The College of New Jersey

Mentored Undergraduate Summer Experience

2009 Abstracts

The College of New Jersey's

Mentored Undergraduate Summer Experience – 2009

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 87 students and 44 faculty members representing 20 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, staff, and invited guests led participatory workshops at Monday lunches on graduate school, public relations, the synergy between art and science, ethics in research, the publication process, and interdisciplinary projects. On Thursday afternoons we enjoyed refreshments while hearing from many students about their ongoing projects. Social activates like dinner at President Gitenstein's home, canoeing the Delaware River, and ice cream socials also encouraged MUSE participants to build community outside of work. In addition, students enjoyed a series of coordinated, fun evening activities. Fifty-one 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 Interim Provost Beth Paul for her vision of long-term growth and sustainability for MUSE and a substantial budget; the rest of the Office of Academic Affairs, with leadership from Provost Carol Bresnahan and invaluable administrative support from Janice Huang; student program assistant Anna Lovett; 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: Sunita Ahlawat, Matthew Bender, Candice Feiring, David Hunt, Jeff Osborn, Nick Ratamess, Ralph Reed, Jess Row, Greg Seaton, and Jennifer Wang. The program is possible due to major financial support from Academic Affairs, with supplemental funding from Dean Jeff Osborn (Science), Dean Taras Pavlovsky (Arts and Communications), Dean Steven Schreiner (Engineering), Dean Susan Bakewell-Sachs (Nursing, Health, and Exercise Science), and the Department of Facilities.

We are very grateful to our generous external funders, the American Chemical Society Petroleum Research Fund, American Society of Plant Biologists, Bristol Myers Squibb, Garden Club of America, Lafayette College Alumni Association, Merck & Co./American Association for the Advancement of Science, National Science Foundation, Pennsylvania Fish and Boat Commission, and the Sanofi-Aventis Research Center.

Janet Morrison

Associate Professor, Director of Faculty-Student Collaborative Activity and MUSE

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Public Art Project: Representing Creativity of TCNJ Schools & Departments

Colleen Napolitano, Art
Faculty Mentor: Dr. Anita Allyn

2009 MUSE Project

In order to celebrate both the opening of the new Metzger Drive apartments and the students who will reside there, a request was put forth for research-intensive, community-related public art pieces to be funded by the Mentored Undergraduate Summer Experience. The proposal selected was a series of banners, modeled after those found on museum facades, highlighting the diversity and creativity found within each of the seven schools offered at TCNJ. In the piece that resulted, each school was assigned its own unique color scheme and style based off of international and historical art movements, with each banner featuring a figure that acts as the 'muse' or 'patron' of its area of study. In addition, familiar items and signs associated with the studies of each school are integrated within the design. In order to better represent where inspiration in these varied fields come from—the students themselves—the hands and eyes of each figure are actual photographs of participants from the MUSE program. The completed series will be displayed together at the apartments upon commencement of the new academic year.

The process of making this piece a reality involved both thorough research and diligence in work. Assigning a style to each school required the use of numerous digital resources and printed material accessed in the campus library. To ensure the best result possible, much needed to be learned about the printing process, and careful attention was given to the study of materials. Visual investigation was also called for in finding the best locations for display. The banners themselves were rendered through entirely digital means but relied heavily on the knowledge of traditional techniques utilized by each historical style.

Personal Statement

My experience in the MUSE program has been quite valuable in allowing me to gain a greater understanding of the professional designing and printing process. This was my first time working on such a large scale, and given my lack of familiarity with the materials and procedures, the project proved to be a great learning experience. Frequent meetings with the deans of each school not only ensured that the representations I created did the departments justice but also allowed me to further connect with the community that the piece seeks to honor. The assistance and guidance of Dr. Allyn created a highly independent yet supportive environment for the piece's development, and her extensive professional knowledge was pivotal in the success of the series. While I did not collaborate with other students over the course of the program, I was able to incorporate the work of my fellow MUSE students into the piece through the photographic elements. Ultimately, this experience has allowed me to experiment creatively in new and challenging ways—without a doubt, something that will inform my design decisions for years to come.

***Inherited Traits* Exhibition**

Karin E. Christiaens, Art History
Faculty Mentor: Sarah Cunningham, MFA

2009 MUSE Project

As curatorial assistant to Sarah Cunningham, director of The College Art Gallery at TCNJ, I supported the research for an exhibition tentatively titled *Inherited Traits* which will be on view January20-February 24, 2010 at The College Art Gallery. This exhibition will feature 5-8 contemporary artists who explore ancestral legacies (their own and others) including shared biological, cultural, and gendered characteristics. The theme of the exhibit has been chosen to coincide with the 2009-10 Committee for Cultural and Intellectual Community (CCIC) theme of "Family."

This summer I thoroughly researched concepts of *family* and *inheritance* from historical, anthropological, sociological, psychological, and biological perspectives in relevant journals and art historical texts in order to provide contextual background for the exhibition. Additionally, I researched current exhibitions as groundwork for several investigative field trips to New York City in order to view work by prospective artists. Moreover, I researched contemporary artists who explore applicable concepts working in a range of artistic media in order to compile a comprehensive list of possible artists for the *Inherited Traits* exhibition. Sarah reviewed this research, shared her own findings, and provided guidance for subsequent inquiries. We will refer to this combined research when selecting the final 5-8 artists to invite for exhibition.

We have begun to contact select artists and galleries to inquire about specific works of interest. Once the artists are confirmed, Sarah will write an introductory essay for the exhibition. My current research will be used to write biographical and interpretative text for each artist as well as a general essay positioning the exhibit in the overarching theme of "Family." My writings will be presented as wall text, on an exhibit web site and/or in the printed catalog. I will also create a suggested reading list to accompany the exhibit.

Personal Statement

Through the MUSE program I have furthered my ability to conduct in-depth research. Exploring the broad themes of *family* and *inheritance* taught me to narrow my frame of focus, collect data in unfamiliar fields, and understand the implications of diverse fields in artists' works. Compiling artists and current exhibitions for consideration allowed me to further appreciate the contemporary art scene. Before taking the position as curatorial assistant, I had limited knowledge of the opportunities for artists and art historians in New York metropolitan galleries and within the field of contemporary art.

Continuing to work on the exhibition this year will allow me to learn firsthand the logistics of curatorial work including contacting artists, writing wall text and an exhibition catalogue (thematic and biographical), preparing for shipping, etc. and developing the layout and design of the show. Serving as curatorial assistant is a rare opportunity for an undergraduate student and it will assist me with future decisions regarding graduate school and serve as an important indicator of experience as I enter my field of choice.

Gottfried Weber's *Gitarrenlieder*: Realizations of Aesthetic and Cognitive Theories

Nicholas Dogas, Music
Ian Highcock, Music
Faculty Mentor: Dr. James M. Day

2009 MUSE Project

This project examined rare songs for voice and guitar by German theorist and composer Gottfried Weber (1779-1839). Of particular interest was the extent to which Weber's theories of music composition, aesthetics and cognition are evident in these compositions. As theorist, Weber was a pioneer of music cognition studies, posing principles by which harmonic progressions are understood by 'the ear', and he defined the concept of 'multiple meaning', in which harmonic entities can be defined in more than one way in certain tonal contexts. As composer, Weber played a vital role in establishing the genre of German art song, or *Lied* (pl. *Lieder*); study of these early songs is essential to achieving a comprehensive understanding of the genre. Today, despite their importance Weber's one hundred and thirteen songs (approximately seventy-five feature guitar accompaniments) are largely forgotten and we sought to remedy this problem.

In our study we found that in fact Weber's concept of 'multiple meaning' is strongly evident in some of his best songs, but we also learned that this element was only one of many factors that contributed to the merit of his Lieder. In our review of period sources, for instance, we found Weber's contemporaries viewed him as having a very original and admirable approach to setting words to music, saw him as unusually sensitive to the subtleties of declamation and expression, and hailed his innovations of musical form. Also in our study, we electronically searched libraries worldwide and viewed historical sources to create the most complete catalog of Weber's solo Lieder to date; prepared selected solo Lieder for what we believe are the first performances in over one hundred and fifty years; created the most detailed analyses to date of selected Lieder by Weber; and developed original German-English translations of numerous song texts, reviews and letters to support our work.

Nicholas Dogas Personal Statement

Collaboration is an extremely important aspect of music making, and the MUSE program has offered the perfect atmosphere for me to work closely with my partner, Ian, and my mentor, Dr. James Day. We have accomplished a lot during these short two months, including locating many of Gottfried Weber's works, compiling Weber's solo art songs into a concise table and creating modern editions of select pieces. While the research aspect of this project has taught me a lot about utilizing both electronic and traditional resources, the performance aspect has truly changed the way I approach my studies. Like many other performers, I typically reference literature and recordings while developing an in-

terpretation of a song; however, Weber's *Gittarenlieder* are so rare that no recordings exist, and I was forced to create a completely unique interpretation to every piece I performed. This creative skill is one that will help me throughout the rest of my career as I am faced with new and even more challenging repertoire and performance opportunities.

Ian Highcock Personal Statement

The MUSE program, in particular my collaboration with Dr. Day and Nick Dogas, has helped me grow both as a musicologist and as a musician. As a musicologist, I have grown most in my appreciation of the resources available to the music researcher, as well as the many aspects of research necessary for a well-rounded investigation. In particular, my translation work with Dr. Day has impressed upon me the importance of not only conveying the meaning of the original German, but to also bring literacy and flow to my English translations. As a musician, I have deepened my awareness and commitment to the many factors that go into a successful performance, whether it be analyzing poetic texts, researching historical context, or correctly interpreting tempo markings. There is no better challenge to musicians than to create an original interpretation, not with the benefit of prior performance models, but using only their combined experience, talent and insight. Together, we have made a groundbreaking contribution to the study of Gottfried Weber's Lieder.

Investigating the Listening and Singing Skills of High School Students

Jessica Esrig, Music Education
Charity Luyben, Music Education
Faculty Mentor: Susan C. Guerrini, Ph.D.

MUSE 2009 Project

The major goal of this project was to create a CD version of the *Vocal Intonation Test* for high school and middle school music teachers to administer to their students. This test was designed to assess the listening abilities of students as they decide whether a major or minor scale is sung in tune or out of tune. In order to achieve this goal it was necessary for two student collaborators to edit examples of student recordings using the software program *Pro-tools*. Once all examples were identified and edited, a master CD was created which will be used in schools this fall to test the reliability of the *Vocal Intonation Test*. We will submit the results of the reliability study to the *Music Educators National Conference* with the hopes of being selected for a poster presentation at their annual convention. We will also submit our research to the *International Society of Music Education* who will be meeting in the summer of 2010 in Bejing, China. Another goal of the project was to gather research information concerning the intonation and listening skills of students who are singers in a high school choir. Many articles and books have been identified, found, read, and discussed which relate to the topic of vocal intonation. This information is being incorporated into an article currently being written concerning the listening and singing skills of high school choral students relative to issues of intonation. Once the article has been completed, it will be submitted to a music education journal for publication.

During this summer we have accomplished the following:

Acquired data through student recordings; judged the data as being correct or incorrect intonation; edited the data, removing static and including verbal directions; created a Master CD recording of the Vocal Intonation Test; researched literature on intonation; and interpreted the data to create a literature review.

Charity Luyben Personal Statement

Participating in the music chapter of MUSE this summer has given me an enlightening perspective on the research field of music. As a future music educator, I am grateful that through this experience I have gained tools that enable me to search, understand and conduct research that will aid and enrich my teaching. Investigating past and present research in the music education field has motivated me to ask more questions and take a stronger interest in how educators develop curricula for public schools. I feel privileged to have taken part in this project and I hope that more education students will participate in the future. By inspiring a new generation of researchers, the education field stands to gain a great deal in better understanding and facilitating classroom learning. Working with my mentor and student collaborator has been a great experience and I am very thankful to TCNJ for providing its students with such a unique opportunity.

Jessica Esrig Personal Statement

My work alongside Charity Luyben under mentorship of Dr. Guerrini has opened a new door for me. I knew from the start that I was interested in this project based on singing accuracy and musical listening ability, but I never thought I would so much enjoy examining journal articles and research to determine if they pertained to our study. After reading many articles, I have found my curiosity heightened and new ideas swimming around in my head. I feel very fortunate to have had this great experience and to have had Dr. Guerrini guiding Charity and I in the research. I have also become more familiar and experienced with the music-editing program *Protools* for compiling a listening assessment test. I hope that our research and our assessment tool both prove useful for music teachers to improve and advance their students' voice production. The skills and knowledge that I have attained from this summer research experience are invaluable and beneficial to my career as a future music educator.

The Power of Underwriters on Stock Sales in India and China

William Ludlow, Finance
Faculty Mentor: Dr. Susan Hume

2009 MUSE Project

This summer I worked with Dr. Hume of the School of Business. We explored the economic impact of fame and the importance of the underwriter on the sale of public shares of stock in both India and China. This is a large ongoing project consisting of a database of more than 1,600 firms that issued new capital since 2005. My summer research was directed at understanding how the stock markets in those two countries work and how the global financial crisis has impacted the ability of firms in these emerged countries to finance capital needs. Capital in finance refers to selling ownership in a firm. The ability to sell capital is vital to the economic growth of India and China. The research is on new companies that sell stock, called Initial Public Offerings (IPOs) and established companies that sell additional shares of stock, or Seasoned Equity Offerings (SEOs). During my research I read literature that discussed the history of these markets and also the history of the stock markets in the US. In addition I worked to become very familiar with the financial database Bloomberg. This database is widely used by financial institutions, traders, investors and corporate treasurers. While collecting data I used the Bloomberg online university certificate program to become certified in equities and fixed income. This helped me to fully understand the power of the database. They have an interactive help desk that is great for data questions that usually come up.

I started my research by studying the stock markets worldwide and read about 30 papers. We produced an annotated bibliography for these countries including working papers. Some of these papers were classic articles on signaling. We found some very new research on this topic. We are interested in knowing whether or not the choice of the underwriter is an important signal to an investor. If this signal is important, then investors may be able to profit by buying stock in companies that have top underwriters. This reference research was important to further develop the motivation for the uniqueness of our research. Our research adds to the understanding of these markets because we add the underwriter fee that is available on Bloomberg. A new contribution is that we are also studying the effects of market uncertainty on the sale of stock in those markets by examining 2007-2008.

