee Personal Statement

MUSE had provided me with an exceptional experience where I worked in a professional environment. I was free to design an experiment with the assistance of my advisor. The process of gathering information, planning/ designing the experiment, and recording and analyzing data is an invaluable resource which should have a positive impact on my upcoming senior project. The obstacles that one encounters in an experimental study and challenges of solving them can only be experienced firsthand. Most importantly, I am prepared for potential research opportunities in graduate school.

Biopolymer Tissue Scaffold Degradation

Erin McMullin, Mechanical Engineering
Faculty Mentor: Karen C. Yan

2010 MUSE Project

Biodegradable polymer-based scaffolds have been engineered to stimulate and direct cell growth and regeneration of tissues. The rate at which scaffolds degrade is a function of different environment parameters such as fluid flow rate, scaffold arrangement, and solution. The objective of this research was to quantify the effects of scaffold design parameters and environmental parameters on scaffold degradation and consisted of both an experimental study and the development of a predictive mathematical model. The experimental study involved multiple fluid flow rates on scaffold degradation through 6-week *in vitro* degradation tests under various flow rates. Polymer degradation was characterized by dry weight mass loss. Using the experimental data, a mathematical model was formulated to predict the mechanical and degradation behavior of the scaffold. The mathematical model of degradation behavior was constructed with Mathematica software and was optimized to fit real data of three different polymers in a static environment. Further studies include adapting the mathematical model to a dynamic system and experimentally validating this model as well as tracking crystallinity changes through degradation.

Erin McMullin Personal Statement

The Mentored Undergraduate Summer Experience has provided me the opportunity to enhance my research skills. Participation in the program gave me valuable insight as to what to expect in graduate research. The experimental aspect of this project has improved my laboratory techniques and I have become more precise and efficient with different laboratory tools. Learning a new mathematical software programs expanded my coding skills. Not only did I become more independent as a researcher, I learned how to work efficiently in a group. This opportunity proved to be a stepping stone on my way to graduate school.

Swarm Intelligence Based Multirobot Systems
Brian Geuther, Mechanical Engineering
Faculty Member: Dr. Yunfeng (Jennifer) Wang

2010 MUSE Project

The objective of this project is to expand upon the field of swarm intelligence multirobotic systems. Taken from the studies of creatures working on collaboration for a small society, such as ant colonies and flocks of birds, swarm robotic intelligence poses a problem that can be solved collectively by multiple robots. In the field of engineering, specific tasks could be solved with one robot. However, these solutions may be complex, inefficient, and error prone. In an effort to solve these problems, research upon multirobotic systems, including the research on swarm intelligence, has taken hold. This research has focused upon the study of the most efficient ways of robotic collaboration, in an effort to reduce complexity, increase efficiency, and reduce the overall cost of finding solutions for problems.

The objective to be solved this summer is to move from one point to another navigating through an unknown area. The designed algorithm combines the ideas of adaptive flocking and implicit individual healthiness. Adaptive flocking algorithms are designed to allow multiple robots maintain a formation as well as separate for obstacles. Healthiness algorithms allow passive communications between robots dependent upon how many good choices an individual robot makes. The use of potential fields based upon "good" and "bad" directions allows for the robots to select the dynamic movement path. The successful combination of these two ideas should generate guidelines for design of successful multirobotic systems.

Brian Geuther Personal Statement

This summer research has given me a great quantity of information about how to conduct effective research. I gained the ability to effectively search through relevant prior research conducted in an effort to better understand what has already been done. When designing my own algorithms, I gained experience with the design and use of sensors as well as selecting compatible hardware. The entire process of professional research has become clearer in its entirety of process.

Study of Heart Tissue Damage via Dynamic Heart Phantom
Mary Kate McDonough
Faculty Mentor: Karen Yan

2010 MUSE Project

Magnetic resonance imaging (MRI) has been used to provide diagnostic information for various heart conditions. In many cases, artifacts related to heart motion appear, which hinder how the imaging process. A dynamic heart phantom (DHP) capable of simulating true cardiac motions is a valuable research tool for improving quality of MRI's and determining critical diagnostic information.

The research focuses on characterizing the stiffness change of the heart tissue due to a myocardial infarction. A prototype of a dynamic heart phantom was developed through a senior design project in collaboration with the cardiac research group at the University of Pennsylvania. During the MUSE program, a set of tests were conducted to establish a performance baseline for the developed DHP utilizing silicone gel as the phantom material. The DHP material properties were modified through the reinforcement of the simulated left ventricle at selected locations to mimic damaged tissue. Modified specimens were tested and imaged for deformation under prescribed conditions using both a Digital Image Correlation (DIC) camera and a MRI. In order to correlate the deformation change with underlying stiffness change, an ANSYS simulation of the DHP system was performed and comparisons were made between the deformations measured and those obtained from imaging techniques.

Mary Kate McDonough Personal Statement

The Mentored Undergraduate Summer Experience has allowed me to better myself and become a more well-rounded person. My research experience through the MUSE program has provided me the opportunity to apply theories and principles I have studied over the past three years to application, and has allowed me to immerse myself into the inner workings of the research process. I have enriched myself through this experience and have gained independence that I can apply in my future as a graduate student and professional engineer. Time management in planning an

experiment from start to finish has encouraged me to become a more independent thinker. An opportunity such as this has provided me with a ticket to a more successful future; it has supplied me with the knowledge base needed for open-ended research tasks. Through the open-ended analysis I have been able to master new skills put forth this summer in MUSE.

Curriculum Development: A Health Behavior Change Model

Nicole Feldman, Nursing; Jillian Harth, Nursing; Jessica Young, History, Psychology
Faculty Mentors: M. Kathleen Philbin, Nursing; Ralph Spiga, Temple Univ. Med. Schl., Psychiatry; Stacen Keating, Nursing; Tami Jakubowski, Nursing

2010 MUSE Project

For this MUSE project an interdisciplinary team of students and faculty developed materials to guide revision of a new clinical learning experience in the pediatric nursing curriculum. In this four-session experience, student nurses assist inner-city high school girls to choose and plan for a change in health behavior. The curriculum has been used for three semesters and is ready for a major revision. Among the sources informing the revision are student's written responses to questions posed during the experience. The MUSE project analyzed responses concerning beneficial outcomes of the experience as a guide to strengthening relevant elements of the curriculum.

In a sequential series of analyses, the student writings were first de-identified and organized by question and session. MUSE students did the bulk of this work. Responses to each question were then entered into a text analysis software program that identifies clusters of words relating to a single topic, the frequency of the words in each cluster, and examples of text containing those words. The team then reviewed the word clusters and the text samples to determine whether the program results were sensible and to find common themes among the clusters. Subsequently, an informal approach to traditional qualitative analysis was used to confirm whether the themes derived from the software output were actually in the writings. MUSE students assigned names to the broad themes. They are "benefits of learning new communication skills" and "building relationships and professionalism". Sub-themes include "benefits of learning to listen" and "success in building trust". Based on these findings the revised curriculum will include pre-clinical practice with non-directive but focused interviewing and with scripted interviewing, opportunities to examine boundaries between friendship and warm professional relationships with clients close in age, and opportunities to explore the links between non-directive but focused interviewing and establishing trust.

Nicole Feldman Personal Statement

The MUSE program has allowed me the opportunity to greatly expanded my knowledge base on the research process. By working closely with my professors, I have learned how to forge a professional relationship while working towards a common goal. Our research project allowed us to analyze data and update curriculum at The College. This experience was one that I can take with me throughout my career as a student as well as my professional career as a nurse in the years to come.

Jillian Harth Personal Statement

Thanks to the cooperation of Dr. Philbin I've had the opportunity to participate in the MUSE research program from home. Since I was unable to travel to TCNJ each week Dr. Philbin was key in formulating research data that I was able to review and organize via computer. Participating in this research experience gave me insight into all the work that goes behind the scenes in order to produce a finished product. Also the importance of working with peers to collaborate on research data to produce an accurate representation of the work. I feel fortunate to have been given the opportunity to be a part of this project.

Jessica Marion Young Personal Statement

Working with the MUSE program has given me a much greater appreciation for the work that goes into research. Seeing the finished product in a published article cannot give justice to the amount of time and effort put into research projects. In addition to a greater understanding of research methods in general, through working with the nursing program, I have gained a greater appreciation of the field and the skills necessary for successful nursing. After participating in the MUSE program I hope to continue with research in the future.