We expanded our research model from the initial research on Brazil and China, our MUSE 2008 project. We expanded our design this summer to measure underwriter performance relative to market index returns in addition to variables related to institutional demand. We are currently working on the variable extractions from the database, testing our understanding of the coding of the relevant variables from Bloomberg. We will continue with the project in the fall, 2009.

Personal Statement

The undergraduate MUSE program gave me a great opportunity to understand the research process. In the beginning, I thought I would have difficulty understanding the articles on the topic, but I found through discussing with Dr. Hume and writing about these ideas that it was much easier. We were able to improve methodologies used in previous papers. I learned how to use databases, especially Bloomberg and econometrics. I hope to be a hedge fund trader and this summer work and the interaction with students and faculty is invaluable to me.

Religion and Health in the U.S.: An Economic Perspective

Marcelo Rivera, Economics
Faculty Mentor: Dr. Donka Mirtcheva, Ph.D.

2009 MUSE Project

During the summer I participated in the Mentored Undergraduate Summer Experience (MUSE) under the supervision of Dr. Donka Mirtcheva on a study titled, "Religion and Health in the U.S.: An Economic Perspective." The purpose of our research project was to examine the relationship religion has on both physical and mental health of different age groups in the United States. Prior research has shown that there is an actual relationship between religiosity and health, but they have focused on either a certain age group or have taken an overall approach (looking at the population as a whole) in their study. Our research project is examining how the strength of the relationship can vary within different age groups and possibly distinguish some factors that are promoting such a trend. For our data set we used

the General Social Survey (GSS) and the Panel Study of Income Dynamics (PSID). The General Social Survey is a longitudinal survey that began in 1972 and has most recently been updated with data in 2008. It is the one of the most frequently used sources for information in the social sciences, aside from the U.S Census. The Panel Study of Income Dynamics was started in 1968. It is a longitudinal study of a representative sample of individuals who reside in the United States. The study focuses on aspects of demographic and economic behavior. Dr. Mirtcheva introduced and guided me through a technical process needed to prepare our data. Before we could begin analyzing our data set, we needed to recode and clean our data to make sure that all the data matched across a number of years. Next, we used a statistical program called STATA to analyze our data and run our regressions. We are currently in the process of analyzing our data.

Personal Statement

Being part of the MUSE program has enriched my knowledge of how to approach a research project more diligently. The MUSE program granted me the opportunity to get hands on experience of a particular field of study within my major. Professor Mirtcheva has guided me through the step-by-step process of constructing a formal research paper with the goal to have it published. I have become more familiar with formal empirical and theoretical literature in the economics field of research. Working on the research project has also educated me on research techniques, topics and software, such as STATA, that I might run into again as a professional or during my time as a student here at the college. I have also been introduced to and taken advantage of some of the facilities that The College of New Jersey has to offer students that I previously was not aware of. The MUSE program has given me the chance to differentiate myself from other candidates when I am applying to graduate school. It has helped me obtain tools that will help me be successful in any future endeavors, whether academic or personal.

Macroeconomics Policy Contributors to Business Failures: a Panel Analysis

Zarah Aslam, Bussiness
Faculty Mentor: Michele Naples

2009 MUSE Project

Economic growth and indebtedness both contribute to business-failure incidence. This project seeks to show that failures are also affected by the extent of income replacement by automatic stabilizers (unemployment compensation, welfare, food stamps). It is argued that when and where states have permitted income replacement to decline, the impact of slow growth on failures is intensified, and thereby the economic contractions is worsened.

If this macro-policy effect on failures can be documented, it provides support for recent federal initiatives to extend unemployment-compensation coverage from 26 to 39 weeks, and to suspend taxation of unemployment benefits. Both policies increase the effective income-replacement from unemployment compensation, helping to prevent business failures and thereby mitigate the ripple effects of the current downturn throughout the economy, as well as helping the unemployed.

Personal Statement

I am working with Dr. Michele Naples on a paper about business failures in the U.S. I have spent the first half of the project researching articles from academic journals on business failures. I have learned a lot about the causes and effects of business failures and also about laws regarding business failures. There is very little research on the business failure rate in the U.S. compared to topics like unemployment, so I have been carefully searching for all relevant articles. I have learned more about statistics (and econometrics) in this project. I've also been able to identify how the business failure rate correlates with different factors like the profit rate or the corporate birthrates. Through this project, I have been able to understand what it is like to do research in economics. I never realized how difficult it was to find supporting research and gathering data for such a topic. Dr. Naples has helped me to understand how difficult and meticulous research is when it comes to creating and testing econometric models. She has been very patient, understanding, and helpful, even though it may take a long time for me to gather the data.

Race and Ethnicity in the Caribbean: A Critical Introduction

JoLynn Graubart, English and Sociology
Faculty Mentor: Winnifred Brown-Glaude, PhD

2009 MUSE Project

Throughout this summer, Winnifred Brown-Glaude and her student JoLynn Graubart have conducted research on race and ethnicity in the Caribbean. The long term goal of this project is to develop an introductory text for undergraduate students that will examine the complex ways in which race and ethnicity are conceptualized and experienced in the English, Spanish, French and Dutch Caribbean. The specific purpose of this summer MUSE project was to develop a preliminary literature review of existing scholarship on this comprehensive topic.

They began by concentrating their research efforts on different regions of the Caribbean: JoLynn focused on the French and Dutch regions, while Brown-Glaude focused on the English and Spanish regions. They have researched contemporary (5-10 years) scholarship on slavery and emancipation in the four regions of the Caribbean and have produced an extensive annotated bibliography which will serve as a foundation for the Introductory chapter of the text, which is tentatively titled 'The Caribbean: Mapping the Geographical and Racial/Ethnic Terrain.'

They have also visited an art gallery, Exit Art, in New York City to observe the exhibit, 'Negritude'. ***Négritude*** is a term coined by the Martinican poet, playwright, and politician Aimé Césaire in the 1930s. The experimental multidisciplinary exhibition explores the visionary 20th century political and artistic movement of the same name which flourished among Black intellectuals in post-World War I Paris and later spread to Africa, the United States and the Caribbean. *Négritude* writers found solidarity in a common black identity as a rejection of French colonial racism. They believed that the shared black heritage of members of the African diaspora was the best tool in fighting against French political and intellectual hegemony and domination. The concept, Negritude, will be discussed at length in the text.

Personal Statement

My experience with this summer's MUSE program was especially beneficial. Having added a second major in sociology this past fall, my collaborative research with Professor Brown-Glaude provided me with an opportunity to explore the ways in which studies of race and ethnicity translate into the sociological field. Our day-trip to a NYC art exhibit added a unique and memorable dimension to the experience, one that certainly brought the complexity of Caribbean race and ethnicity to life. Since the project is in its beginning stages, I was asked to look at a wide range of information. I am walking away from this summer experience able to say that I have learned an enormous amount about the historical and political implications and complications of race, creolization, and colonization in the French and Dutch Caribbean islands.

The True Well of English Vndefyled?: Chaucer, Spenser, and Lydgate

Adam Engel, English
Faculty Mentor: Glenn A. Steinberg, PhD

2009 MUSE Project

Virtually every course that surveys English literature includes Geoffrey Chaucer's *Canterbury Tales* as one of its cornerstones. Chaucer's position as one of the great writers in English history is secure, and his work is justly admired. But Chaucer's frequent characterization as "the father of English poetry" may be undeserved in some respects. The narrative poetry and drama of writers in the centuries immediately after Chaucer, while sometimes indebted to Chaucer for storylines or characters, seem distant from their great English precursor in terms of style, imagery, versification, and language. In the 1590s, Edmund Spenser characterized Chaucer as the "pure well head of Poesie" (Mutabilitie Cantos 7.9.4), but Chaucer's fourteenth-century poetry is in fact unusually far removed from Spenser's sixteenth-century writing, even when Spenser attempts to write in a consciously archaic style for poetic effect. For this reason, Adam Engel and Dr. Steinberg have been reexamining Chaucer's reputation as "the father of English poetry" using the tools of modern literary and linguistic analysis. We have attempted to measure and reevaluate Chaucer's role as an influence on later writers, especially Spenser and his fellow Elizabethans. By way of contrast to Chaucer, we are also examining the corresponding influence of the poetry of John Lydgate, who wrote just one generation after Chaucer and was almost as famous and ad-

mired in Spenser's day as the author of the *Canterbury Tales*. While little known or read today, Lydgate may actually have contributed more to the development of English poetry in subsequent centuries than Chaucer did. We are currently looking at the poets' diction using word counting software, and Dr. Steinberg plans to move onto syntax following the summer's end.

Personal Statement

Working with Professor Steinberg this summer has been an eye-opening experience. By approaching Medieval texts using technological methods new to the humanities, I have witnessed the potential discoveries as well as the challenges and setbacks present at every step of a research project. Over the course of the MUSE program, Professor Steinberg and I have encountered useful scholars and programs that have brought us closer to proving who the "father of English poetry" truly is. I now have a better idea of what academic research entails, how to utilize all the resources at my disposal, and how two people can put their heads together to make a difficult task, in this case a revision of history, more feasible. I hope to remain a part of this project as it unfolds after this summer, when Professor Steinberg will be looking into further elements of Chaucer, Lydgate, and Spenser's style such as syntax. I am happy to have worked with a professor whose enthusiastic guidance has made this process both intellectually rewarding and enjoyable.

Motivators of Volunteerism and Civic Action among Emerging Adults in an Urban Community

Cynthia Pierre, Psychology
Faculty Mentor: Dr. He Len Chung

2009 MUSE Project

This summer I worked in collaboration with Dr. He Len Chung during the Mentored Undergraduate Summer Experience. My primary objectives were to (1) conduct face-to-face interviews with African-American emerging adults recruited from programs in Trenton (e.g., Isles YouthBuild, Mercer Street Friends), and (2) code and analyze the qualitative portions of the interviews. The qualitative items in our interview capture motivators for participating in different volunteering and civic activities because these activities are especially crucial to urban community growth. Our work this summer is particularly important because previous research has focused on primarily Caucasian, middle class samples. My research consisted of applying qualitative coding methods and already existing scales that deal with volunteering motivators to our data.

Before tackling the data coding, I conducted research on motivational factors linked to sustained volunteerism. According to the functional approach to motivation, people engage in the same behaviors for different reasons, for different ends, and in order to serve different psychological functions. This approach went hand in hand with our interview's open-ended items, which allow individuals to generate their own responses and explanations of their motivations.

For the MUSE project, we were interested in understanding both motivators and barriers to participation. Using the Volunteer Functions Inventory (VFI) measure as a framework, which accounts for various motivators to volunteering (Understanding and Enhancement, for example), I began to code and categorize participant responses with Dr. Chung in an effort to develop a coding manual. We are currently refining this manual as well as analyzing frequencies of coding categories. During the final week of the MUSE program, we will also consider motivators of and barriers to civic action. After the coding analysis is complete, we hope that our enhanced understanding of motivators (and barriers) for this population will help to support increased levels of pro-social community activity.

Personal Statement

Through the Mentored Undergraduate Summer Experience (MUSE), I was given a valuable opportunity to exercise and develop my research skills in community and developmental psychology. Not only was I able to refine my interviewing skills and enrich my knowledge of the relevant literature, especially with respect to the motivators of volunteering activities, but I took on the additional, more challenging responsibility of applying this research to our qualitative data. In this regard, my role transitioned from that of an assistant--where I was simply delegated tasks and assignments—to one of collaborator, where I worked closely with a professional to develop a best-practice design and analysis of the data. Although neither Dr. Chung nor I was well-versed in qualitative methods before the program's start, our close partnership allowed us to educate one another and reinforce each other's strengths as the weeks progressed. This

professional collaboration and my hands-on experience with collecting, coding and analyzing qualitative data will surely prepare me for a research-oriented doctoral program in clinical psychology.

Pride: Correlates of Emotion and Behavior

Michael S. Lamm, Psychology
Faculty Mentor: Dr. Chu Kim-Prieto

2009 MUSE Project

Previous research indicates that cultural background can influence the expression or experience of emotions. Data collected through the TCNJ Emotion Lab was analyzed using computations such as a one-way analysis of variance (ANOVA), t-test analyses, and post-hoc analyses, all through the statistical software, SPSS 15.0. The surveys used assessed self-esteem, acculturation, pride, personality, positive and negative affect, and a participant's quality and process of life. The analysis of data will evaluate a participant's race, ethnicity, religious views, and geographic location of influence to detect a difference in the expression of emotions, specifically pride, in comparison to the participant's demographic responses. Data was collected using participants recruited from The College of New Jersey's campus throughout the summer MUSE session. The goal of this study is to expose the variation of emotion expression across cultures. Once the analysis of data is complete, a manuscript will be prepared, in collaboration with Dr. Chu-Kim Prieto, for publication in a professional scientific journal. The results of this research will provide a foundation for future research, in the upcoming year and on, which will explore the expression of emotions related to subjective well-being and other such differences across cultures.

Michael Lamm Personal Statement

The College of New Jersey's MUSE research program has afforded me an opportunity unlike any other. My learning experience has extended far beyond the psychological research process and computing data analyses through statistical software. In addition to these new assets to be added to my repertoire, I now have the knowledge of what conducting research as a career, whether in graduate school or in industry, would be like. I have found out through this program that research is definitely the field that I want to extend my experience within when I approach my next level of education. Under the supervision of Dr. Kim-Prieto, I have taken a research project under my wing with intense requirements on the part of the investigator and, after a lot of hard work, ended up with a successful outcome. This is something that I can be proud of and definitely a program that I can recommend to other students at The College of New Jersey interested in conducting any type of research.

Prejudice: Correlates of Emotion and Behavior

Mia Marciante, Psychology
Faculty Mentor: Dr. Chu Kim-Prieto

2009 MUSE Research

Our research project attempts to gain a deeper understanding of the processes that underlie the lived experiences of emotions, as well as better understand the role of the specific emotions in our lives. My study examines the consequences of stereotypic portrayals of women. Data was collected using participants from The College of New Jersey throughout the spring semester and the MUSE summer session. Participants were primed with different reading passages characterizing women in different ways. The present study assessed the impact of stereotypes through both an explicit self-reported measure and through a more implicit behavioral measure of aggression. Participants' implicit reaction was evaluated by comparing amounts of hot sauce allocation while explicit reactions were evaluated by comparing responses on various surveys directed towards members of typically devalued groups. Surveys were also used to assess social dominance orientation, personality, pride, and self-esteem. Data was analyzed using computations such as a two-way analysis of variance (ANOVA) through statistical software, SPSS 15.0. The analysis of data also evaluated the participant's race, ethnicity, and geographic location of influence to detect a difference in the expression of emotions in comparison to the participant's demographic responses. Once the analysis of data is complete, a manuscript will be prepared, in collaboration with Dr. Chu-Kim Prieto, for publication in a professional scientific journal. The results of this research will provide a foundation for future research, in the upcoming years, for the TCNJ Emotion Lab.

Mia Marciante Personal Statement

The MUSE program was an opportunity not only to conduct valuable research but also gain valuable preparation for graduate school and future professional endeavors. Working closely with faculty has allowed me to collaborate in a setting similar to that of graduate school. My ability to communicate my research has also been strengthened through the various activities and presentations provided by the program. Rather than just reading and learning about past research I was able to actually take part in the research process. Through this hands-on experience I was able to use various databases and software tools, such as SPSS 15.0. The skills I have acquired and strengthened this summer will certainly give me an advantage while conducting research in the future whether in future classes at TCNJ or in graduate school. The research conducted during MUSE could also potentially be published and could become an important addition to existing research in social psychology. I have learned so much from this experience and I am truly lucky to be one few who were able to participate.

Entitlement and Organizational Attraction

Daniel A. Neyman, Industrial/Organizational Psychology

Faculty Mentor: Dr. Jason Dahling

2009 MUSE Project

During the Mentored Undergraduate Summer Experience, I worked under the tutelage of Dr. Jason Dahling. Our main objective during the MUSE program was to pilot test a model, which will be used for a broader study that will be continued on into the fall semester. The pilot study dealt with finding reasons behind why certain individuals are attracted to certain organizations. Organizational attractiveness is the degree to which prospective applicants view the organization as a desirable entity with which they would like initiate some relationship. This attractiveness is achieved in part due to the different traits that applicants associate with each organization. We studied the different types of attributes that individuals high in narcissistic entitlement find most attractive. Along with narcissistic entitlement, we included material values in this study. People who are high in material values tend to place high values on material goods and view them as a means of happiness and indicative of their socio-economic status. We believed that there would be a significant relationship between narcissistic entitlement and material values, since the two constructs deal with the constant need to get whatever it is that you believe you deserve, whether or not that is actually true. Results show that individuals high in narcissistic entitlement are likely to be attracted to organizations that are seen as upper class, glamorous, and successful. Those high in narcissistic entitlement were also found to have high leadership aspirations in their careers. Future research could look to observe the types of careers that entitled individuals want, as compared to the types of careers they believe that they will actually choose. Careers chosen based on these traits will be disappointing and dissatisfying because certain (unreasonable) expectations will not be met.

Personal Statement

The MUSE Program has helped me on a number of different levels, by giving me the opportunity to develop new skills and experiences. From this program I have practiced writing collaboratively, gained comfort with multivariate statistics, and learned a great deal about the revision and publication process. This was my first experience with developing an individual study idea, and given my intentions to apply to graduate programs, this will put me in a much better position to do so. The MUSE Program provided me with the time and resources to put together a study that otherwise I might not have been able to do. Overall, the MUSE Program has helped transition from a very capable research assistant to an independent researcher.

Comparing Memory Functioning in Younger and Older Adults

Stacey Diana, Psychology

Faculty Mentor: Dr. Tamra Bireta

2009 MUSE Project

Stacey Diana and Dr. Tamra Bireta have been working together in the Memory and Aging Lab since the Fall semester of 2008. They began preliminary research on this current project in the Spring 2009 semester. They have been working intensively on this project throughout the summer with the hope that they will collect enough data to write a manuscript for this study. The study involves two groups of participants, younger adults and older adults (over 60

years of age).

The researchers are interested in short term memory and are focusing on three different phenomena that affect this type of memory. These memory phenomena include the world length effect, the phonological similarity effect, and the effects of concurrent articulation. Past research has shown that people have better recall for shorter words rather than longer words, hence the word length effect. Research has also shown that people have better recall for words that are phonologically different, or the phonological similarity effect. All of the participants in this study were asked to perform a memory task in which they were either asked to recall a list of letters or a list of words. On some trials, the participants were asked to participate in concurrent articulation, or saying "1, 2, 3, 4..." out loud repeatedly. The researchers hypothesized that participating in concurrent articulation would remove the word length and phonological similarity effects for younger and older adults.

The researchers are interested in finding out if the effect of concurrent articulation is similar in younger and older adults, or if the effects change with healthy aging. If this memory phenomenon changes with aging, this will indicate that perhaps memory functions fundamentally differently in older adults. The results of the study show that their hypothesis is correct for younger adults and they are still analyzing the data for the older participants. 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 memory in their later years.

Stacey Diana Personal Statement

I have always enjoyed working with Dr. Bireta and have been honored to work with her this summer through the MUSE program. Working with this program has taught me a great deal about leadership. I have taken on the role of project manager with this research and have a lot of responsibility. Once all of the planning was done for the project, Dr. Bireta took a step back and began acting solely as a mentor to me, someone I could go to with any questions or concerns about my research. Working with the MUSE program during the summer months has allowed me to work rigorously on the project, without having the demands of other classes or extracurricular activities. I have enjoyed learning about the different memory theories and phenomena that are involved with our research and hope to continue working on this project with Dr. Bireta until we are able to write the manuscript and submit the paper for possible publication.

Demographic and Land Use Changes and Their Implication for Carbon Mitigation Schemes in the Ecuadorian Amazon

Angelika Gutiérrez, Sociology
Faculty Mentor: Dr. Diane Bates

2009 MUSE Project

Throughout this summer, I have had the privilege to work with very unique data sets. The data consists of multiple waves of surveys and censuses from a research site in the Amazonian region of Ecuador. We began the summer with three different data sets of information, all of which were from a specific decade. Consolidating them into one huge set allowed us to create a longitudinal study. Once this was completed, we were able to analyze the data and look for an answer to our main research question, which was to determine how land use activities affect the migration of household members, especially young men and women. In addition to working with programs such as SPSS for this research project, Dr. Bates and I also took trips to Rutgers University. We used their facilities in order to find articles relevant to the study and analysis. I was able to meet Thomas Rudel, Dr. Bates' mentor from her educational career. He also provided us with further documents relating to the research site in the Ecuadorian Amazon. These eight weeks have allowed me to gain new insights in regards to this region as well as the identify changes that have been occurring due to migration.

Angelika Gutiérrez Personal Statement

As a Sociology major with a concentration in Health and the Environment, I wanted to combine my passion for social scientific research, health and the environment and Latin America during this summer. The goal of this research project was to work in collaboration with my mentor, learn about some of the changes that are happening within the Ecuadorian Amazon and formulate my own research question from the data. Thanks to the MUSE Program and Dr. Bates I have exceeded this goal. Not only have I gained a greater understanding of research, I was given the opportunity to do graduate work as an undergraduate student. This project has provided me with new information and skills that I will be able to apply as I further my education.

Feminist Geographies: Theory, Methods, Application

Leigh Sullivan, English/Women's and Gender Studies
Tamra Wroblesky, History/Women's and Gender Studies
Faculty Mentor: Janet Gray, PhD

2009 MUSE Project

Our focus for this project has been *The Indian Alps and How We Crossed Them* (1876) by Elizabeth Sarah Mazuchelli, an extended memoir of the author's sojourn in the hill station of Darjeeling with her husband, a British army chaplain, and a trek they took into the high Himalayas with almost a hundred local porters. Led by a high-ranking British official and facilitated by a local aristocrat, they traveled along the border of British control in a miniature replica of colonial India, depending for supplies on independent Himalayan nations, less than two decades after the Sapoy uprising led to the replacement of company rule by imperial rule. Scholarship on this text has appeared in histories and critiques of women's writing on aesthetics, travel, mountaineering, and science, as well as in research on gender and colonialism. Our challenge has been to absorb and think beyond existing research, using conceptual tools from feminist critical geography. Previous researchers have concluded that, as an artist, geographer, and privileged colonial subject, Mazuchelli was able to maneuver and transgress Victorian gender boundaries. Our provisional thesis adds that the mountains function as an alternate space—neither "public" nor "private," masculine nor feminine—where Mazuchelli pursued self-realization by inhabiting the mountain space in a way that depended upon asymmetrical intimate relationships with colonial others. While collaborative writing is not routine in the humanities, the project has been structured throughout to maximize our dialogue, seeking synthesis while honoring the differing perspectives that each of us brings to the topic.

The complexities of the colonial circumstances that made Mazuchelli's stunning adventure possible—and nearly disastrous—challenge each of us to find our position in relation to a conundrum that divides previous scholarship: was Mazuchelli a heroine or an exploiter?

Leigh Sullivan Personal Statement

The MUSE summer research program has given me a greater appreciation for the amount of work and discipline that goes into in-depth research. As an English major, I have written many research papers, yet only now after the MUSE program have I begun to grasp the type of patience that goes into the research of a topic which does not have much academic publications surrounding it. Looking at this project through a literary lens has given me the opportunity to research the underlying issues of the text and study what Mazuchelli, the woman travel writer, is attempting to elucidate about her society, gender constrictions, and her own role while trekking in the Himalayas. Through the joining of my major and my minor, Women's and Gender Studies, I have found a great attachment and connection to feminist geography and especially the effects of women's travel logs on the literary world. Through the MUSE program I have only begun my passion for research and the opportunity to write about research will hopefully catapult me into a future of becoming a professor.

Tamra Wroblesky Personal Statement

The Mentored Undergraduate Summer Experience has allowed me to participate in a unique and remarkable research opportunity as an undergraduate. The program has allowed me to merge together my history and women's and gender majors by investigating the exciting recent field of feminist geography. I have learned how to use different lenses when reading historical documents, a skill that will greatly help me in the future. The field of historiography is constantly changing, and through my personal research I have realized the many biases that exist in writing due to gender, class, age, race, and sexuality. The MUSE program has strengthened my desire to continue my studies, especially in the area of my honors history thesis. I hope to further look at alpine spaces in the late 19th century and their relationship with European explorers and the colonial "others." This research experience is the perfect stepping stone to prepare me for a career committed to accepting all culture in this world.

Classifying Online Captioned Television Documentaries for Use as an Instructional Tool

Hillary MacDonald, Education of the Deaf and Hard of Hearing, Math/Science/Technology
Lindsay Wanko, Education of the Deaf and Hard of Hearing, Psychology
Faculty Mentor: Dr. Barbara Strassman

2009 MUSE Project

Developmental writing programs utilized in schools today capitalize on children's experience with all types of print as a model for their own writing. "Children must read like a writer, in order to learn how to write like a writer." (Smith, 1983, p. 562). This notion is the basis of mentor texts, models to be used in the classroom, which act as a guide for students to later emulate in their own writing. As students learn through the study of mentor texts, good writing can follow a variety of genres, many of which are expository in nature. We are focusing on expository text structures because these structures are critical to helping readers and writers gain content knowledge, write meaningful texts, and obtain valuable employment, which is often dependent on the ability to clearly write expository prose. As the 21st Century requires children to be able to read and write in both the print and the digital worlds (Leu, 2000), classrooms should not be limited to print only examples of expository texts, but rather take advantage of the variety of digital resources that also contain such structures. Our project entails utilizing captioned resources for classroom use.

To date, we have watched over one hundred captioned educational programs from the Teachers Domain website (http://www.teachersdomain.org/) and have categorized segments by expository text structures. We have created a transcript and graphic organizer for the most exemplary segments. The materials we have created, as well as the background research that has been accumulated throughout the summer, are the basis of an article that we are drafting for submission to the February 2010 edition of *The Reading Teacher*. In addition, we are preparing an online lesson plan and corresponding materials for ReadWriteThink (http://readwritethink.org/), a website that provides teachers with resources for language arts instruction.

Hillary MacDonald Personal Statement

This summer's MUSE program has offered me an enriching experience. With my research mentor, Dr. Barbara Strassman, and fellow student collaborator, Lindsay Wanko, I have been able to work as both a researcher and as part of a team developing an innovative teaching strategy. While in this program, I have enhanced my professional writing skills and have gained worthwhile insight into the process of preparing a research-based manuscript for publication. As a collaborator on our manuscript, I have learned how to give valuable input as well as receive critiques from my colleagues. I feel that the instructional techniques and tools that we have produced are practical for teachers and will have positive effects on students' writing abilities. I look forward to seeing our idea utilized in the classroom and hope to incorporate these techniques in my own future teaching career.

Lindsay Wanko Personal Statement

As a student in the Deaf Education Program at TCNJ, I have spent my undergraduate career learning about effective instructional strategies to use in the classroom. This summer, while in MUSE, I was presented with the valuable opportunity to see first hand how such strategies are actually formulated. For this particular project, I was privileged to work alongside Dr. Barbara Strassman and Hillary MacDonald on the development of an innovative educational technique to be utilized in the classroom as a means to improve students' comprehension and writing of expository text structures. For the duration of this experience, I have witnessed the dedication and hard work necessary to embark on such a project and have been thrilled to watch this idea come to life over the past few weeks. Moreover, as a member of this collaboration team, I have developed greater research skills, and a glimpse into the process involved when creating a manuscript to be published. I am grateful for this experience and anxiously await utilizing the techniques we've generated this summer in my classroom.

Human Testing of an Orthotic, Assistive Exoskeleton for the Hand

Bunmi Olaloye
Faculty Mentor: Dr. Brett BuSha

2009 Muse Abstract

Over 450,000 Americans currently suffer from diseases that result in muscle weakness, characterized by loss of strength and dexterity in the skeletal muscles that control hand movement. An orthotic exoskeleton was designed and built to compensate for the loss of function by actuating both pinching and grasping motions. The device closely mimics hand anatomy and physiology with three movable digits – thumb, index and remaining finger group. The objective of the MUSE project was to validate the design of the device by performing experimental protocol on healthy subjects. The quantitative assessment of the device compared electromyography (EMG) recorded from the forearm muscles while subjects performed a series of pinch and grasps to a target force by clenching a hand dynamometer. EMG was recorded with exoskeleton active (motors on), exoskeleton passive (motors off) and with the device off (bare hand). To ensure that the device can successfully assist the wearer in completing everyday tasks subjects were required to pick up 4 objects and place them in a target box. Objects included glass cylinder, plastic ball, pencil, and plastic mug. Preliminary results show a 100, 97, 85, and 60 percent success rate in recorded trials for the mug, cylinder, ball and pencil respectively. The average time required for moving the objects from start to the target box was 4 seconds for all four objects. These results prove that the exoskeleton is successful at actuating pinching and grasping motions while completing everyday tasks.