A Comparative Study of Carolina Chickadee Molt Dynamics in the Pine Barrens and Urban Habitats

Camille Deering, Biology
Michael Wang, Biology
Faculty Mentor: Dr. Luke Butler

2010 MUSE Project

Immediately after nesting each year, Carolina Chickadees replace all their feathers in preparation for the coming winter. We conducted an eight-week field study of the dynamics of this feather replacement (molt) in Carolina Chickadees (*Poecile carolinensis*) of central New Jersey. In particular, we compared the molt dynamics of chickadees inhabiting the New Jersey Pine Barrens to the molt dynamics of chickadees inhabiting suburban Ewing. Because molt is known to be sensitive to environmental and temporal factors, a comparison of molt timing (onset and duration) between these very different habitats can offer insight into the impact of human activity on chickadee life cycles.

Pine Barrens chickadees were sampled in two areas of the Collier's Mills Wildlife Management Area: a contiguous forest site and a fragmented forest site. These samples were compared to chickadees captured in backyards in Ewing. Chickadees were captured by luring them into mist nets (fine nylon mesh hung between poles) with playbacks of chickadee calls and songs. We gathered detailed molt data from each bird, and applied colored leg bands before release.

Chickadees started molt earlier in Ewing than in the Pine Barrens, suggesting that living in the suburbs may advance the transition from breeding to molt in this species. Interestingly, Pine Barrens chickadees appeared to "catch up" to the Ewing population, so that birds in both populations completed molt about the same time in late summer, and long before any risk of severely cold weather. This is the first study to demonstrate an effect of human habitation on the molt dynamics of a North American songbird.

Camille Deering Personal Statement

My participation in the MUSE program has been an enriching experience. By working with Dr. Butler capturing and tagging chickadees, I gained a strong foundation in field study techniques which will benefit me as I pursue ecological studies in graduate school. This full immersion experience has allowed me to obtain a level of field proficiency that I could never gain from classroom or lab work. I have also learned how to operate as a team and to persevere to overcome the unique challenges presented by field work. My research has taught me how to think critically and to constantly reassess my current research approach in order to maximize success. As the summer progressed, I gained more confidence in my abilities as a researcher. I have now achieved a genuine level of independence, and I feel like an equal collaborator on this project.

Michael Wang Personal Statement

My interest in evolutionary history started when I read *Full House* by Stephen Jay Gould and realized how little I knew about the process. I indulged my fascination and independently read several books about different evolutionary models. However, I never had an opportunity to learn how modern research is conducted to create and test such ideas. The Muse program at TCNJ gave me the chance to see, firsthand, how researchers go about observing and testing trends in wildlife and how specific studies can bring about inferences about larger scale phenomenon. Working on chickadees with Dr. Butler was challenging given the difficult conditions in the field; but ultimately, I gained useful skills such as innovative problem solving and data processing and analysis. As a rising sophomore, I found the Muse discussions to be a helpful resource in planning my future; after looking over a number of options and the steps I would need to go through, I learned to allocate the proper amount of dread to each choice.

Exploration of the Pet-1 mouse as an animal model for Sudden Infant Death Syndrome (SIDS)

Samantha Conte, Biology
Laurie Delatour, Biology
Faculty Mentor: Dr. Jeffery Erickson

2010 MUSE Project

Sudden Infant Death Syndrome (SIDS) is a leading cause of postnatal infant mortality in developed countries. Although the underlying basis for SIDS is not known, several major risk factors, including prenatal exposure to nicotine, have been identified. Analysis of brain tissue from infants dying of SIDS has revealed abnormalities in the brainstem

serotonin (5HT) system. This has led to the 5HT "triple risk" model which hypothesizes that death from SIDS can result when 1) a vulnerable infant (one with abnormalities in brain 5HT) is exposed to 2) a life-threatening environmental stressor (e.g., a low oxygen environment) during 3) a critical period of early postnatal development. A failure to spontaneously resume rhythmic breathing (autoresuscitate) after prolonged apnea (cessation of breathing), has long been suspected as a proximal cause of SIDS.

For our MUSE project we have continued an ongoing study designed to assess the effects of prenatal nicotine exposure on breathing behavior in 5HT-deficient Pet-1 "knockout" mice during early postnatal development. Specifically, we have used plethysmography to compare autoresuscitation responses in neonatal "wild type" and knockout mice exposed either to saline or nicotine during prenatal development. In addition, we have established an immunohistochemical staining protocol for localizing the nicotinic acetylcholine receptor alpha (nAchRα) subunit in mouse brainstem tissue. This technique may now be used to document the extent of nAchRα expression in brainstem 5HT neurons as a first step toward exploring potential interactions between nicotine and 5HT that influence the development of postnatal breathing behavior. Finally, we have extended a previous study to determine whether abnormal maternal behavior in Pet-1 heterozygous dams could account for the high neonatal mortality we have previously observed in Pet-1 knockout neonates. Combined, these studies will further our understanding of the role of serotonin in the development of breathing behavior and its potential link to SIDS.

Samantha Conte Personal Statement

After starting the MUSE program this summer, I soon discovered the extent of my unfamiliarity with many of the laboratory techniques used. Although I have spent the past year performing independent research with Dr. Erickson, this intensive 8 week program has presented challenges I had not previously encountered. This opportunity has enabled me to gain proficiency in new technical skills, further develop my problem solving abilities, and adapt to changes in experimental conditions. Furthermore, close collaboration with my faculty mentor and colleague has fostered a greater understanding of the research focus by reading scientific literature related to our topic of study. My improved ability to work independently, diligently, and efficiently, while asking questions and troubleshooting all problems along the way, will be instrumental during the rest of my undergraduate studies as well as during my future endeavors in the medical field.

Laurie Delatour Personal Statement

Through the MUSE program, I had the opportunity to become fully immersed in the research conducted in Dr. Erickson's lab using Pet-1 "knockout" mice as an animal model for SIDS. This experience has allowed me to use the techniques and apply the knowledge that I have gained through course work to explore a scientific question in depth. I have enhanced my ability to draw from various sources and think critically when faced with problems that arise during the course of research. This summer, I was exposed to various aspects of the research process including establishing the protocol for experiments, optimizing the procedure, collecting data, and analyzing the data. From these experiences, I have gained a better understanding of and appreciation for what a career in research would entail. This experience has been very rewarding and I am grateful to have had the opportunity to work closely with other students and faculty members. The skills and knowledge that I have acquired over the summer will serve as a firm foundation as I continue with independent research next semester.

The genetic regulation of sex determination in *Caenorhabditis elegans: tra-5*

Julia Kim, Biology
Colin Gold, Biology
Faculty Mentor: Dr. Darrell Killian

2010 MUSE Project

What genes are required to determine whether an organism will develop as a male or a female? Mutations in the human sex-determining gene, the SRY gene, are associated with birth defects that affect sex-specific characteristics. In the Killian lab we are using the nematode *Caenorhabditis elegans* as a model organism to study the genetic regulation of sex determination. The two sexes of *C. elegans* are male (XO) and hermaphrodite (XX). Both males and hermaphrodites contain the same genetic information, but which genes are turned on/off can determine the difference in anatomy, physiology, and behavior of the worms. *her-1* (hermaphrodization) is a gene that encodes a secreted protein that promotes

male development. *her-1* expression is low in hermaphrodites and high in males. Inappropriate activation of *her-1* in hermaphrodites makes them develop as males. We have identified a gene called *tra-5* (transformation) that is required to repress *her-1* expression, to ensure proper hermaphrodite development. Hermaphrodites lacking the *tra-5* gene develop masculine characteristics. We hypothesize that *tra-5* represses *her-1* at the level of transcription: the first step in the process of gene expression.

To test this hypothesis, we created a transgene by fusing the *her-1* promoter with the gene encoding the green fluorescent protein (GFP). Worms with the transgene fluoresce when the *her-1* gene is expressed. Using fluorescence microscopy, we analyzed GFP fluorescence in four conditions: males, hermaphrodites, hermaphrodites lacking the *tra-5* gene, and hermaphrodites with extra copies of the *tra-5* gene. Our results show that GFP fluorescence, and thus *her-1* expression is increased in *tra-5* mutants and decreased by additional copies of the *tra-5* gene. The data support our hypothesis that *tra-5* is a negative regulator of *her-1* and our results assign a role to a previously uncharacterized gene in *C. elegans*.