Bunmi Olaloye Personal statement

In the field of biomedical engineering research is crucial to the development of new instruments and equipment that shape the future of the discipline. Through the MUSE program, collaborating with Dr. BuSha and Michelle Rotella on the testing of the PC-HAND has given me an appreciation for the research process. It was an opportunity to apply the skills acquired in the classroom setting to research challenges. I gained insight into the progression from design to data collection and writing for publication. In efforts to publish a paper, we explored literature on existing designs of hand exoskeletons to compare and contrast the validation of the device. The MUSE program was an invaluable experience that gave me an opportunity to collaborate with colleagues—sharing ideas, and learning from mistakes made along the way.

Quantification of the Effects of Exercise on Cardio-Respiratory Control

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

2009 Muse Project:

Breathing and heart function (cardio-respiratory activity) is controlled by the brain using information from feedback sensors that provide information on previous breaths and heartbeats. Thus, cardio-respiratory control is an integrative process in using this past information to define the characteristics of each new heartbeat and breath. The integrative behavior of cardio-respiratory control relates to the stability of the system; the more integrative the behavior, the more stable the system. The purpose study was to quantify the stability of the cardio-respiratory system during different levels of mild exercise. 16 healthy males and 16 healthy females were fitted with an elastic band that measured changes in chest volume. Surface electrodes were placed on the chest to measure ECG activity. Subjects sat first motionlessly for approximately 20 min. and then performed two levels of exercise on stationary bicycle breathing through the mouth for approximately 15 min each. Then, breath to breath intervals (BBI) were calculated for 188 consecutive amounts of breaths, and heart beat to heart beat (RRI) intervals were calculated time indexed with the BBI data. The variability of RRI and BBI were analyzed using both non linear and linear methods. The nonlinear method of de trended fluctuation analysis described the stability of the cardio-respiratory system; a higher value implies that there is a higher level of integration. Results indicated that minimal levels of exercise result in a decrease in short term temporal correlations for the BBI, however increased exercise result in an increase in short term temporal correlations. Minimal exercise resulted in a decrease in the long-term temporal correlations of RRI, however a increase in exercise resulted in an additional increase in the long-term temporal correlations of the RRI. This data provided important insight in the understanding cardio-respiratory control, which can be used to study and identify breathing disorders.

Sagar Sutaria Personal Statement

The MUSE program has been very enjoyable and enriching learning experience. It has been pleasure to not only collaborate with my fellow engineering peers, but also with students and faculty from different disciplines through our weekly meetings. I had the great opportunity to do research within the exciting field of biomedical engineering. A strong understanding of physiology that I took away from this research was very important for me due to my future aspirations of pursuing a career in medicine. MUSE also provided an opportunity for me to form a mentor-mentee relationship that allowed me to expand my intellectual curiosity and provide me proper direction and guidance. Research has opened up a path with endless possibilities and great opportunities. I very much enjoyed my work and want to continue researching throughout my academic career. The MUSE program has taught me a great deal and has allowed to me explores the limitless world of research.

Aerodynamic Characteristics of Saccate Pollen

Bhumi Shah, Biomedical Engineering
David Talarico, Mechanical Engineering
Faculty Mentor: Dr. Lisa Grega

2009 MUSE Project

The pollen grains of many wind-pollinated conifers have one to three air-filled sacci, which have been thought to add surface area, yet add minimal weight, thereby increasing dispersal distance. By matching the Reynolds number found with real pollen grains in nature, we hope to observe how the sacci and/or the surface ornamentation affects the settling speed of the grains. Based on previously developed computational models, models were printed using stereo lithography (3D printing). The settling speeds were to be further validated by dropping scaled-up pollen grain models in glycerin. Each model consisted of two halves which match up to create a full 3D representation of actual pollen grains. The 3D models were then weighted with metals 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.

The orientation of the pollen as it is falling is important in obtaining the correct drag coefficient. To assure that the drag coefficient found was accurate, we only used data for models that were observed falling in the correct orientation. Models that fell askew were discounted and replaced. This orientation can be found by dropping the scaled up models in different initial orientations and recording their final orientations. A video camera was set to record the models falling in glycerin in order to accurately record the velocity of the models. The position in the frame can be used to find the velocity of the falling model using the frame rate. Modeling pollen both with and without sacci indicates that sacci can increase dispersal range. Conifer pollen grains were collected and observed using a compound light microscope in order to confirm the shapes of the models created.

Bhumi Shah Personal Statement

Collaborating with Dr. Grega and David under the MUSE program has greatly enriched my research and teamwork abilities. Through this project I was able to learn various techniques, such as using stereo lithography, and also increase my knowledge and familiarity with the Pro Engineer software. By analyzing how the pollen models fall in the glycerin tank, I increased by knowledge of fluid dynamics which will be useful when I take the course in the future. Since it was important that the data be precise and accurate, I developed meticulous and efficient independent laboratory skills. Not only did the project involve data analysis using Excel, but also it involved hands on work such as carving out the models and joining them together. The project combined the disciplines of biology, mechanical engineering, and graphic design. 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.

David Talarico Personal Statement

My involvement in this research project has taught me a great deal about fluid dynamics and teamwork. While at times Bhumi, Tom, and I had different opinions, we worked out our differences and arrived at a compromise. As we became more familiar with the process involved with our project, we began to exploit individual strengths to become more proficient as a whole. I hope that this proficiency gives us enough time for some water tunnel testing, as I would be inter-

ested to know the effects of a cross wind on the dispersal distance. The asymmetric nature of the grains leads me to believe that some rotational motion may occur in a cross wind. This may decrease the settling velocity much like the maple tree's seeds (helicopter like wings attached to seeds) do. If such an effect is occurring in nature, it may prove to be critical in assessing the affects of the sacci on dispersal distance.

The Cooperation of Multi-robot System Using Swarm Intelligence

Jennifer Field, Mechanical Engineering
Sean Brigandi, Mechanical Engineering
Faculty Mentor: Dr. Yunfeng (Jennifer) Wang

2009 MUSE Project

Multi-robot systems use a group of similar robots to work together. They can collectively accomplish complex tasks that are beyond the capabilities of a single robot. They have great potential and many attractive applications. The cooperation issue of multi-robot systems is a technical challenge. Inspired from the swarm behavior of social insects such as ants, termites, wasps and bees, this project is to develop swarm-intelligence based multi-robot systems and cooperation algorithms. We focus on two areas: algorithm development, and robot design and prototyping.

The algorithm development was achieved by conducting intensive literature research on swarm behavior and swarm robotics to understand the characteristics of social insects (gathering, aggregation, flocking, schooling etc), as well as current work and technical issues for swarm robotics. Motivated by several other scholars' work, we developed a decentralized flocking algorithm which is achieved through only individual robot's decision (not relies on a specific robot that supervises the movement of other robots). In this algorithm, each robot dynamically selects two neighboring robots within its sensing range and maintains a uniform distance with them. This makes any three neighboring robots form an equilateral triangle.

The robot design and prototyping were accomplished by using LEGO Mindstorms NXT robotic tool kits. This is very challenging since their ability for implementing swarm robots is unknown, as they have never been used for swarm robots. The capabilities and limitations of using NXT kits for swarm robots' communication, localization and mapping have been thoroughly investigated and tested. A functional prototype has been constructed and used to verify our decentralized flocking algorithm.

Sean Brigandi Personal Statement

Throughout the MUSE program I learned a great deal about robotics as well as how important collaboration was with my fellow classmate, Jennifer Field, and mentor, Dr. Jennifer Wang. At the beginning of the summer we worked together researching articles related to swarm robotics to understand the characteristics of social insects and examine previous work done by others. Through our discussion of the articles we were able to develop our own ideas as to how we could contribute to the swarm research field. After combining our own ideas with those of others, we created an algorithm and implemented it using LEGO Mindstorms NXT. Using LEGO NXT's gives our project its own distinctiveness as it is an area that has not yet been explored. I am very proud of the work Jennifer, Dr. Wang, and I have done and all that we have accomplished. I have gained valuable experience from the MUSE program that I can use for the rest of my academic career as well as for my future endeavors.

Jennifer Field's Personal Statement

As an engineering student, I have had the opportunity to work on small-scale collaborative projects before, but not to the extent I have had with the MUSE program. While collaborating with Sean Brigandi under the supervision of our mentor Dr. Jennifer Wang, I have developed a better understanding of collaboration and teamwork. Incidentally, our project modeled our own human experiences, since our robots also had to collaborate with one another. Our project objectives were to have four individual robots cooperate with one another to complete a final task. Although self-sufficient, the robots could combine efforts to accomplish a greater goal that might otherwise be impossible. I feel as if this was true in our own research efforts, as each person contributed to the project and played an integral role in the completion of this venture.

Evaluation of the Effect of Cement Viscosity on Cement Mantle in Total Knee Arthroplasty

Eric Rohrs, Biomedical Engineering
Faculty Mentor: Dr. Manish Paliwal

2009 MUSE Project

Aseptic loosening of the tibial implant is one of the major reasons of failure in Total Knee Arthroplasty (TKA). The cement viscosity at the time of application to the bone influences the cement penetration and stability of the prosthesis. There are currently a number of cements available with a wide range of viscosities and set times. Four cements of different viscosities were selected for analysis (Simplex-P, DuPey-2, Palacos, and Endurance). Currently more viscous cements are preferred as they set up faster, and reduce operating room time and subsequently the total cost of the procedure, however faster setting time may come at the expense of decreased penetration into the bone, and reduced stability of the construct.

To gain better understanding of the load transfer and stress distribution at the bone-cement-stem interfaces, the cement mantles created by the four cements in surrogate sawbones tibiae (Pacific Research, WA) were modeled and analyzed using Ansys (a commercial finite element analysis software). Sawbones were used for easy availability, and bone porosity control. Frictional stress, pressure, sliding distance, and total stress were studied at the contact interfaces, which may contribute towards construct stability. Palacos had the maximum interface pressure, sliding distance, and total stress, while DePuy-2 had the lowest total stress.

Parametric analysis was carried out using Ansys, by varying bone permeability to study the flow profile of the cement into the bone. It will be useful in optimizing cement mantle profiles with desired stress distribution.

The impact of cyclic loading on sample constructs (tibial implants fixed with the four cements in surrogate tibia) is being investigated. The samples were prepared for mechanical testing by putting them in Bondo (3M, Maplewood, MN). A customized fixture was designed and fabricated for testing the samples using MTS Mini Bionix 858, a state-of-the-art material testing machine.

Eric Rohrs Personal Statement

Through the Mentored Undergraduate Summer Experience (MUSE), I have greatly increased my understanding of the research field, and the various programs and processes involved. Starting with research from recently published articles and my understanding of the problem at hand, I collaborated with my research partners (Scott Wentzell and Dr. Manish Paliwal) and worked to model, simulate, and analyze the sample cross-section best illustrating the cement mantle. Next, to complement and validate computational results, I developed an experimental protocol for the study, and designed & fabricated the required jigs and fixtures. I worked to create a protocol for performing physical experimentation as well as the analysis necessary to compare the computer simulation results to experimental results. The MUSE program has greatly improved my ability to solve problems and think independently, as well as collaboratively. These attributes will be vital in graduate school and further research opportunities.

Mechanical Force-Induced Cell Damage

Kamila Paluch, Biomedical Engineering
Faculty Mentor: Karen C. Yan, Ph.D

2009 MUSE Project

Tissue engineering integrates science and engineering disciplines in growing functional tissues and organs for repair and replacement of damaged ones. Various types of bio-fabrication methods have been developed to manufacture products with living cells incorporated via mechanical means. The cells experience unusual mechanical disturbances, which may lead to cell damage or abnormal cell functionality. In order to study whether cells remain viable when subjected to process-induced mechanical disturbances, we focused on a 3D cell-printing process via pressure-induced deposition. Previous experimental studies have shown that process parameters such as pressure applied and the nozzle size affect cell viability in the tissue scaffold. In order to link mechanical force with cell damage, Computational Fluid Dynamics (CFD) analysis was employed to model the flow system and determine the local environment of the living cells under various pressures and nozzle diameters. FLUENT, an engineering analysis software, was utilized to determine the magnitude and duration of shear stress experienced by the cells. 2D models were generated first and the CFD analyses were performed. Together with the experimental data, the results from the 2-D analyses suggest the combination of longer exposure time and lower stress can lead to greater cell damage and, hence, indicate exposure time

as a crucial factor. More detailed 3D analyses were conducted; the magnitude and duration of shear stress that cells experience were determined via a particle tracking method. An empirical function was subsequently developed to compute a damage index for an individual cell as a cumulative effect of exposed shear stress and duration. The predicted cell damage results for the simulated cases generally captured the experimental trends. While the present study provides a useful tool to optimize the bio-printing process and increase cell viability, further research is required to address the effects of mechanical forces on cell functionality.

Kamila Paluch Personal Statement

MUSE has provided me with unique opportunities as well as valuable experiences. I've acquired knowledge and practice in fluid mechanics and tissue engineering, gained insight on using innovative engineering analysis software, and improved on my abilities in tackling open-ended problems. After spending my junior year researching the project with Dr. Yan and dedicating eight weeks to improve our methodology, the significant results obtained were all the more rewarding. Aside from my own research, MUSE has exposed me to interesting ideas posed by students and faculty members across various disciplines. The weekly program meetings led by our mentors have also undoubtedly helped prepare me for my future endeavors. Although I have worked collaboratively with my mentor throughout the program, I definitely feel more independent as a researcher, and I find this crucial as I am preparing for graduate school. Overall, it was a great opportunity to work on a project in an emerging interdisciplinary field and to gain exposure to the rigors of advanced scientific research at my very own college.

Biopolymer Tissue Scaffold Degradation

Maria Swift, Biomedical Engineering
Faculty Mentor: Karen C. Yan Ph. D

MUSE 2009 Project

Biodegradable polymer-based scaffolds have been used for tissue engineering to direct cell growth and regeneration of tissues. It is vital to control the degradation of tissue scaffolds in order to provide adequate local environment; and multitude factors affect the scaffold degradation rate. The objective of this research is to understand effects of scaffold design parameters and environment on scaffold degradation. While the project consists of experimental study and development of predictive mathematic models, our current effort focuses on the experimental aspect. The experimental work entails systematic studies of scaffold degradation in a simulated physiological environment and focus on characterizing physical behaviors of 3D polymer tissue scaffolds as a functional of degradation. Previously, we studied on the effects of material composition, pore size and cellular activities. During this summer, we investigated parameters related to the fluid environment via a six-week experiment. Specifically, the solution volume and the pH value of the solution are for a static setting, and fluid flow rate and stress applied are for a dynamic environment. Scaffold samples made of poly(ε-caprolactone) (PCL),a biocompatible, biodegradable polymer were used. In the static set-up, the samples were submerged into solution. Subsets of samples were removed at specific time and weighed after being patted dry and then after being vacuumed dry. The progress of scaffold degradation was characterized by micrography and measuring changes in weight and water uptake. From our study thus far, clear trends were observed in term of both the volume of solution and the solution type. For the dynamic environment, we have designed a bioreactor which can provide varying flow rates and house multiple scaffold samples. The bioreactors are currently being fabricated in house, and expected to be completed by the end of week 7. Studies related to dynamic environment will be continued during the fall semester.

Personal Statement

Through the MUSE program, and the guidance and patience of Dr. Yan, I have begun to develop my skills as a researcher and a future biomedical engineer. This program has provided me with the opportunity to be a part of an ongoing study unlike anything I've experienced in my courses. Through the hands on experience such as conducting experiments in lab, learning engineering software and the use of mathematical models and conducting literature research, I learned to tackle an open ended problem and gained valuable design and research experience. In addition, Dr. Yan has taught me how to branch out and make scientific findings. This program also allowed me to be a part of the community through sharing my project and learning from others' studies as well as various topic discussions. Ultimately, I acquired the research skills through this experience, which will prepare me for graduate/medical school. I look forward to continuing work on this project in the fall semester.

Design Investigation of Algae Photobioreactor for Use in Secondary Education Classrooms

Adam Brunner, Technological Studies
Faculty Mentor: Dr. Matthew Cathell

2009 MUSE Project

We are investigating the growth of oil-rich microalgal species in a controlled photobioreactor of our own design and construction. A photobioreactor (PBR) is a piece of technological used to grow and support biological material using a light source. PBRs allow algae to grow in a nutrient-rich aqueous medium with control over environmental variables, such as light, CO_2 and O_2 concentrations, temperature, etc. The algae, which can be rapidly grown in a highly dense vertical configuration, can be used to sequester carbon and produce "green" biodiesel fuel.

Our PBR consists of vertical transparent tubes containing the algae+medium, a high-intensity light source, and a sparger that bubbles air for gas exchange and agitation. Through research, we have found that biofilm formation is a persistent issue in industrial PBRs. For this reason, we have also designed and implemented an automated cleaning mechanism to keep the PBR walls clear of light-blocking algae films. Our design could be implemented in a secondary education setting, using simple materials and tools commonly used in technology education. Future work on this project includes further research on cleaning mechanism designs, modeling of fluid dynamics, and long-term analysis of algal biofouling behavior.

Personal Statement

Through the work that I have completed and some that I will be continuing in the MUSE program; I have been able to learn a great deal not only about the basis of my topic, algae, but about how hard it can be to develop and fabricating a mechanism as well as certain other topics such as intellectual property and creating a press release. Almost everything that I have encountered this summer has allowed me to further myself in my studies and develop a direction on what I want to do. This program has been invaluable to me.

The Effects of Resistance Exercise Rest Interval Length Manipulation on Exercise Kinetics and Kinematics: A Gender Comparison & the Influence of Maximal Muscle Strength on Acute Resistance Exercise Performance Using Different Rest Intervals

Christina Chiarello, Health and Exercise Science
Anthony Sacco, Health and Exercise Science
Faculty Mentor: Dr. Nicholas Ratamess

2009 MUSE Project

The purpose of our research project was to investigate the effects of rest interval length on resistance exercise performance. The first study we conducted was a gender comparison in which subjects performed three protocols consisting of four exercises (bench press, incline bench press, shoulder press, and bent-over row). We manipulated the time of rest (one, two, or three minutes) the subject had in between bench press sets (the first exercise performed in sequence) only in order to determine the effect it would have on the subsequent exercises. We recorded the number of repetitions, repetition power, and velocity for each exercise. Our second study examined the intervals of timed rest on only the bench press exercise for men who were classified as lifting 205 pounds and under or 285 pounds and over for their one repetition maximum (1RM). This allowed us to examine the potential of muscle strength being a factor affected by rest interval (RI) manipulation in between sets.

Preliminary results indicated that gender differences were observed during performances of the bench press, incline bench press, and shoulder press exercises. Females performed more repetitions (despite the RI length) in the bench press and incline press but males performed more repetitions for the shoulder press. It does not appear that RI length during the first exercise in sequence (i.e. the bench press) affects subsequent performance of exercises stressing similar or different muscle groups. Our results also indicated that strength played an important factor in predicting total repetitions for both the one and two-minute rest intervals. The group of men whose 1RM was less than 205 lbs performed significantly more repetitions then the stronger group (men whose 1RM was greater than 285 lbs) for the one and two-minute RI. No significant difference was shown between the two groups for the three-minute rest period. There was also no significant difference between the groups for average power and fatigue rate during each set. In conclusion, the data collected indicates that both maximal muscle strength and gender play significant roles in acute weight training performance when less than three-minute RIs are used. In addition, it does not appear that RI length of the first exercise performed affects exercises performed subsequently. The results from this study provide important data not only for those involved in the field of Exercise Science but also for those individuals who engage in resistance training for sport, health, and recreation.

Christina Chiarello Personal Statement

My involvement in the MUSE program has supplied me with the tools and experience necessary to enhance my knowledge in the field of Health and Exercise Science as well as in the research community. Working in an applied environment allowed me to take a more active role in my education. I am grateful for my partner and faculty mentor who helped and motivated me throughout our research. I truly enjoyed working with our subjects as well, whose determination and humor made our research rewarding and fun. My experience in the MUSE program has led me to have a greater appreciation for the procedures, creativity, and determination that makes discovery through experimentation possible

Anthony Sacco Personal Statement

The MUSE program has offered me an invaluable experience to use the skills I have learned in the classroom and apply them in a laboratory setting. I enjoyed collaborating with Christina Chiarello and Professor Ratamess, two people who are as passionate about studying the human body and its mechanisms as I am. I learned a lot about the role rest interval plays in resistance training and explored mechanisms which control fatigue during resistance training. The experience I have gained through the MUSE program will help me as I move forward to graduate school and throughout my professional career. I look forward to continuing my work in the performance lab this upcoming year.

Effects of Low-Impact Care of Preterm Infants: Resurrecting an old study

Leah Waldron, Nursing
Steve Chen, Nursing
Andrea Stress, Nursing
Faculty Mentor: M. Kathleen Philbin, RN, PhD

2009 MUSE Project

An interdisciplinary clinical study done in the early-90s was stopped (due to construction in the hospital) with data collected for only a small number of infants. Journal editors refused to publish it at the time. Currently, however, there is an international interest in having such studies in print so that a meta-analysis with a large combined sample can be completed. The editor of one of the pediatric journals has indicated an interest in reviewing this old study for publication. During the intervening years the convention of dropping participants who were discovered to have been included erroneously changed to a convention called "intention to treat" meaning that even if the participant did not meet entry criteria the collected data had to be included because that was the investigators original intention. Under the new convention some babies whose data was excluded from original data set were added back to the subject pool thus increasing the sample size slightly. The hypothesis of the study was that infants whose own behaviors were allowed to guide the timing and manner of nursing care would become stable more quickly than infants cared for by traditional methods, i.e., by following a schedule of tasks with minimal influence from the infant. The findings based on the revised data supported the hypothesis.

Students reviewed all the collected data from original paper files and old floppy discs, located and corrected errors in data transcription, created a new database, and generated new tables and graphs of the findings. Students also reviewed the relevant literature published after the old study was closed and created a table showing similarities and differences between studies in terms of sample characteristics, outcome measures, etc. Attention to detail in reading the old, much-used paper records and care in resolving discrepancies within individual records were primary concerns.

Steve Chen Personal Statement

The MUSE program has given me much in the last eight weeks. I have learned the process behind writing a grant proposal for a research study. I have learned to collaborate with other students when help was needed, and to use that collective knowledge to complete a task. I have also learned to come to grips with the complex nature of research papers, allowing me to break down the individual components of an article in order to grasp the author's message. I have listened to insightful lectures, eaten my fare share of free food, and even managed to include myself in a neighboring research project; but out of all the new and educational experiences, it will be the increased interest in research that will stick with me hereafter.

Leah Waldron Personal Statement

Participating in the MUSE program and my team's project taught me a lot about what it takes to get a study published. I gained invaluable insight into just how meticulously data must be scrutinized in order to be truthful and thorough. Before working on updating the NIDCAP study for publication I had no idea just how many people a study must be proved to and how much effort researchers put in. I really feel that the time I spent working on the project will positively influence our chances for publication. It feels good to know that I was a valuable member of the team. Getting to know the professor and my team mates makes me feel more secure about the school year; I know how kind and smart they are, and know I could go to them for advice. Overall, it has been a great experience.

Andrea Stress Personal Statement

My time spent with fellow nursing classmates and our faculty mentor in this summer's MUSE program has opened my eyes to the world of nursing research. As a field that is not well-understood outside of the quite small realm of nursing researchers, I was unsure of how I would be specifically contributing to this summer project. Pouring over scholarly articles, becoming best friends with the library journal database, reading until my eyes gave out, writing draft after draft of just one paragraph, and staring at a computer screen for hours on end was not quite what I had in mind, but needless to say, I have a newfound appreciation for those who make a career out of performing studies for the benefit of the nursing profession.

Effects of Initial Feeding Experience on Later Feeding Problems: Writing an NIH Grant Application

Joseph Licci, Nursing
Andrea Stress, Nursing
Renauld Williams, Nursing
Faculty Mentor: M. Kathleen Philbin, RN, PhD

2009 MUSE Project

Preterm infants are over-represented among infants with problem feeding behavior and inconsistent or faltering growth during the first year of life. While many reasons for this have been examined, the study proposed in this grant application will be unique in testing the effect of feeding methods used by nurses during feeding acquisition on the development of later feeding behaviors and growth. The "novel" method is focused on the quality of the infant's experience during early feeding while the traditional method focuses on the quantity of food ingested.

The MUSE project was to identify and compare assessment measures used to establish initial comparability between the two groups of infants and behavioral as well as growth outcomes. Parent assessments were also considered because a parent's emotional status and behavior during feeding is believed to affect the infant. Each student worked on locating and studying literature from one or more assessment areas with the goal of determining which assessment among several would be the most effective for this particular study. Students located and contacted some authors (or their offices) to request assessment documents. Assessment areas included measures of maternal depression, anxiety, and stress, measures of mother and infant behaviors during feeding, parent reports of infant feeding behavior, and measures of growth (CDC? WHO? weight-for-length? Changes in Z-scores?). Students also located literature back-up for discrete behaviors used in an observational checklist of feeding in the hospital. Options for "best" measure were discussed in a journal club format and discussed informally by the group. After the measure thought to be most appropriate was chosen the student wrote one or two paragraphs describing the options and defending the choice. These paragraphs were revised and polished and will be used in the grant application.

Joseph Licci Personal Statement

Although it was curtailed due to prior summer engagements, my experience with Dr. Philbin in the MUSE program was more valuable than I could have ever hoped. It was exciting to be a part of a grant proposal in the nursing field. My main focus was to sift through recent literature for comparative material explaining why certain outcome measures were more appropriate than others for the study at hand. I soon found out that for each outcome measure, like the Parent Stress Index (PSI), numerous studies on psychometrics had been conducted and choosing the best one would be a project in itself. I can only hope that what seemed like a small part of the entire project, was actually a great help to Professor Philbin and her research. Although this research with Dr. Philbin was completely voluntary, I would not hesitate to work with her again in the future.

Renauld Williams Personal Statement

Collaborating with Dr. Philbin and the other students in researching preterm infants has been an enlightening experience for me. I have learned much about the research process that I will be able to incorporate into my own research when the Fall semester begins. Participating in the MUSE program has also allowed me the opportunity to learn about other interesting research projects that professors and students are working on. I've had the opportunity to meet new people and discuss research topics with students from majors other than my own. The MUSE program has instilled in me a new appreciation for research that I may not have experienced otherwise. As an undergraduate student, I am always thinking about what type of career I would like to have in Nursing after graduating; and Nursing research has become a more realistic option after working on a research project this summer. Being a part of MUSE has been a great experience that will help me academically and intellectually as I continue in my education.

Sampling Freshwater Mussel (*Elliptio complanata*) Populations for Conservation Genetics

Zach Goldstein, Biology
Cara Zetterstrom, Biology
Faculty Mentor: Curt Elderkin, PhD

2009 MUSE Project

This summer, studies were conducted on the conservation genetics of the freshwater mussel *Elliptio complanata* from Canada, Maine, and Pennsylvania. The goal of this project is to sample *E. complanata* populations from several sites along the North American east coast in order to analyze the DNA of different populations. Knowledge of the genetic structure of the target species is essential for the development of effective conservation plans. Unionids, which include *E. complanata*, are a family of bivalve mollusks found throughout habitats around the world, with 297 recognized taxa in North America alone. However, over 70% of North American freshwater mussel species are listed as threatened or endangered. *E. complanata* is a medium-sized mussel so named for its oval shape and is found along the Atlantic coast from Nova Scotia to Florida. Because they are common and widespread, they may have genetic structure among populations that remains intact, and it is important to understand the genetic makeup of *E. complanata* populations in order to further conservation efforts. Samples were collected from the St. John, Miramichi, and Kennebecasis River drainages in New Brunswick, Canada. In Maine, samples were collected from Narraquagus, Union, St. George, Penobscot, and Kennebec River drainages. Small samples of tissue were removed from the mantle of at least 30 individuals per site and stored in ethanol for future testing. Other species encountered include *Margaritifera margaritifera, Lampsilis radiata, L. cariosa, Leptodea ochracea,* and *Pyganodon cataracta*. More samples will be collected from several sites in Pennsylvania. These data will be analyzed for genetic markers, contributing to efforts to understand the range and distribution of *E. complanata* in North America.

Zach Goldstein Personal Statement

The MUSE program was a uniquely different experience from my last research internship. Over the last two summers I worked in a microbiology lab, so this summer's field research turned out to be a great opportunity to both enjoy the outdoors and learn about conservation ecology. This internship has broadened my research experience and given me the chance to apply knowledge from past ecology-related courses. It also allowed me to improve lab techniques I have leaned in the past and develop new skills that are applied in the field. I found the complement of field and lab work to be interesting and engaging, and it has changed my perspective on the work graduate study entails, leaving me a more well rounded student.