Julia Kim Personal Statement

Participating in MUSE this summer provided a valuable opportunity to gain firsthand experience in performing research in a focused academic setting, along with practice in scientific analysis and discussion. The program increased my confidence in a future research career, and also helped to broaden my research interests and laboratory skills. At the same time, I learned the value of patience and perseverance, and the nature of discipline and commitment required for scientific research. I enjoyed interacting with the MUSE community during weekly meetings and presentations, as I learned more about the work of my fellow students and earned advice from professors. Most of all, I appreciated the mentorship of my professor and the close collaboration in which we were able to work throughout the duration of the program.

Colin Gold Personal Statement

During my time at TCNJ's MUSE program I have learned invaluable life and research-related lessons. I had researched in Dr. Killian's lab prior to the MUSE program, but this intensive experienced gave me a firsthand experience of what a career in research would be like. I've also learned a lot about the patience, perseverance, and efficiency it takes to conduct experiments, which I expect to translate into all aspects of my life. It has been a lot of fun getting to know the Biology department's faculty and my fellow students better. The faculty mentors have shared important advice about future career and graduate school plans with us, and a few interesting stories along the way. My level of work has also matured during these past weeks. When the program began, I was reliant on my mentor for instructions, and now my work is almost autonomous. If the program had continued for another week or so, I think I could reach an expert level.

Investigating the Coordination of Multiple Steps in Gene Expression: The Functions of Npl3's Domains

Daniel Mitchell, Biology
Faculty Mentor: Dr. Tracy Kress

2010 MUSE Project

The central dogma of molecular biology states that DNA is transcribed into RNA. The RNA molecule, after modifications have been made, is then translated into a protein. Splicing is an example of one such modification, where non-protein coding sequences are excised from a piece of RNA as the protein coding sequences are fused together. In *S. cerevisiae*, known as budding yeast, Npl3 is a protein thought to be directly involved in the splicing of many RNAs; it also interacts with transcription factors that facilitate the generation of RNA from DNA. We are interested in the mechanism by which Npl3 coordinates splicing and transcription.

Npl3 contains a N-terminal domain, two different RNA recognition motifs, and an RS domain. By isolating individual domains and certain combination of domains, we can run tests to determine which of these domains are important for coordination of the splicing process and which are important for transcription.

Npl3 is found only in yeast, but is highly related to SR-proteins found in mammals. Improper splicing is implicated in several forms of cancers; therefore a better understanding of Npl3 may be relevant to human health.

Daniel Mitchell Personal Statement

Having the opportunity to work with Christine and Dr. Kress has taught me valuable lessons both in and out of the laboratory, and being a part of the MUSE community has been similarly enjoyable and enriching. Not only has the

MUSE program helped me further define my professional goals, but it has also helped me plan how to mesh those professional goals in with my personal goals. I'd like to thank all of the Biology department faculty for their help and advice, the rest of the MUSE faculty for their support, and to all the other MUSE students for their part in making these two months so memorable.

Investigating the Coordination of Multiple Steps in Gene Expression: The Role of Snu66

Christine Scaduto, Biology
Faculty Mentor: Dr. Tracy Kress

2010 MUSE Project

Our lab studies the steps of gene expression using the model organism *Saccharomyces cerevisiae*, also known as baker's yeast. Because gene expression is a fundamental cellular process, it can be studied in organisms such as yeast and give important insight into how the same process functions in humans. Two critical steps in gene expression are 1) the synthesis of RNA from DNA (the RNA serves as a "working copy" of the DNA) and 2) RNA splicing, during which discrete segments of an RNA molecule are pieced together in different ways to encode different types of functional proteins. Misregulation of either process can result in abnormal protein production that may ultimately lead to decreased cell viability or cell death. We study proteins that have a potential role in coordinating RNA synthesis and RNA splicing to ensure accurate and efficient gene expression. One protein studied in the lab that is believed to coordinate these processes is Snu66. Snu66 has been show to physically interact with proteins involved in splicing, and mutating Snu66 results in a defect in splicing. Additionally, preliminary data indicates genetic interactions between Snu66 and proteins involved in RNA synthesis. The goal of our summer research is to investigate the mechanism by which Snu66 works with both the RNA synthesis and RNA splicing protein complexes in the cell to ensure accurate and efficient regulation of gene expression. Information gathered in these experiments can lead to a better understanding of the cause of many diseases, including cancer.

Christine Scaduto Personal Statement

This summer, I worked on a project with Dr. Tracy Kress in which we investigated proteins that coordinate the steps of gene expression. This project was a continuation of my research during the previous semester, and one that I will pursue during the upcoming year. I feel very fortunate to have participated in MUSE and have gained a great deal from this experience. The chance to completely immerse myself in an independent research project allowed me to confirm my interest in pursuing a graduate degree in molecular biology. Additionally, I would like to thank the faculty in the department of biology for creating a friendly, supportive environment and dispensing such helpful advice. Not only did this program allow me to strengthen my laboratory techniques, but I have gained skills in problem solving and communication that will benefit me in areas of my personal and professional life. I really enjoyed this experience and hope that many other TCNJ students will get the chance to participate in the MUSE program.

Osmoregulation in blue crabs *Callinectes sapidus* through modulation of expression of the α and β subunits of Na^+, K^+-ATPase

Danny Markowski, Biology
Teresa Askander, Biology
Faculty: Dr. Donald Lovett

2010 MUSE Project

The blue crab *Callinectes sapidus* lives in estuarine environments where the water's salt concentration varies from dilute to full-strength seawater. The blue crab is able to osmoregulate, meaning it can regulate its blood salt concentration when exposed to changes in salinity. The enzyme Na^+,K^+-ATPase (ATPase) is a salt pump that is responsible for the crab's ability to osmoregulate. Our lab previously found that activity of ATPase changes in response to changes in seawater salinity. However, the modulation of ATPase activity is unknown. One possible mechanism for regulating an enzyme's activity is modification of the amount of mRNA in cells. mRNA is produced by genes and is used to synthesize specific proteins. ATPase is composed of two proteins called the α and β-subunit. We are trying to determine whether the amount of mRNA for either or both of these subunits varies when salinity changes, which will show whether either of the subunits regulates the activity of the ATPase. It is possible that only one subunit regulates the enzyme, and thus is

responsible for changing the activity of ATPase. We found that when crabs are transferred from high to low-salinity, the relative amount of α-subunit mRNA increased significantly to its maximum level between 4 and 8 days and then dropped to its basal level by the end of acclimation. However, when crabs are transferred from low to high-salinity seawater, the relative amount of α-subunit mRNA dropped to nearly zero within the first 2 days of exposure and began to rise to basal levels towards the end of acclimation. We currently are working to determine whether there are changes in the relative amount of β-subunit mRNA when salinity changes. If the concentration of only one subunit changes, we may be able to determine which of the subunits is the regulatory component of Na^+,K^+-ATPase.

Personal Statement for Danny Markowski

When I came into the MUSE program this summer as a rising junior, I knew my role in Dr. Lovett's lab would be significantly different than my previous experience in his lab. Prior to this summer, I had shadowed Professor Lovett during freshman year and joined his lab for 2009's MUSE program. I entered the lab this year with confidence from all of the experience and advice given to me in the previous summer. Within the first few weeks I realized this summer's experience I would need to be much more independent. However, I soon found out we were going to be focusing in on a completely different branch of Dr. Lovett's research. Through close interactions with my fellow collaborator Teresa Askander and Dr. Lovett, I realized there was still much more for me to learn, but more importantly, I realized I was capable of handling myself when faced with new challenges. I would like to formally thank both of them and the MUSE program for preparing me to become a successful scientist.

Personal Statement for Teresa Askander

My experience in the MUSE program this summer was very different than my expectations. I had previously shadowed in Dr. Lovett's research lab during my freshman year, but I quickly realized that I lacked skills that were essential in order to be an independent researcher. My fellow collaborator Danny Markowski and Dr. Lovett were patient enough to help me gain those skills throughout the summer. Not only has MUSE allowed me to gain insight from my mentor and collaborator, but interactions with other faculty members in the program has enhanced my interest to pursue a career in the sciences. As a first generation American, I truly appreciate the experience I have gained through the MUSE program. I am eager to continue research in the sciences in the future. I would like to formally thank Danny and Dr. Lovett, as well as TCNJ for providing me with the opportunity to participate in the MUSE program.

Genetic Variation in populations of wild plant pathogens

Rawinder Parmar, Biology
Faculty Mentor: Dr. Janet Morrison

2010 MUSE Project

Very little is known about the population genetics of wild fungal species. The smut fungus *Sporisorium ellisii* is a pathogenic that infects *Andropogon virginicus*, a common bunch grass. The fungus severely debilitates the ability of the host to reproduce by replacing the grass flowers with spore filled sori, positioning the fungal spores for enhanced dispersal. Our data show a wide geographic range for this fungus, but no research so far has described the genetic structure of the species. My goals this summer were (1) to optimize the conditions for using Inter-Simple Sequence Repeat (ISSR) DNA molecular markers on *S. ellisii* (i.e.: annealing temperature, magnesium concentration, template concentration), and (2) to use them to screen eight samples of single spore *S. ellisii* isolates from one Pennsylvania population for genetic variation. We currently have 13 primers that successfully yield distinct and multiple DNA bands. After screening our samples and an outlier sample from northern Virginia, we found that genetic variability does indeed exist within a population of *S. ellisii* and between populations. After we confirm the repeatability of these results for all 13 ISSRS, we will address the subsequent question of whether genetic variability of the smut fungus exists within an infected plant.

Rawinder Parmar Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) has provided me the opportunity to continue to work on a project that I have been working on for the past few semesters. I was able to troubleshoot and edit existing protocols to further my project. As such, I continued to learn how to critically address the road blocks that were presented. Also by doing so, I learned more about the molecular techniques that I was using.

Regulation of GLD-1 Germline Tumor Supressor in *Caenorhabditis elegans (C. elegans)*

Sharon Bushi, Biology
Sarah DeGenova,Biology
Faculty Mentor: Dr. Sudhir Nayak

2010 MUSE Project

The tightly regulated turnover of cellular proteins is essential to normal development. When this process becomes corrupted, the mis-regulation of proteins involved in cell division and differentiation can result in unrestricted cell division (cancer). One such a protein, GLD-1 (germ line defective), is a translational repressor endogenous to the germ line in *Caenorhabditis elegans* with multiple functions in germ line development. Mutations that cause a loss of GLD -1 function result in aberrant progression through meiosis and germ line tumors. Using a GLD-1::GFP (GLD-1 fused to green fluorescent protein) reporter we screened for genes that alter GLD-1 expression. The 80 genes isolated fell into two general categories: 1) translational regulators, which resulted in a decrease in GLD-1 expression similar to chemical inhibitors of translation, and 2) proteasome pathway components, which altered (increased) GLD-1 expression. Taken together, these results suggested that GLD-1 is partially regulated via a rapid turnover rate. Thus, the focus of the research performed during MUSE was to estimate the GLD-1 protein turnover rate and begin to identify signals that result in its degradation. The first step in this process was to be able to reproducibly detect GLD-1 using two major assays: florescence recovery after photobleaching (FRAP) and Western blotting. We were able to identify conditions that allow for the identification of GLD-1 protein via Western blotting of whole worms. We also determined the proper experimental conditions for GLD-1 analysis via FRAP on specific regions of the germ line. Results from these assays have furthered our knowledge of GLD-1 regulation and the data gathered will aid in our continued study of the protein.

Sharon Bushi Personal Statement

MUSE is an amazing educational experience that gave me an opportunity to interact on a personal level with professors in a way that no college course could ever offer. The eight weeks of lab work and meetings with the research community culminates in the form of a poster forum and presentation. This entire process, one that ended much too soon, was invaluable for my future in the scientific professional world. The interest that I've developed in the project I worked on during the MUSE program has caused me to want to work in Dr. Nayak's laboratory next year. This sense of scientific partnership in learning, found in MUSE, is how I envision research occurring at the graduate level.

Sarah DeGenova Personal Statement

The MUSE program was an awesome opportunity that reinforced my plans of pursuing a graduate degree in the field of genetics. During the year I participate in independent research, however research is often put on hold due to class requirements. MUSE allowed me to research without the distractions of class work, which provided the time necessary to perform experiments that could not have been completed during the year. MUSE gave me a better perspective on what graduate work entails and allowed me to learn a great deal more of experimental designs and techniques that will aid me in my future endeavors as a graduate student. Now that I have a firm understanding of these experimental processes, additional time would have been of great value in furthering my project.

An analysis of the *squid-like* genes in zebrafish: roles and regulation

(funded by Bristol Myers Squibb)

Michael Poulose, Biology
Maunil Sheth, Biology
Faculty Mentor: Dr. Marcia O'Connell

2010 MUSE Project

We are interested in studying the early embryonic development of *Danio rerio* (zebrafish), a model organism for vertebrate study, and in particular in understanding the roles of two gene families that may be involved in regulating pattern formation during embryogenesis. Homologs of these genes, called *zsquida, zsquidb,* and *zorba,* were identified first in fruit flies (*Drosophila*), and in this species the *squid* and *orb* genes involved in the regulation of gene expression at the RNA level. Furthermore, *Drosophila squid* is required for proper dorsal/ventral patterning, and *zorba* appears to regulate the expression of key patterning genes via translational control. In light of the central roles these genes play in the

temporal and spatial coordination of fly development, we have pursued an analysis of a) the expression of these three genes in early zebrafish embryos, and b) the potential functions of the protein products. This summer we were able to confirm, using PCR and gel electrophoresis followed by restriction digest, that *zsquida* and *zorba* are maternally expressed, and therefore present during the early stages of zebrafish development. Furthermore, our analysis of the polyadenylation status of the *zsquida* mRNA, also via PCR, suggests that this RNA is subjected to translational control via a mechanism that may involve the zorba protein. Following the expressional analyses of *zsquida* and *zorba*, we were interested in the functional analysis of the two *squid* homologs. The 2 modes of determining the function we employed were: overexpression of the two genes in the embryo, and knockdown of expression of the two genes in the embryo. This was achieved by microinjection of *in-vitro* transcribed RNA, and microinjection of morpholinos, respectively. In the future, we hope to continue the functional analysis in order to get a better understanding of the roles of these genes and their products.

Maunil Sheth Personal Statement

During the last couple of months, I have come to realize the importance of research in advancing our knowledge base. I feel fortunate to have been given the opportunity, through MUSE, to contribute to the scientific society, albeit seemingly insignificant, my findings this summer. I have learned many valuable skills during MUSE such as designing and understanding relevant experiments to answer specific questions and test hypotheses in a credible manner. In addition, I acquired competence in conducting experiments carefully and in analyzing the data (or lack thereof) that rarely are in accord with the expected results. Equally important are the relationships that I built with fellow students and mentors during the program. The weekly lunches and presentations from other faculties were refreshing and gave me a perspective of the collaboration that is possible with different fields. I also enjoyed the various activities throughout the course of the program that made this experience all the more interactive. I am confident that the skills that I acquired this summer are invaluable and will aid me in future endeavors.

Michael Poulose Personal Statement

The TCNJ MUSE program has given me the opportunity to understand the complexities behind research, from the rare, but sweet victories to the many, many trip-ups along the way. Regardless of the outcome, it has given me a variety of skills I can bring to any profession I wish to seek in the future. Troubleshooting, planning for the future, and practical skills were all tools I used in the course of the past weeks in order to continue our research. The funny thing is, I probably learned the most from all those trip-ups and delays in the research. Learning from Dr. O'Connell the past few weeks was fulfilling and enjoyable. The advice, guidance and care she offered will never be forgotten. All together, the program helped forge new friendships, while strengthening already existing relationships. These eight weeks gave me the chance to test my abilities by applying the knowledge I obtained over the years and using it to answer questions that have never been asked before. It was an amazing experience that I will always appreciate.