Cara Zetterstrom Personal Statement

I found the 2009 MUSE program to be an experience that I will never forget. I really enjoyed feeling like I was part of a team and I had fun participating in this research experience. Looking back on the project, I can really see all of the stages of mentoring. In the beginning I felt very timid and needed Dr. Elderkin to show me exactly what to do. As time went on, I felt more and more like Dr. Elderkin's peer and equal. By the end, I definitely felt like a collaborator on a larger project and I felt important. The progress we made on our trips indicated how much we had grown. I feel that this MUSE experience has given me many skills as well as an insight into what the world of research is like. Since I plan to be a high school biology teacher and not a research biologist, I can say that this program has helped me to become a very well rounded scientist with more confidence in my own field.

Gene Dosing and Maternal Behavior: Is There a Heterozygous Phenotype in the Pet-1 Mouse Strain?

Sarah Middleton, Biology
Faculty Mentor: Dr. Jeffery Erickson

2009 Muse Project

Our lab is interested in understanding the role of serotonin (5-HT) in the maturation of breathing behavior during early postnatal development, using the 5-HT-deficient (Pet-$1^{-/-}$) knockout mouse as a model system. These mice lack ~70% of brainstem 5-HT neurons, display depressed and irregular breathing, and ~25-30% percent die suddenly within 5 days of birth. We do not yet know why many of the Pet-$1^{-/-}$ mice die early and until now have suspected problems with control of breathing in the pups. However, it was recently reported that Pet-1 function is required for normal maternal behavior. Specifically, effective maternal behavior is completely lacking in Pet-$1^{-/-}$ dams resulting in 100% pup mortality within several days of birth. In contrast, wild-type dams exhibited excellent maternal care (almost no newborn mortality), while the behavior of heterozygous (Pet-$1^{+/-}$) dams was not assessed. Since our previous studies used Pet-$1^{+/-}$ dams exclusively to generate newborn litters, it is possible that abnormal maternal behavior in Pet-$1^{+/-}$ dams contributed to the high pup mortality rate we observed previously. This study was designed to test this possibility, by developing overnight infra-red video recordings and daytime observations to compare maternal behavior in wild type, Pet-$1^{+/-}$, and Pet-$1^{+/-}$ dams during parturition and the early postnatal period.

To date, our sample sizes are limited and it is not yet possible to draw firm conclusions concerning genotype-specific differences in maternal behavior. Nevertheless, we have documented one Pet-$1^{-/-}$ dam (the only knockout studied so far) that successfully reared pups, in complete contradiction of previous reports. This suggests that additional factors (environmental?), in addition to genotype, influence the expression of maternal behavior in the knockout. Future work will use the infra-red recording techniques developed this summer to fully assess heterozygous maternal behavior, and will follow up on our surprising initial result with the Pet$^{-/-}$ dam.

Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) program has given me the opportunity to gain valuable research experience that will aid me both in acceptance to graduate school and my eventual work there. Prior to this summer, I had little practical experience in even basic lab techniques. I now have an array of experiences and skills at my disposal, which will make my transition to graduate school much less overwhelming. I also gained a tremendous amount of experience throughout the program in reading primary scientific research articles, a skill which should not be underestimated! Most importantly, however, MUSE has helped me gain confidence as a researcher and a thinker. Though I still have a lot to learn, I now have confidence that I can handle the challenges of graduate school and what lies beyond. For all these things, I am very grateful for this experience.

Continued Studies of Nicotine Influences on Autoresuscitation Responses to Hypoxia-induced Apnea in Serotonin-deficient Pet-1 Knockout Mice

Emily Reichard, Biology
Faculty Mentor: Dr. Jeffery Erickson

2009 MUSE Project

Sudden Infant Death Syndrome (SIDS) is the leading cause of post-neonatal infant mortality in the United States, although the biological basis for it remains elusive. Accumulating evidence suggests that many infants at risk for SIDS may have an underlying abnormality of brainstem serotonin (5HT) neurons. Furthermore, a variety of environmental risk factors for SIDS have been identified, with maternal smoking being one of the most widely recognized. It has been suggested that SIDS deaths may result in a vulnerable infant from a failure to autoresuscitate after a period of hypoxia-induced apnea. Autoresuscitation is a defensive cardiorespiratory response to prolonged exposure to hypoxic conditions, i.e. a "last-ditch" effort to resume normal breathing. In rodents, prenatal exposure to nicotine has been shown to adversely alter this autoresuscitation response.

This summer, in a continuing study, serotonin-deficient *Pet-1* knockout mice were used to examine the effects of prenatal nicotine exposure on the autoresuscitation response. *Pet-1* knockout mice have a 70% reduction of serotonin neurons in the brainstem, and previous studies from our lab have shown that the autoresuscitation response is impaired in the knockout. The purpose of this study was to determine if nicotine exposure during fetal development can exacerbate

the autoresuscitation deficit in the newborn knockout mouse pup. Pregnant heterozygous dams were implanted with a mini-osmotic pump that delivered either a nicotine solution (60 mg/kg/day) or water (control). On postnatal days 0.5, 4.5, and 9.5, pups were placed in a head-out plethysmograph and baseline breathing and autoresuscitation responses were measured. We are currently analyzing data collected from *Pet-1* knockout and wild-type mice from both nicotine and water treatment groups to ascertain if any nicotine-induced changes in breathing behavior occurred.

Emily Reichard Personal Statement

Participation in the Mentored Undergraduate Summer Experience (MUSE) program has allowed me to develop a better understanding of the true nature of scientific research. Throughout the program, I learned a variety of laboratory skills that will help me not only in the remainder of my undergraduate career but also in graduate school. Furthermore, my ability to think critically about research questions as well as analyze and draw conclusions from raw data has improved greatly. The MUSE program also provided me with the opportunity to learn about new topics through interactions with students participating in other areas of research. Overall, involvement in MUSE has allowed me increase my skill and knowledge of scientific research and the research process as a whole, and I am grateful to have had this experience.

Modulation of Gene Expression in Blue Crabs in Response to Changes in Seawater Salinity

Michael Kaufer, Biology
Daniel Markowski, Biology
Faculty Mentor: Dr. Donald L. Lovett

2009 MUSE project

This summer we examined changes in gene expression in crabs in response to transfer from dilute seawater to full-strength seawater. Crabs that inhabit coastal estuaries (where the salinity of the seawater fluctuates continually) must be able to regulate the salt content of their blood in both dilute and high-salinity seawater. The enzyme Na^+,K^+-ATPase (called ATPase for short) in the gill cells of crabs is responsible for pumping salt from the seawater into the blood. Our lab's previous research already has demonstrated that when crabs are moved from high to low-salinity seawater, the gene for ATPase is stimulated and levels of mRNA from the gene increase within 4 days (mRNA is used to synthesize enzyme molecules). Subsequently, the amount and activity of ATPase enzyme increases to a maximum within 8 days. This summer, we determined that the amount of mRNA in crabs transferred from low to high-salinity seawater drops to almost zero within 2 days. It remains very low until 18 days after transfer and then it increases again. ATPase activity decreases gradually during the first 4 days after transfer and then remains low for as long as the crab remains in full-strength seawater. In all organisms, old enzyme molecules are continually broken down and replaced by new ones. Our data suggest that crabs in high-salinity seawater no longer need to pump as much salt into their blood and, therefore, they allow the excess ATPase enzyme molecules to be broken down without replacing them. Thus, crabs do not unnecessarily expend resources to synthesize either mRNA or new ATPase enzyme molecules until these are needed. By 18 days, all excess enzyme has been broken down and gill cells begin to synthesize more mRNA in order to synthesize new ATPase molecules. Eventually, these data may be used to understand human hypertension and kidney disease.

Personal Statement Danny Markowski

When I came into the MUSE program this summer as a rising sophomore, I had minimal lab experience. I had shadowed Professor Lovett during the second semester of freshman year, but as an unofficial member of his lab, I did not have any real responsibility. Within the first few weeks I realized this summer's experience would be completely different. Unfortunately, I found that I lacked confidence and many basic lab techniques. However, by the third and fourth week of the program I was feeling more independent and confident thanks to the guidance of Dr. Lovett and my fellow student collaborator Mike Kaufer. I thank both of them, as well as the MUSE program as a whole, for giving me the opportunity to have first hand experience with a possible future career.

Personal Statement Michael Kaufer

As an individual intending to pursue a career in the sciences, the MUSE program has provided me with an experience that has proven to be quite beneficial towards my future goals. As a member of Doctor Lovett's research lab for the past two semesters, I had mistakenly assumed that this summer would be similar in terms of the work and responsi-

bilities. This assumption proved to be quite inaccurate once the project began. Unlike my prior experiences, I was expected to contribute much more to the advancement of the project. Doctor Lovett treated both me and my fellow student collaborator, Danny Markowski, as equals rather than as his students. In this environment, we were able to come up with our own ideas and insights, leading to greater success in the lab. I thank Doctor Lovett and Danny for engaging in this wonderful experience with me, as well as the MUSE program and TCNJ for providing the opportunity.

Populations of Plants and Their Pathogens in the Wild

Faculty Mentor: Janet Morrison

Optimizing the Use of Inter-simple sequence repeat (ISSR) Markers to Detect Diversity in *Andropogon virginicus*

(funded by the Garden Club of America)
Lauren Frazee, Biology

2009 MUSE Project

Andropogon virginicus (broomsedge) is a dominant grass species during early old field succession in the eastern United States. It is commonly found infected with the specialist smut fungus *Sporisorium ellisii*, which eliminates seed production in infected tillers and increases individual mortality. Native to the eastern United States, it is naturalizing in California and invasive in Hawaii. Population genetic analyses of this species would be valuable in determining relationships between populations in its native and introduced ranges as well as in evaluating levels of intra- and inter-population genetic diversity. Additionally, differing levels of genetic diversity may affect the ecology and infection rates of plant populations. To carry out a population genetic analysis of *A. virginicus* throughout its exotic and native range, we intend to use inter-simple-sequence repeat (ISSR) markers, due to their high repeatability, polymorphism, and ability to differentiate between plant populations and among individuals within a population. We have visualized (with agarose gel electrophoresis) and optimized the amplification of plant genomic DNA markers with several ISSR primers, through the alteration of annealing temperatures and Mg2+ concentrations used during PCR (polymerase chain reaction). We found four primers to be repeatable and polymorphic among individuals tested from an *A. virginicus* population in Tyler State Park, Pennsylvania.

Personal Statement

I feel very lucky to have worked and collaborated on this project with Dr. Morrison, my peers, and other Biology Department faculty members at TCNJ. Over the past eight weeks, I gained a sense of pride and ownership for my ideas and the progress that I have been able to make. At the same time, I developed a greater respect for the field of biology as a whole and the fact that I now comprise a small and dependent part of it. Overall, participating in MUSE has made me aware of the arduousness of conducting research as well as the prerequisites for its success: determination and a passion for learning. I look forward to finding a graduate program that inspires me to draw on these qualities while pursuing answers to an even greater intellectual challenge and academic goal.

Smut fungus infection and detection of the perennial grass *Andropogon Virginicus*

(Funded by the American Society of Plant Biologists SURF)
Jacquelyn Harth, Biology

2009 MUSE Project

We have examined the interaction between the grass species *Andropogon virginicus* and the smut fungus *Sporisorium ellisii*, which can cause total or partial infection. Currently, we know that infection with *S. ellisii* is displayed in the reproductive structures of *A. virginicus*, but we do not yet know about the pathogen's mode of transmission and infection. Furthermore, while natural populations of *A. virginicus* are commonly found infected with *S. ellisii*, we have had difficulty replicating infection in a greenhouse setting, which is crucial for further experimentation. Twenty-five partially infected plants were collected from Mercer County Park Northwest due to their ability to produce seeds on their remaining healthy tillers. Seeds from these mother plants were propagated in a greenhouse for use in a large-scale greenhouse inoculation experiment. Teliospores collected from the same partially infected plants were developed into four different inocula: teliospores taken from the same plant as the target seed, mixed teliospores, mycelial cultures

grown from single teliospores, and mixed mycelial cultures. Each inoculum was applied to four seeds, four seedlings, and four adults per mother plant. Plants will be monitored until flowering, at which time successful infection will be visible. Additionally, since infection can only be detected upon flowering, I am optimizing a method known as fungal detection PCR, which tests for the presence of *S. ellisii* DNA within the plant body. I am verifying preliminary results from our lab that used a DNA primer that amplifies *S. ellisii* DNA but not *A. virginicus* DNA and suggested that the fungus overwinters in the root crown of its host plant. Future plans include using the method to track *S. ellisii* through *A. virginicus* as it moves from root crown to flowering shoot during the growing season, on plants tagged and collected from a natural *A. virginicus* population.

Personal Statement

I am extremely grateful to have been given the opportunity to participate in the 2009 Mentored Undergraduate Research Experience. The ten research intensive weeks I spent here have allowed me to fully immerse myself in my project in a way that is not possible during an academic semester. Not only have I learned various useful lab techniques, but I have developed invaluable research skills, such as critical thinking, problem solving, and perseverance. Additionally, I was able to work collaboratively with my peers, both in the biology department and other disciplines, as well as with my research mentor. I am also more self-assured as an independent researcher, and have gained confidence in my ability to make informed decisions. Overall, my MUSE experience has been very rewarding, and the skills I have developed here will most certainly prove useful when I attend graduate school.

Analysis of GLD-1 Protein Turnover Rate in the *Caenorhabditis elegans* (*C. elegans*) Germ Line

Faculty Mentor: Sudhir Nayak

Using *Caenorhabditis elegans* (*C. elegans*) to screen for bioactive small novel proteasome inhibitors

Dana King, Biology

2009 MUSE Project

The germ line of *C. elegans* offers a unique model system to study the activity of chemical agents such as proteasome inhibitors. The polarized structure of the germ line affords continually dividing and differentiating cells with defined boundaries for the various stages of the cell cycle. Importantly, the regulation of the cell cycle, including the mechanism for apoptosis, or programmed cell death, is well conserved between *C. elegans* and humans. Given that proteasome inhibition triggers apoptosis in other systems, we have developed an additional level of scrutiny for a chemical screen of proteasome inhibitors. Our long term goal is to implement the screen for the identification of bioactive compounds to be used as potential cancer treatments. We are screening for apoptosis by utilizing a strain that clearly labels dying cells with a halo of Green Fluorescent Protein (GFP) and provides a high signal to noise ratio relative to other measures of apoptosis. Our preliminary data indicates that some of the chemicals identified as active by increased levels of a reporter protein in the preliminary screen do increase the levels of apoptosis in the germ line in treated worms. Currently, we are using RNAi knockout of various components of the proteasome as well as established proteasome inhibitors to determine if the increased apoptosis is due to proteasome inhibition. The further development of this screening protocol will allow for the high throughput screening of bioactive compounds as well as have further research implications in understanding the function of the proteasome in *C. elegans*.