Genetic and Biochemical Analysis of Cytochrome P450 Proteins that Regulate Plant Growth and Development
(funded by the American Society of Plant Biologists)
Kelly Salmon, Biology
Faculty Mentor: Dr. Leeann Thornton

2010 MUSE Project

Plant growth and metabolism are affected by many internal and external factors. External factors include soil quality, availability of water, and light conditions. Internal factors, including a multitude of hormones and enzymes, translate external conditions into changes in growth and metabolism. Cytochrome P450 enzymes (P450s), a super-family of proteins that are found in all living organisms, are examples of such enzymes. We are studying members of the 72A sub-family of P450s (CYP72A) in the model plant *Arabidopsis thaliana* to determine their roles in plant growth and metabolism. Of the eight CYP72A enzymes in Arabidopsis, none have yet been characterized but four have been shown to cause dwarfism when they are over expressed, implying that they play a role in growth and development. Our ultimate goal is to determine the functions of these four enzymes. We are using Arabidopsis knockout mutants to try to see any differences that are noticeable in the plant as a whole without the enzyme. These differences may hint at the role of the enzyme. However, in order to determine the specific function of the enzymes, we need to isolate each enzyme for biochemical analysis to determine its substrate. This requires cloning the genes into *E. coli* so that the bacteria will be able to

produce the enzyme. We have successfully cloned three of the four genes into *E. coli* and have begun inducing expression to see if we can make the bacteria produce large amounts of enzyme that we will then be able to collect and isolate. Once we can successfully express and purify the enzymes, we will be able to begin analysis to determine each enzyme's substrate and therefore attempt to determine the biochemical role in the plant.

Kelly Salmon Personal Statement

I am so glad to have the opportunity to participate in MUSE. I work in Dr. Thornton's lab during the school year, but working over the summer is a great experience. Being able to work full-time in lab has allowed me to advance my project much more than I would have been able to during the school year alone. I have built on my research skills and have learned much more about what it is like to be a full-time scientist. In addition, being a part of the community within the biology department and the MUSE community as a whole has been a great way to learn from others and improve my ability to explain my research to others, both in biology and in other fields. The research techniques and communication skills that I have learned will benefit me greatly in the rest of my time at TCNJ as well as in my goal of attending graduate school and pursuing a career in research. Thanks so much to Dr. Thornton for being an awesome mentor!

Stickleback Fish Evolution

(Funded by TCNJ Academic Affairs, TCNJ MUSE Program, National Institutes of Health)

Kaitlyn Schiels, Biology
Gregory Way, Biology
Faculty Mentor: Dr. Matt Wund

2010 MUSE Project

The evolution of animal behavior has recently gained much attention in the scientific community. In particular, animals serve as a model for studying the shy-bold axis of human personality. Our research utilizes three-spined stickleback fish (*Gasterosteus aculeatus*), because they express a wide range of behavioral responses to various environmental stimuli. This expression range is varied not only within the species, but also within independently evolving populations as a result of genomic variability. Additionally, the stickleback genome has been sequenced which provides a molecular basis for explaining the observed behavioral traits.

Firstly, we subjected three hundred lab-reared F_2 fish to a series of three assays, and scored their behavior. The assays were designed to test overall movement and the fish's response to a water treatment infused with the scent of trout, a novel predator to the F_2 generation. Ultimately, we attempted to objectively identify consistency in behavior across contexts, which would indicate the presence of a behavioral syndrome. We then attempted to localize this observed behavioral variation on a molecular level. Purified DNA samples from each of the three hundred F_2 fish were tagged with an individual barcode and ligated to a series of adaptors and primers. Samples were then multiplexed together to create a RAD tag library in preparation for high-throughput Illumina sequencing.

Thus far in Muse, we have adapted the protocol for creating RAD tag libraries, and have begun analyzing data from behavioral experiments. The preliminary data indicates the absence of behavioral syndromes, as individual fish seem to react differently across the three assays. In the future, we hope to determine specific regions of the three-spined stickleback genome that correlate to the observed shy or bold behavior, which can impact knowledge regarding human personality.

Kaitlyn Schiels Personal Statement

The Mentored Undergraduate Summer Experience 2010, enabled me to gain valuable skills that are applicable not only to the laboratory but to life as well. Under the guidance of Dr. Wund, I have grown to appreciate the tremendous undertaking that a research project entails. I was exposed to a multitude of new experiences that accompanied new challenges, which catalyzed my overall growth and improvement. I was given the opportunity to travel to Alaska, and immerse myself in a project that required both field and lab work. I had the opportunity to meet numerous researchers, studying diversified topics, ranging from behavior to genetics. In the lab, I spent the summer refining a protocol, which I plan to implement in the fall. It is in the lab, that I gained my most notable skill, which is the ability to troubleshoot. The very nature of science is uncertainty, and thus the ability to identify problems and refine techniques is of invaluable worth. MUSE has been a truly worthwhile experience and enriching experience.

Gregory Way Personal Statement

Working in the lab with Dr. Wund this summer for the MUSE program has provided me with incredible opportunities and many important experiences. Not only did I learn about the ecology, behavior and practical applications of threespine stickleback fish, but also, working closely with colleagues in similar fields, about structures of a lab community. In the lab, I studied the behavior of stickleback fish with a goal of determining if behaviors remain constant in different environments thus indicating the presence of a genetically based personality. Additionally, we were offered the opportunity to travel to Alaska for an intensive two week period of field and lab work where we learned various practical and specific techniques. While in Alaska, and throughout the program, I gained a profound appreciation of the perseverance, patience and critical thinking skills required to perform research projects as a scientist. In the future, I hope to use these skills and knowledge as I further my education and eventually pursue a career in the field of science.

Cocrystals as a Means to Control Polymorphism in Pyrazinamide

Devon Cocuzza, Chemistry
Faculty Mentor: Dr. Heba Abourahma

2010 MUSE Project

Polymorphism is the ability of a molecule to exist in more than one possible form in the solid state. Each polymorphic form has its own unique crystal structure which is responsible for determining the physical properties such as stability, solubility, hygroscopicity and dissolution rate among other things.

The objective of our research is to examine cocrystals as a method to control polymorphism. Cocrystals are crystalline materials that are comprised of at least two different components that are solid at room temperature and are held together by non-covalent interactions. The target polymorphic compound in our study is pyrazinamide (PZA). PZA is an active pharmaceutical ingredient (API) used for the treatment of tuberculosis and is known to exist in four different forms: alpha, beta, gamma, and delta. Since amides are known to have high affinity to carboxylic acids and amides, we considered cocrystal formers (coformers) that contain these functionalities such as benzoic acid, anthranilic acid, 3,5-dintrosalicylic acid, isophthalic acid, 3-hydroxybenzoic acid, and isoniazid. Our experiments consisted of reacting equimolar amounts of PZA with each coformer via liquid-assisted solid state grinding and in solution. The products were characterized using Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), Nuclear Magnetic Resonance (NMR), Infrared Spectroscopy (IR) and Powder X-Ray Diffraction (PXRD). We further examined the persistence of a particular cocrystal formation in the presence of different solvents during liquid-assisted solid state grinding including methanol, ethanol, THF, DMSO, DMF, acetone, acetonitrile, and water. Herein we will present the synthesis and characterization of PZA cocrystals obtained to date from the above mentioned experiments.

Devon Cocuzza Personal Statement

Since this is my second year participating in the MUSE program my experiences this year were different then they were last year. Last year I spent most of my time growing accustomed to collaborative research. This year, however, I felt was much more fruitful. Having gone through a summer of research already I was much more familiar with the tools necessary for being productive. Nevertheless, I still feel like I learned even more this summer because I had a base of knowledge that was previously established. I am very thankful for the academic growth that I have achieved as a result of my time in the MUSE program. Moreover, I am grateful for the opportunity to work closely with faculty and friends in the chemistry department and develop meaningful relationships.

Assessing the Stability of Theophylline Cocrystals in the Presence of Competing Coformers in the Solid State

Jennifer Urban, Math and Chemistry
Faculty Mentor: Dr. Heba Abourahma

2010 MUSE Project

Cocrystals have become an increasingly popular subject of study in the chemistry community. It is generally known that physical properties of a compound, including solubility, hygroscopicity, and stability, can be altered when cocrystallized with other molecules, termed "coformers". Our goal is to assess the stability of a cocrystal in the solid state in the presence of competing coformers and determine the possibility of displacing one coformer in a cocrystal with another. The results could be important in the pharmaceutical industry if a cocrystal were to make it to the formulation

stage as it would have to be ground into a tablet with excipients, binding materials and others.

We have focused our attention on theophylline (TP), an active pharmaceutical ingredient (API) that is used in asthma medication. Theophylline makes a good model system for this study since a number of theophylline cocrystals with a variety of coformers have been reported to date. To achieve our goal, two general types of experiments were conducted: selectivity and competition experiments. In the selectivity experiment the theophylline is ground with equimolar amounts of two coformers and the relative affinity of the theophylline to the coformers is determined. In the competition experiment, a prepared cocrystal of theophylline is ground with a competing coformer that is known to form a cocrystal with theophylline. With each experiment, grinding time is varied between 20, 40, and 60 minutes to determine its effect on the experimental outcome. Cocrystals of theophylline that were studied in this project include those with 4-nitrophenol (PNP), 4-hydroxybenzoic acid (HBA), salicylic acid (SAL), 2-hydroxynaphthoic acid (HNA), melamine (MLM), acetamide (AA), nicotinamide (NIC), and isonicotinamide (i-NIC). The products from each experiment were analyzed by powder x-ray diffraction (PXRD), differential scanning calorimetry (DSC), and infrared spectrometry (IR). So far the cocrystal, in the presence of competing coformers, has the ability to be displaced. For the competition experiments it has been found that with MLM and PNP the TP·HBA remains intact; with AA, NIC, and i-NIC, TP·HBA partially converts to the other possible cocrystal; and with SAL and HNA, TP·HBA partially converts to the other possible cocrystal while also forming an unidentified phase.

Jennifer Urban Personal Statement

In the sciences, collaboration is incredibly important. Anyone planning on working in the field of chemistry must be able to work with their peers and superiors, thus, participating in the MUSE program was an excellent opportunity for me. Being fully immersed in chemistry lab work for 8 weeks straight is very different from working with a professor during the school year when one has to juggle classes, homework, clubs, and other activities along with the research. It has given me a taste of what working as a full-time researcher in chemistry is really like. I have learned so much in the past year working with Dr. Abourahma, and I am extremely grateful that she allowed me the opportunity to work with her for the past two summers.

Identification of *Salvia divinorum* using laser desorption mass spectrometry

Alexandra Malin, Chemistry
Faculty Mentor: Dr. John Allison

2010 MUSE Project

Salvia divinorum is a psychoactive plant that is slowly becoming illegal to possess throughout the United States. Therefore, developing a confirmatory test that selectively identifies the presence of the plant is necessary, for law enforcement.

Laser desorption mass spectrometry (LDMS) is an important tool we have demonstrated for this very purpose. In the LDMS experiment, a sample inside the mass spectrometer is irradiated with pulses of UV light from a nitrogen laser. The instrument then measures the time it takes for gas phase ions that are formed to travel a certain distance (roughly 1 meter), and converts these values to the corresponding mass values of the ions. This technique helps differentiate between the *Salvia divinorum*, other species of salvia, and teas that have a similar appearance to *Salvia divinorum*.

Laser desorption mass spectra were obtained for a set of similar plant samples using two different forms: leaf and extract. The leaves were dried and crushed, then placed in the instrument. Some of the crushed leaves were mixed with chloroform for thirty seconds. The resulting extracts were dispensed into wells of a sample plate and allowed to dry. Only very small amounts of each form of plant material were necessary for the spectrometer to detect differences that could not have been detected visually. There were similarities between all of the spectra due to commonalities in all plant life. However, *Salvia divinorum*'s psychoactivity comes from its unique active component which is called Salvinorin A. We were successfully able to identify the presence of Salvinorin A in all of the laser desorption mass spectra of *Salvia divinorum* as well as the absence of the compound in the other salvia species and teas.

Alexandra Malin Personal Statement

Working in the MUSE program with Dr. Allison has given me significant experience in Forensic Science research. Participating in such an intensive research program has definitely prepared me for continuing with my research during the school year. I have learned how to work more independently in a laboratory setting and have further perfected my

accuracy in basic laboratory techniques. Also, my ability to operate an instrument like the laser desorption mass spectrometer is very useful for future goals. Working with salvia has sparked an interest in Forensic Toxicology. Upon graduation, I would like to pursue a doctorate degree, concentrating in that field. I will be able to apply all the skills and knowledge I have obtained this summer, making all that I have learned invaluable towards my future in forensics.

Salvia Divinorum: Developing a Presumptive Test Using TLC

Lauren Belloff, Chemistry
Faculty Mentor: Dr. John Allison

2010 MUSE Project

Salvia divinorum is a psychoactive plant indigenous to the Sierra Mazateca forest of Oaxaca, Mexico. This plant was used by Mazatec shamans in spiritual ceremonies and now has become a popular drug. This plant can be smoked, chewed, tinctured, and will create hallucinogenic effects lasting fifteen to thirty minutes. There are thousands of different species of *Salvia*, but only *Salvia divinorum* contains the psychoactive constituent salvinorin A. Currently *Salvia divinorum* is illegal in forty percent of the United States and may soon become illegal in New Jersey and other state, so this is a good time to study its chemistry. There is currently no presumptive test for *Salvia divinorum*. A presumptive test is used by police officers in the field to determine probable cause for arrest on possession of illegal substances. The tests often produce a unique color when the illegal substance is mixed with one or more chemical reagents. The color determines positive confirmation for an arrest, while more complete testing must be done in a laboratory later. If a color test can be developed, law enforcement officers will be able to efficiently determine *Salvia divinorum* in states where it is illegal.

Our research this summer started with John D. Jermain's article "Analyzing *Salvia Divinorum* and Its Active Ingredient Salvinorin A Utilizing Thin Layer Chromatography and Gas Chromatography/Mass Spectrometry". Salvinorin A was visualized after performing thin layer chromatography (TLC) as a bright pink spot on the TLC plate, using vanillin as a reagent. A sample set was developed containing different Salvia species and teas that looked similar to *Salvia divinorum*. TLC was performed for all the samples and none exhibited the bright pink spot. Since TLC was able to develop a unique color we tried to create a presumptive test based of the TLC visualization chemistry. We attempted to transfer the chemistry used in TLC into solution with the same chemical reagents to produce the same color. A bright pink color is formed when the analyte is *Salvia Divinorum*; however further research must be conducted to develop simpler reagents to produce a unique color.

Lauren Belloff Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) has provided me with the opportunity to further enhance my laboratory skills in research. This program allowed me to continue working on my previous research from Spring the semester. My mentor's positive corroboration has improved my confidence to work independently in the lab. This project furthered my understanding on the chemistry of presumptive tests, including how and why they work. Also, this program has furthered my understanding of TLC and how different reagents allow for selective visualization. MUSE has given me the skills to independently develop new scientific methods. The research experience I have acquired this summer will benefit my continued research next semester and future goals as a forensic chemist.

Understanding the Effect of Ionic Liquid on the Folding and Conformation of a Helical Peptide

Jia Lin Huang, Chemistry
Faculty Mentor: Dr. Michelle Bunagan

2010 MUSE Project

Recent studies have shown that ionic liquid exhibit unusual but useful solvating properties. With regards to proteins, ionic liquids have emerged as a popular solvent for protein storage, as ionic liquids have been shown to stabilize the folded protein conformation. As the overall mechanism of stabilization is not yet fully understood, we have sought to study the effect of ionic liquids on small model proteins that exhibit a single type of secondary structure. Previous studies have indicated that helical peptides are susceptible to low temperature aggregation in the ionic liquid, whereas the helicity increases with increasing temperature and is stable at temperatures well above the aqueous melting temperature. In order to better understand these temperature-dependent conformational dynamics, we have used Fluores-

cence Resonance Energy Transfer (FRET), to probe the end-to-end distance of a small helical peptide (AKA_2) in the presence of the ionic liquid 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl) imide. Our preliminary results indicate a complex energy transfer relationship in which the donor, ⊙-cyanophenylalanine, is capable of energy transfer to the ionic liquid as well as the intended acceptor, tryptophan. Analysis of these results will continue in an attempt to deconvolute the contributions from these two acceptors, calculate the peptide end-to-end distance, and elucidate the peptide conformation in ionic liquid.