Personal Statement

The MUSE program at TCNJ has given me an unparalleled opportunity to experience research at a level not possible during the academic year. MUSE 2009 offered focus and intensity in the laboratory while still facilitating the exchange of information and ideas between departments with interdisciplinary talks and activities. The time I have spent this summer in the lab with my mentor and peers has allowed me to understand both the scope and the depth of my research. I no longer fumble blindly through my work; I see the final goal stretched out before me and I can draw out the path necessary to reach it. The problem solving skills as well as lab techniques that I have developed this summer will be indispensible to achieving success in research in the future. I hope to continue to explore this complex and fascinating field at the graduate school.

Development of Small Molecule Proteasome Inhibitors Using *Caenorhabditis elegans*
Michela Fiaschi, Biology

2009 MUSE Project

The proteasome is involved in a variety of processes including cell cycle regulation, morphogenesis, differentiation, cell surface receptor modulation, DNA repair, and numerous others. Due to its critical role in the cell, inhibition of proteasome function results in cell cycle arrest and/or apoptosis. This property has generated considerable attention in the development of proteasome inhibitors as anti-cancer therapeutics. We have developed a high throughput screen for small molecule proteasome inhibitors using the real-time analysis of *C. elegans* germ line morphology. The basic strategy for the development of the novel small molecule templates incorporates structural elements from naturally occurring proteasome inhibitors epoxomicin pharmacophore and NPI-0052 backbone.

In wild-type worms, the GLD-1 protein has a tightly restricted expression pattern with low levels present in mitosis, high levels of accumulation during meiotic progression, and low levels during oogenesis. We reasoned that any compound that interrupts the cell cycle would result in a breakdown in germ line polarity and would be identifiable by a change in expression of the GLD-1::GFP fusion protein. As a secondary screen, bulk DAPI (4',6-diamidino-2-phenylindole) staining and staining of dissected germ lines is being used to identify disruptions in nuclear morphology. The basic protocol has been scaled to a 96-well format. Our future directions include confirming the effects of the novel proteasome inhibitors using direct approaches for the disruption of proteasome function. Our preliminary data suggests that *C. elegans* can be used as a whole animal screening system for the identification and development of bioactive compounds.

Personal statement

The MUSE summer research program has provided me with the unique opportunity to further research on my own project as well as collaborate with another student in my lab. Our partnership allowed us to find much more supporting evidence for my hypothesis, and our collaboration made it possible in a timely manner. Furthermore, my project was unique in that the chemicals I used on my worms were synthesized by the Chemistry Department. These many collaborations made my project an interactive interdisciplinary project. This summer I have learned to asses my results and evaluate how they support or reject my hypothesis. I have truly been able to work with a wonderful group of peers and learned that teamwork was the key to our progress in both our collective and individual projects. As a result of this experience, I feel fortunate to have explored a field that I want to pursue in graduate school.

Phenotypic Variation in Natural Isolates of *Caenorhabditis elegans* (*C. elegans*)
Christina Fang, Biology

2009 MUSE Project

We have initiated an analysis of variation in natural isolates of the model organism, *C. elegans* in order to identify phenotypic differences that can be used for genetic analysis. Preliminary observations of phenotypic differences among the strains, such as growth rate and environmental behavior, suggest that extensive natural genetic variation is present between strains of the same species. This project is centered on cataloging the interspecies differences in germ line development and structure. To characterize the germ line morphology of the natural isolates, we are employing DAPI (4', 6-diamidino-2-phenylindole) staining of both whole worms and dissected germ lines. DAPI is a fluorescent dye that specifically binds to DNA and allows for the visualization of all somatic and germ line nuclei in the animal. Thus far, our preliminary data from comparison of the natural isolates to the laboratory wild-type control indicates that variation in overall germ line structure exists and is consistent within each isolate. The strains that show qualitative divergence from the wild-type were also dissected to examine their germ lines in more detail. We are currently generating quantitative data from measurements of the mitotic zone, transition zone and pachytene region, number of progeny, number of oocytes and number of sperm. Ultimately, we would like to use this information to identify genetic variants that result in differences in gene expression that correlate with the phenotypes of each isolate.

Personal Statement

My experience with the Mentored Undergraduate Summer Program (MUSE) has been an incredibly fulfilling one. Although I spent this past year shadowing an upperclassman in Dr. Nayak's lab, this program has allowed me to

fully undertake my own project. While providing me the opportunity to improve my laboratory skills, I have been able to independently make decisions in the lab, collect and interpret data. This research experience has helped me develop invaluable organizational, analytical, and research skills I would not have been able to otherwise learn in the classroom. The MUSE program encourages interdisciplinary and collaborative work which has in part allowed me to meet other peers across many disciplines who share the same passion for research. The skills and knowledge I have gained these past eight weeks will not only greatly help me in my future academic coursework and independent research but also in my aspiration of a physician and researcher and I am grateful for having been given this opportunity.

An Analysis of the Four *zsqd* Genes in Zebrafish: Expression and Regulation

Maytal Firnberg, Biology
Vilma Muca, Biology
Faculty Mentor: Marcia O'Connell, SUNY

2009 MUSE Project

We are interested in pursuing an analysis of the maternal regulation of embryonic patterning in zebrafish (*Danio rerio*). In zebrafish, as is true in many species, due to the lack of transcription during early embryogenesis only the maternal mRNAs are available for translation if new protein is needed to regulate patterning events. We have focused on studying the regulation and expression of the mRNAs for four genes, sqdlA, sqdlB, sqdlC, and sqdlD, all of which share homology with a gene called *squid* which was first identified in *Drosopila melanogaster*, the fruit fly. In flies *squid* plays a role in the patterning of the dorsal-ventral axis of the embryo. We identified four homologous genes in the *D. Rerio* genome using bioinformatics. We have performed experiments aimed at investigating whether these genes play similar roles in zebrafish by determining 1) when these genes are expressed and 2) how they are translationally controlled. We have used PCR to follow the expression of the genes, and to determine whether the poly(A) tail length of their mRNAs fluctuates between stages in the embryo. Changes in poly(A) tail length indicate when translational control is occurring by cytoplasmic polyadenylation. Our results show all four genes (sqdlA, B, C and D) are indeed expressed in early stages of the embryo (1-2 cell, 64-512 cell, 1k cell, sphere and shield). Interestingly, sqdlC is expressed more abundantly at the sphere stage and beyond, which indicates that it is likely to be re-expressed zygotically. The third task to be done involves perturbing the translation of these mRNAs to analyze protein function, by injecting morpholinos into the embryos. If temporal or spatial changes occur as the embryo develops, this information can be combined with the expression data to develop hypotheses regarding the roles of these four genes during embryogenesis in fish.

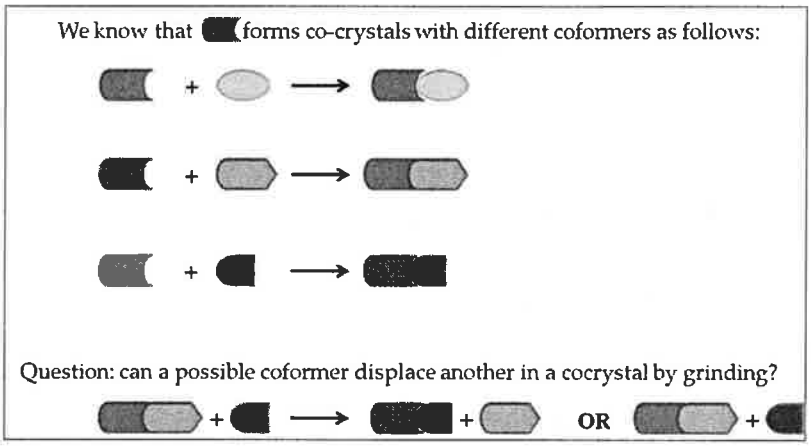
Vilma Muca Personal Statement

Applying for the MUSE Program was the best decision I made for this summer. It has been amazing to connect with students with similar aspirations as myself and communicate with faculty on a personal level. I am thankful for having the opportunity to gain laboratory skills that will be useful in the future. Even though I have made minor mistakes in lab, I have learned from them, and become much more confident working in a lab setting. My previous genetic knowledge has greatly expanded through the critical thinking and experimentation I have done. At the same time, dealing with fish and being introduced to embryo development in flies and fish have all been new experiences. I am really interested in continuing this research during the academic year in hopes to discover the functions of at least one of these genes. I have immensely enjoyed the bar-b-cues, trips and activities that the MUSE Program has generously provided us over these past weeks. I am glad to say I have made several unforgettable memories this summer!

Maytal Firnberg Personal Statement

This summer, the Mentored Undergraduate Summer Experience 2009 program gave me the opportunity to experience life as a developmental biologist. In Dr. O'Connell's lab, I learned various skills and methods involved in scientific exploration as well as problem solving and critical thinking techniques. MUSE has given me a chance to immerse myself in research involving molecular genetics and developmental biology that was far beyond anything I have learned in the classroom. In addition, MUSE has given me the opportunity to experience a facet of biological research that greatly differs from the aquatic ecology lab that I have participated in since my sophomore year. The knowledge and skills I have gained through MUSE, both practical and scientific, will surely come in handy for the future.

coformers including 4-nitrophenol, acetamide, melamine, salicylic acid, and 1-hydroxy-2-naphthoic acid. TP•HBA was ground with each of the coformers for 20, 40, and 60 minutes. To verify the results and determine theophylline's selectivity, grinding experiments of theophylline in the presence of two coformers (not co-crystallized) were also run. The products from each experiment were analyzed by differential scanning calorimetry, thermogravimetric analysis, infrared spectrometry, and powder x-ray diffraction to determine whether theophylline remained co-crystallized with the original coformer, switched coformers, or if no co-crystals were present. Our results to date suggest that theophylline prefers acetamide over HBA over 4-nitrophenol. Ultimately we hope to determine a coformer hierarchy for theophylline.



Personal Statement

Having never before participated in research of any kind, I was unsure of what to expect my MUSE experience to be like. That being said, I never guessed that I would have the amazing experience that I did. Not only was I able to work with a great faculty mentor and a peer collaborator, who is as interested in chemistry as I am, but I was also fully immersed in chemistry and the lab work associated with it for the first time. I learned invaluable skills from working in the lab, planning out exactly what direction to take the project, and from discussing project details with Dr. Abourahma. The MUSE program has convinced me that research in the field of chemistry is something I would eventually like to do as a career.

New Research In Forensic Chemistry

Faculty Mentor: Dr. John Allison

Measuring the Chemiluminescent Reactions of Luminol

Danielle Panaccione, Chemistry

2009 MUSE Project

In the field of forensic science, crime scene investigators may employ the use of a chemical commonly called luminol, which aids in the detection of blood. Even if a blood splatter has dried or been washed away and is no longer visible with the unaided human eye, luminol can be sprayed onto the area and the blood stain will glow as it reacts. The blue light emitted by this chemiluminescent reaction can be measured, and much literature can be found in both chemical and forensic journals, as well as on the internet, although it is often incomplete. One issue of interest is that forensic scientists often report that luminol reacts with blood and bleach, while giving little information about how the two reactions are different and how to tell them apart at a crime scene. In chemical journals, there is generally more information regarding luminol's reaction with not only blood and bleach, but with certain solutions of ions of metals such as cobalt, copper, and iron.

The research I have done with Dr. John Allison has allowed me to react blood, bleach, and metal ion samples with luminol products to measure both the intensity of the light given off as well as the duration of the light emission. Also, the two brands of luminol products available to forensic scientists were used for each reaction to be compared against each other. The purpose of this work is to get an accurate idea of these chemical measurements in order to present them in a forensic journal, essentially providing information on what is known in the chemical world to be applied and further understood in the real world, as well as establishing the differences in the reaction of luminol products with blood and other samples both in solution and dried on various substrates.

Danielle Panaccione Personal Statement

Working on this project has allowed me to gain an invaluable experience in the chemistry lab, practicing lab skills and learning about designing and carrying out experimental research. Being able to completely immerse myself in this project has provided me the opportunity to feel connected to the work and get excited about its outcome. My research and that of my peers has given me an in-depth glimpse of the vast aspects of chemistry that are applicable to understanding and improving the techniques and tests used in the forensic field. Participating in MUSE this summer has permitted me to not only work with a great mentor and classmates, but it has given me the chance to explore an area of interest that will undoubtedly help me in the future.

Determining the Presence of Gun Cleaning Oil in Gun Shot Residue

Robyn Pyle, Chemistry

2009 MUSE Project

There has been much discussion in the forensic community concerning the exact definition of gunshot residue (GSR). Once thought to be unique to GSR, the three-component (barium, lead and antimony) particles of the residue can also be generated by nail guns and brake liners. The generation of these particles by objects other than guns lessens the evidentiary significance of GSR. Our project focuses on identifying components of gun cleaning oil in GSR; if these components can be detected in the residue, this could be useful for several reasons. If a shootout occurs between gang members and police officers, and the source of a bullet is unknown, it may be more likely that gun cleaning oil will be found in an officer's gun than in a gang member's weapon. Also, nail guns and brake liners do not come into contact with gun cleaning oil; if the oil is present in the GSR, it is highly unlikely that the particles came from anywhere other than a gun. Our theory is that, as a bullet leaves the barrel of a recently cleaned gun, it "wipes" the gun cleaning oil from the sides of the barrel. The gun cleaning oil would then be "wiped" from the bullet as it passes through its target, where it could be detected using gas chromatography. We have found that, although the high temperatures in the gun barrel burn most of the gun cleaning oil away, several of the heavier components are easily detectable. Therefore, we encourage the forensic community to consider gun cleaning oil to be a component of gunshot residue analysis.

Personal Statement

The MUSE summer research program has given me a unique opportunity to use the knowledge I've gained from the classroom and apply it to a real laboratory environment. I have enhanced my independent laboratory skills and developed my understanding of scientific literature. The classroom laboratory setting is quite different than that of a research lab, and MUSE allowed me to fully immerse myself in my project. I have learned that mistakes can sometimes lead to breakthroughs, and that patience and determination are essential when performing research. The skills and experience I have gained through the MUSE program will help me not only in my last year at TCNJ, but in graduate school and beyond as I pursue a career in the forensic sciences.