Jia Lin Huang Personal Statement

The research experience I have gained from Mentored Undergraduate Summer Experience (MUSE) has provided me with a taste of what it means to be a full-time researcher in chemistry, which I hope to pursue in the future. Not only was I able to fully exercise knowledge learned in classroom, but I was also able to sharpen up my laboratory skills. Most importantly, I was able to develop theories and analyses based on previous research conducted by either myself or my fellow researchers in the group. I have come to realize that I fully enjoy the process of preparing and analyzing samples, and the feeling of achievement whenever I overcame challenges. In the near future, I hope to study in a related field in graduate school or enter industry where I can conduct research in small groups.

Using Fluorescence Correlation Spectroscopy to Monitor Protein Conformational Dynamics

Lindsay Baker, Emmanuel Martinez Alcaraz, Chemistry
Faculty Mentor: Dr. Michelle Bunagan

2010 MUSE Project

Fluorescence Correlation Spectroscopy (FCS) is a high resolution method becoming more widely used in the field of biochemical processes; in this study, it is manipulated to observe the conformational dynamics in protein unfolding. The FCS technique is used to observe and analyze the fluorescence fluctuations as fluorescent molecules diffuse in and out of the observation volume of the high resolution objective. The photons emitted by the fluorescent molecules are collected by an avalanche photodiode detector and analyzed by a digital correlator to extract the fluorescence auto-correlation function. This function contains information regarding the time-scales of the dynamic processes which cause the fluorescence fluctuations, such as diffusion, triplet state blinking, and conformational changes. In this project, the fluorescence fluctuations of Alexa Fluor 488-labeled hemoglobin (labeled-Hb) has been observed via FCS under various denaturing conditions and analyzed via the auto-correlation function. The auto-correlation dynamics refer to the protein structural changes, which in this case are likely a result of protein denaturation (unfolding) induced by the chemical denaturant urea. Fitting routines can be used to determine the diffusion time and hence the hydrodynamic radius of the protein. Knowledge of the protein size can be used to elucidate the unfolding behavior.
This summer, FCS measurements of labeled-Hb were made under various denaturing conditions. Additionally, ensemble fluorescence experiments were used to optimize the conditions for preparation of labeled carboxy hemoglobin. These fluorescence results indicate the possibility that the Alexa Fluor 488 fluorescence is quenched by the nearby heme group, which would complicate FCS study of fully folded labeled-Hb.

Lindsay Baker Personal Statement

Working alongside student collaborator Emmanuel Martinez Alcaraz and faculty mentor Dr. Michelle Bunagan, the 2010 MUSE program has been an exceptional learning experience for me. I was excited when I first found out I would be participating in MUSE, yet I was nervous because I had never participated in chemical research before. I hoped that the program would boost my laboratory skills and general confidence in my work, and I was right! During the first week, Dr. Bunagan made certain that the student collaborators fully understood her research before beginning the data collection. Furthermore, throughout the program Dr. Bunagan found journal articles pertaining to the project for our group to read, and our discussions on these articles greatly enhanced our understanding of the research. By the conclusion of the program, I was able to develop my own ideas regarding experiments to run and how to interpret the results. Overall, I am grateful for the opportunity to improve my confidence and participate in an intellectually stimulating program.

Emmanuel Martinez Alcaraz Personal Statement

This research program, MUSE, allowed me the opportunity to continue a study I began to take part of this past spring semester but in its own way, it uniquely enriched my problem-solving and critical thinking skills. The independence given to us fostered a richer learning experience by allowing me to attempt to understand new complex concepts by myself and then giving me the opportunity to explain it to my research partner, Lindsay. Even though I had worked with our faculty mentor before, these 8 long weeks transformed me from a research student (who only knew key words) to a collaborator in this study. I thought it was funny how through many journal articles read; you end up noticing who the leading researchers are in this emerging field. And finally, the social activities definitely helped find other students and professors with similar interests which added to the program experience.

Molten Flux Method to Synthesize Thermoelectric and Magnetic Materials

Sarah Wehrhan, Chemistry
Valisha Edwards, Chemistry
Faculty Mentor: Dr. Chan

2010 MUSE Research

This summer's project is a continuation of a last year's MUSE project to make thermoelectric materials. These materials can be used to convert waste heat into electricity or use electricity to remove heat. The most commercialized application is the small refrigerator that operates from a cigarette lighter in vehicles. The cooling system does not require any chlorofluorocabons (CFCs) or hydrofluorocarbons (HFCs) which are known to destroy the ozone layer and increase green house gases, respectively.

This summer we have been focusing our research on developing new complex structures through the molten flux method. The use of an alkali chalcogenide flux (A_2Q_n, where A=Na, K, Rb, Cs, Q=S, Se, Te) allows the reaction to be conducted at lower temperatures than traditional solid state chemistry (400-800° C). In a typical reaction the following elements and compounds are loaded into a fused silica ampoule under a nitrogen atmosphere:

$wK_2Se_{2\,(s)} + xLa_{(s)} + yBi_{(s)} + zSe_{\,(s)}$.

The ampoule is flamed sealed under a vacuum and then heated in a furnace to a desired temperature and then cooled slowly to produce single crystals.

Using this method we are able to vary the stoichiometry of the elements we put into each reaction. Since our research is primarily exploratory, phase identification becomes a very important aspect. We use powder x-ray diffractometer and single crystal x-ray diffractometer to identify new products. The single crystal x-ray diffractometer allows us to obtain three dimensional positions of the atoms in a crystalline compound along with unit cell dimensions, bond-lengths, bond-angles, and site occupancy. The powder x-ray diffractometer allows us to examine the purity of our reaction products. We have identified and solved the structures of a host of compounds including $K_2Bi_2La_2Se_9$, K_2GeSe_4, Cs_2Se_5, $KBiSe_2$ and $K_2Bi_8Se_{13}$. The most promising of these compounds for thermoelectric properties is $K_2Bi_2La_2Se_9$, which has a new structure that has been unreported.

We have also studied the synthesis of magnetic materials with interesting properties. The first project focused on analyzing and developing a superconducting Ba—K—Fe—Se compound. The motivation for this project comes from a report of a superconducting $Ba_{0.6}K_{0.4}Fe_2As_2$ compound. This compound is composed of iron arsenide layers that are separated by barium and potassium. Because FeAs has the same structure as FeSe we believed that a selenium analog (Ba—K—Fe—Se) could also have superconducting properties. Presently the reactions we have analyzed have only yielded binary and ternary compounds. In order to target a quaternary compound we now attempting different synthesis temperatures to steer thermodynamics of the reaction towards the quaternary product.

This summer we were very successful in synthesizing new compounds and studying our reactions. Many of our new compounds contain novel structures that could have new and interesting properties. Some compounds are known but we have found a better solution to the crystal structures. We are now focusing on studying the properties of these new compounds and hope to publish our results in an American Chemical Society Journal in the upcoming year.

Sarah Wehrhan Personal Statement

The Mentored Undergraduate Summer Experience was very beneficial to me to train and work along with my peers. I was able to enhance my confidence and independence in the field of chemistry. I am very fortunate to have such an experience to be working with others to further improve my understanding of solid state chemistry. During the program, I learned about new and different methods, as well as learning the chemical importance of my project.

Valisha Edwards Personal Statement

The Mentored Undergraduate Summer Experience has been a helpful asset in my academic career. Throughout my time in this program I was able to build on my social skills, presentation ability as well as my academic enhancement. Thanks to the Mentored Undergraduate Summer Experience I have learned insightful information through communicating with peers whom allowed me to leave with more knowledge than I came into the program with. Within this program I have enhanced my comprehension in solid state chemistry giving me the pleasure in attaining a goal I once saw as a challenge. Upon learning different methods and applying different synthesis I feel confident in explaining the chemical significance of my project.

Matthew Kita Personal Statement

Working this summer at TCNJ in the MUSE program was an awesome opportunity. Being able to experience chemistry research so early in my undergraduate career gave me great perspective on the opportunities that await me. Now that I have research experience I have a much better idea of what I want to do after graduating college.

Investigating *C. fumiferana* FPPS using homology modeling and pyridinium bisphosphonates as selective inhibitors

Reshma Jacob, Chemistry
Faculty Mentor: Dr. Stephanie E. Sen

2010 MUSE Project

The focus of our research is to elucidate the structural features of the enzyme farnesyl diphosphate synthase (FPPS) in insects, with the long-range goal to develop biorational insecticides. FPPS is responsible for the construction of wide range of isoprenoid compounds that serve many biological functions in animals, plants, fungi, and bacteria. FPPS is also a required enzyme in the biosynthesis of juvenile hormone (JH), a unique isoprenoid found only in insects that regulates many aspects of insect growth, metamorphosis and reproduction.

FPPSs have been well studied in a variety of organisms, and inhibitors of this protein are used clinically to treat certain bone disorders in humans. In insects, there are several structural variants of FPPS, including "type 2" FPPS, which is present only in Lepidoptera. As this insect order includes a large number of agricultural pests, the type 2 protein represents an attractive target for insecticide development.

The pyridinium bisphophonate class of FPPS inhibitors was chosen as a starting point for the development of a selective type 2 FPPS inhibitor and to develop a working model of the type 2 FPPS active site. The potency of these compounds is due to their ability to tightly bind to the enzyme's active site by mimicking of the natural intermediate formed during catalysis, as well as the use of the hydrolytically insert bisphosphonate moiety. The proper placement of appropriately sized hydrophobic groups within this inhibitor structure is expected to provide selective inhibition of type 2 FPPS.

We have prepared and tested 5 compounds for biological activity against type 2 FPPS of the spruce budworm (a known lepidopteran pest). We also performed parallel studies with a non-lepidopteran FPPS to assess compound selectivity towards the type 2 protein. The results of these studies suggest that selectivity can indeed be achieved. Furthermore, with the use of computational methods, an active site of model of the type 2 FPPS has been prepared that provides a rationale for the observed inhibitory potency and selectivity. The results of these studies will be presented.

Reshma Jacob Personal Statement

I found the Mentored Undergraduate Summer Experience of 2010 to be very rewarding. Being able to work as the sole undergraduate researcher in Dr. Sen's lab this summer was a different experience, as during the semester, intensive personal attention cannot always be given to the larger research team (usually 4-5 in Dr. Sen's group). This summer, research was a true collaboration, wherein Dr. Sen and I would work together to plan and perform the experiments, to analyze the results, and to problem solve. This allowed us to have a more cohesive strategy towards the research. The specific work performed during the summer has furthered my knowledge in computational chemistry and organic synthesis. In addition I learned how to perform *in vitro* assays to determine inhibitory potency. In total, this experience has deepened my understanding of what is involved in developing a targeted inhibitor. I look forward to working further on my project in the fall and feel that this summer was a very enriching experience indeed.

Early Stages of Ice Sublimation
Joe Grippaldi, Physics
Faculty Mentor: Dr. Nathan Magee

2010 MUSE Project

This summer I am working with Dr. Magee on a project designed to give us information on the growth and sublimation of ice particles in the very early stages of development. There are two main theories on how water vapor is sublimated onto ice particles and we hope that this experiment will help reveal which theory is a more accurate depiction of this occurrence.

The idea of this experiment is to use an in-situ ellipsometer to gather data from early ice growth. An ellipsometer is a device that uses lasers to analyze thin films and give data on things such as index of refraction and growth rate. My specific project is to design and build a diffusion chamber for the sublimation to take place. Basically, this chamber needs to be pressurized and insulated to maintain specific pressures and temperatures. We will be using thermoelectric coolers to chill the inside of the chamber and provide a relative humidity to promote ice growth. The ice will sublimate on a small substrate mounted in between two thermoelectric coolers.

Currently, we are in the process of building a prototype diffusion chamber that is being built with relatively inexpensive materials. We will try to finish the prototype chamber by the end of the MUSE program and home to then build the real chamber over the course of the school year.

Joe Grippaldi Personal Statement

My work in the MUSE program has given me high hopes to find a job that is both interesting and enjoyable. Aside from the abstract and poster presentation, the MUSE experience has been very relaxed, allowing us to get our work done without any unwanted worries. My collaboration with Dr. Magee has been enjoyable as well. He does a good job of getting us to do what we need to do on our own; showing us how to go about it without doing it for us. Working alongside two other physics majors also helped to provide some socialization as well. MUSE has been a unique experience that will hopefully lead me to bigger and better things in the future.

Sublimation of Ice Particles in Upper Troposhpheric Conditions
Kayla Spector, Physics
Faculty Mentor: Dr. Nathan Magee

2010 MUSE Project

Cirrus clouds, which form in the upper troposphere, are made of small ice particles in the size range of 10 to 100 μm. These tiny particles play a large part in determining the effect of cirrus clouds in global climate change scenarios. There is a discrepancy between the predicted behavior and the observed behavior of cirrus clouds, which cover a wider area and sublimate slower than models predict. The focus of my research, under the direction of Nathan Magee, was to better understand the sublimation rates of ice under cirrus-like conditions.

Most of my work this summer focused on refining the methods by which we create, levitate and observe ice particles. To produce the particles, a fine mist is sprayed into liquid nitrogen and then passed through sieves to separate particles by size. We designed and machined a microparticle collection system which minimized the handling of the particles between creation and levitation. By initially trapping the particles in a small steel cup which is then attached to an electrode, the ice is less likely to congeal. Individual ice particles are then launched from the electrode and balanced in an electrodynamic levitation cell, within a vacuum chamber which is housed in a freezer. I also created a program using Labview, which enabled us to collect more precise data on the voltages of the launching electrode.

The ultimate goal of the research is to observe levitated ice crystals at a range of temperatures (-80°C to -40°C) and pressures (100 mb to 1000mb) and to use experimentally determined sublimation rates to refine the equations that incorrectly predict behavior ice particles under these conditions.

Kayla Spector Personal Statement

The MUSE program has given me access to experiences that will be invaluable throughout my undergraduate career and beyond. I learned to work collaboratively with my mentor and other student researchers to design and implement components of several experiments. I also worked on independent problem solving skills, research tactics,

computer programming in multiple languages, machining, soldering and electrical repair, and presentation preparation. These skills will be useful in my studies and other career ambitions, and am I grateful to have had this experience in the beginning of my undergraduate work.

Acoustic Raindrop Disdrometer

John Lenehan, Physics
Faculty Mentor: Dr. Nathan Magee

2010 MUSE Project

Weather forecasts are incredibly important for airports, farmers, and also the average person, and as a result these reports need to be as accurate as possible. Modern radar imaging can roughly estimate the cumulative amount of precipitation by measuring the intensity of the storm, but this does not provide completely accurate results. The storm appears to be much more intense when the rain drops are larger, rather than when the drops are smaller and there are more of them, even if the actual precipitation levels are equal. As a result, the drop size distribution, or the size and quantity of the drops, is required in order to make more accurate predictions.

My work this summer with Dr. Magee focused on building an apparatus that could measure the rain drop distribution, while being relatively affordable to reproduce. The design focuses on the acoustics of a raindrop to gauge its size and the frequency of drops. A large part of the project was spent on design and the build of the actual apparatus. We developed a system that incorporated a suspended metal plate with pickups on the underside that record the sound of raindrops hitting the surface. Once this design was finished, the next step was to analyze the recorded sound and create a program that could count the amount of drops and determine their size based off the raw data of the sound waves.

The programming stage is still ongoing and we plan to record and analyze more data. By comparing the audio data to visual and physical recordings of rainfall, we will be able to create a program that can accurately gauge the distribution based solely on the audio recordings.

John Lenehan Personal Statement

I am very fortunate to be able to work under Dr. Magee this summer in the Mentor Undergraduate Research Experience Program. This experience provided me with a great amount of skills that I wouldn't have been able to gain anywhere else. While working alongside Joseph Grippaldi and Kayla Spector, I was able to learn the importance of collaboration, as well as the importance of independent research. Working with Dr. Magee has given me the ability to work confidently in the lab and the machine shop, both of which will be invaluable skills in the future. The MUSE program has also enriched my learning experience here at TCNJ by allowing me to feel more connected with the school and Professors. I am glad to be able to have participated in this program and I know it has opened many doors for me here at TCNJ and beyond.


TCNJ