The Scott Test for the Detection of Cocaine

David G. Goodwin Jr., Chemistry

2009 MUSE Project

Dr. John Allison and student collaborator David Goodwin from Lafayette College have been working on the chemistry behind the Scott Test, a common field test for cocaine. The Scott Test is a type of presumptive test used by police for on-the-scene drug identification. Surprisingly, much of the chemistry involved in the test is unknown despite its frequent use by police to apprehend suspects possessing a suspicious white substance. In the Scott Test, a milligram of unknown sample is added to a red solution containing cobalt. Then chloroform is added to the solution, causing the formation of two layers. If the chloroform layer turns blue, then cocaine is present. Unfortunately, the steps in between the addition of cocaine and the color change have never been made scientifically clear and require further chemical study. Therefore, this research has involved altering many chemical conditions in the Scott Test to collect data that is key to both quantifying and understanding the mechanism involved in this presumptive test. It is important to understand why the test works so it can be further validated and developed.

Personal Statement

As a chemistry major from Lafayette College, the MUSE program has provided me the incredible opportunity to carry out research with Dr. John Allison at the College of New Jersey. Having had interest in Dr. Allison's work ever since high school, I have finally made it into his laboratory to take part in a unique forensic chemistry project. This experience has enabled me to apply my laboratory skills and chemical knowledge obtained from past research projects at Lafayette College to my specific field of interest, forensic chemistry. The project has also exposed me to many chemical techniques while teaching me the process of research from start to finish. I have worked hard, been intellectually challenged, and have been excited about the amazing progress we have made on our research. I have also grown as a chemist and further developed my interest in forensic chemistry. When I am solving crimes a few years from now, I will give Dr. Allison a call and thank him again for getting me started.

Effect of Ionic Liquids on a Small, Alanine-based Peptide

Leigh Murray & Karson Schmidt, Chemistry
Faculty Mentor: Dr. Michelle Bunagan

2009 MUSE Project

Ionic liquids are defined as organic salts that are liquids at room temperature and have melting points below that of water. Ionic liquids have become materials of great interest to the chemical field due to their unique and useful properties. With regard to biomolecules, they have been found to stabilize and solubilize proteins, prevent aggregation, and serve as solvents for long-term storage, although the molecular mechanism by which this is achieved is yet to be fully understood. Research in this area has focused on large protein systems defined by multiple secondary structural elements and many intermolecular interactions, and this protein complexity has made the exact mechanism of stabilization by ionic liquids difficult to determine. This study aims to avoid these problems by assessing the effect of ionic liquids on small peptides, which represent single secondary structural elements.

AKA_2 is a 19-residue, alanine-based, α-helical peptide, which is a well-used model system for the study of the helix-coil transition. Using 1-butyl-1-methylpyrrolidinium bis (trifluoromethylsulfonyl) imide, the effect of neat ionic liquid on the secondary structure of AKA_2 was observed. Circular dichroism spectroscopy (CD) of AKA_2 in ionic liquid revealed that, as temperature increased, the peptide appeared to become more structured, and may have undergone an α- to 3_{10}- helical transition, which was not observed in aqueous solution. The increased helical CD signal may be an effect of increased solubility at higher temperatures. However, the 3_{10}-helical structure, which is unusual for AKA_2, may be formed so as to maximize the number of intra-helical hydrogen bonds in the weakly accepting solvent. Not only do these results have implications for understanding ionic liquids as protein solvents, but this system may also provide a useful model for further characterization of the α- to 3_{10}- helical transition. Additionally, trpzip4, a β-hairpin peptide, is currently in production for similar study.

Leigh Murray Personal Statement

Working with the MUSE program this summer, I was able to conduct research without the time constraints placed during the school year. I was able to gain a better understanding of laboratory procedures, and also learned how to operate more of the instruments that the chemistry department has to offer. I also learned how to better read, understand, and write scientific literature. Working in close contact with other MUSE groups not only made the experience more enjoyable, but also added to the overall experience this summer.

Karson Schmidt Personal Statement

The MUSE program has been a very enriching experience for me, and has provided me with a great opportunity that I may have otherwise not had. Through participation in this program, I have not only further developed my laboratory and critical thinking skills, but also my interest in chemistry. Working closely with both my research partner and our faculty advisor has helped me to be more confident and independent in my research practices. I know that the valuable knowledge and skills gained this summer will serve me well in my years to come at TCNJ and in my future career in medicine.

Synthesis of Metal Nitride Nanomaterials

Tom Green, Chemistry
Faculty Mentor: Dr. Benny Chan

2009 MUSE Project

Chemical conversion of nanostructured materials from one chemical composition to another is a recent idea that has drawn the attention of many research groups. The synthesis of nitride materials is notoriously difficult. We hope to use conversion chemistry to form nitride materials of desired morphologies. The goal of this research is two-fold. 1) synthesize metal sulfide and nitride nanoparticles, 2) synthesize nanostructured materials from reactive nanoparticle precursors using various porous templates. An example of the type of conversion chemistry we are interested in is as follows:

Reaction 1: $2Cr(NO_3)_3$ (PVP aq) + $3Na_2S$ (PVP aq) ⟶ Cr_2S_3* (s) + $6NaNO_3$ (PVP aq)

Reaction 2: Cr_2S_3* (s) + $2NH_3$ (g) ⟶ 2CrN (s) + $3H_2S$ (g)

In reaction 1 chromium nitrate is dissolved in an aqueous solution with the surfactant polyvinylpyrrolidone (PVP) and then reacted with sodium sulfide to create a colloidal suspension of chromium(III) sulfide nanoparticles. The chromium (III) sulfide is dried and then heated in a tube furnace with flowing ammonia gas at 750° C to form the chromium nitride nanoparticles. To date, we have been successful in forming chromium nitride as identified by powder X-ray diffraction. We have attempted to make iron nitride nanoparticles and have obtained a characteristically ferromagnetic material. Powder X-ray diffraction has shown several compounds are formed. We hope to characterize our products by transmission electron microscopy to determine particle size.

We have also attempted to use our sulfide nanoparticle suspension to infiltrate nanostructured templates. Once in the template, the sulfide is converted to the nitride and we hope that the final products take the shape of the template. We have used closed packed silica spheres (230nm as measured by UV-Vis) as our templates. The scanning electron microscopy images were not able to resolve the features. We require higher resolution SEM to examine our nanostructures.

We have shifted our attention towards metal nitrides with catalytic applications (Mo_2N, Fe_2N and W_2N). Although these compounds are well known, our synthetic strategy could produce materials with particularly large surface areas which could enhance catalytic activity. Considering that most nanostructured materials produced to date require expensive equipment, we believe that this research is a significant contribution to the scientific community because of the relative ease and inexpensive synthetic strategy.

Tom Green Personal Statement

I have been working on this project with Dr. Chan for the past two semesters and I am very pleased to have had the opportunity to continue this research as part of the 2009 MUSE program. I would like to thank all the coordinators for making MUSE possible. This has been an invaluable learning experience unlike any classroom based course that I have taken thus far. I would especially like to thank Dr. Chan for being a great mentor.

Building block approach to designing thermoelectric materials

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

2009 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. 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 prepared ternary building block chalcogenide precursors, $K_2P_2Se_6$ with a stoichiometric combination of high purity reactants.

P_2Se_5 (s) + K_2Se (s) à $K_2P_2Se_6$ (s)

The materials were characterized by X-ray diffraction to confirm the structure and purity. The building block precursors were reacted with $LaCl_3$ under solvothermal conditions to target a new material. Solvothermal reactions are accomplished in a closed system at temperatures above the normal boiling point of the solvent, i.e. similar to a kitchen pressure cooker. Conditions varied from 125°C to 175°C and included the solvents such as ethylenediamine, acetonitrile, and water.

$K_2P_2Se_6$ (s) + $LaCl_3$ (s) à $KLaP_2Se_6$ (s) + KCl (aq)

We have found clear crystals with a powder XRD pattern that could not be identified. We hope this new compound contains 4 elements and retains the linear chains in the $K_2P_2Se_6$.

We have reacted elements and binary compounds. This method is more common in the literature but has very little predictive ability to know what structural motifs will exist in the final compound.

w **K_2S (s) + *x*** **$LaCl_3$ (s) + *y*** **Ge (s) + *z*** **S (s) à K-La-Ge-S (s) + KCl (aq)**

Single crystals were obtained at temperature 150°C and with an ethylenediamine and KF solvent mixture. Several new products have been identified by powder X-ray diffraction. Complete structural analysis by single crystal x-ray diffraction will be performed in the fall.

Sarah Wehrhan Personal Statement

The Mentored Undergraduate Summer Experience was very beneficial to me to train and work alongside 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

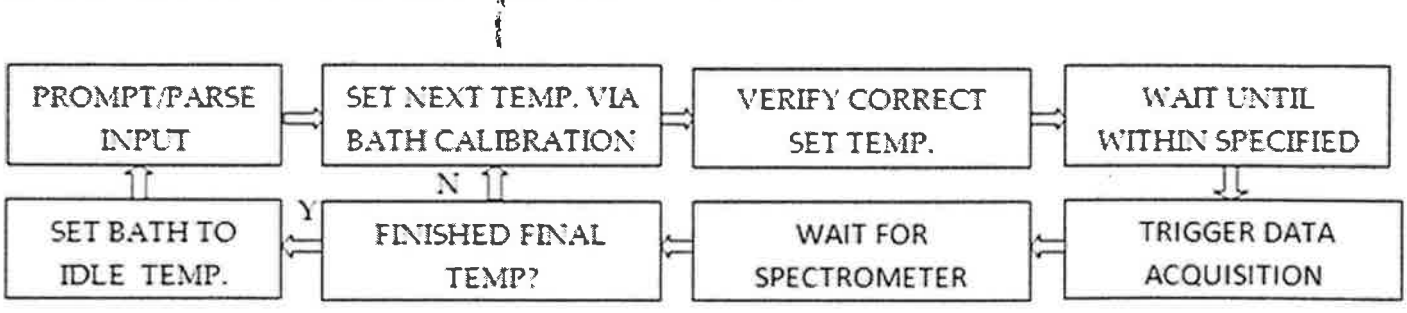
The Mentored Undergraduate Summer Experience has been a helpful asset in my academic career. Throughout my time in this program I was able to enhance my social and presentation skills. Thanks to the Mentored Undergraduate Summer Experience I have learned insightful information by communicating with MUSE peers. 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.

Constructing a Digital Filter for Adaptive Signal Averaging

Christopher Brinton, Electrical Engineering
Faculty Mentor: Dr. Donald Hirsh, Chemistry

2009 MUSE Project

As an introduction to LabVIEW software, a fully automated temperature control system for an instrument called the Luminescence Spectrometer was developed. The components of the temperature control system were the spectrometer, a temperature-controlled circulating water bath, and the LabVIEW software with digital I/O interface and serial port. The completed temperature control system operated as shown below.



The LabVIEW programming skills obtained in developing an automated temperature control system were then applied to my main project, improving the signal to noise ratio of the Electron Paramagnetic Resonance (EPR) spectrometer using digital signal processing. This was deemed possible from the results that C.J. Cochrane and P.M. Lenahan obtained in their "Adaptive Signal Averaging" study on EDMR scans, which involves a technique called adaptive filtering.

Whereas a conventional filter, either analog or digital, has set parameters to remove noise from a signal, an adaptive filter changes its specifications (a weight vector) instantaneously based upon its error in predicting a "desired" signal. For this application, the desired signal was the result of a few conventionally averaged scans. Cochrane and Lenahan claim that, compared to conventional signal averaging, their method yields an 11.3-fold improvement in the signal-to-noise (S/N) ratio. We have integrated their adaptive filtering scheme into our EPR spectrometer and we see a significant improvement in S/N. We will compare the S/N obtained with adaptive filtering to that obtained using a "moving average", a more conventional and simpler method of high-frequency noise reduction.

Personal Statement

The 2009 MUSE program was my first experience in research and has been both an intriguing and enlightening experience. Dr. Hirsh has taught me a great deal about collaboration and has given me guidance in achieving my two objectives. At the beginning of the eight weeks I possessed little knowledge of adaptive filtering, and even less of how to program in LabVIEW. However, with my mentor's guidance I found just how similar this programming environment is to others, and just how applicable my studies in Electrical Engineering are to different instruments. My outside research has focused on programming in LabVIEW, and on reading excerpts from the text *Adaptive Filtering* by Paulo S.R. Diniz to understand the mathematical theory behind the subject. Through MUSE, I have not only improved upon equipment but have also learned a great deal about digital signal processing and programming techniques that I will encounter in my later years at TCNJ and beyond. I have thoroughly enjoyed working with Dr. Hirsh and certainly am excited for any research opportunities in the future.

Modeling Nitroxide Spin Label Conformations on DNA Scaffolds

Joselle McCracken, Chemistry
Faculty Mentor: Dr. Donald Hirsh

2009 MUSE Project

DNA is a self-assembling molecule that is integral to the biology of every living organism. As such, not only does DNA have a great deal of research surrounding its unique structures and forms, but it is easily synthesized and readily available. These properties make it an ideal scaffold to use to bind smaller molecules with particular electromagnetic characteristics. By understanding these characteristics, in the future we may begin to apply DNA to nano-scale circuitry.

Dr Donald Hirsh's research focuses on a specific DNA scaffold containing 19 base pairs. Attached to one strand's end is a nitroxide radical. On the complimentary strand a single thymidine base has been modified to hold an EDTA moiety, which can complex a metal ion and bind to the opposite strand. However, much about how the EDTA-complexed metal-ion binds the DNA and how the nitroxide radical orients itself in solution are still being explored.

The project I worked on this summer had two branches. The first was to melt DNA and analyze its Absorbance and Circular Dichroism spectra to determine both global and localized melting temperatures. Recently, the metal ion used to bind EDTA had been changed from Dysprosium to Terbium, and comparing the thermodynamic properties of the two DNA duplexes permitted the conclusion that the EDTA-complexed metal ion/DNA interactions are very similar for Dy(III) and Tb(III) ions. The second was to use HyperChem to model new orientations for the nitroxide 'Spin Label'. A disconnect had developed between two large bodies of experimental data, requiring reconsideration of the DNA scaffold at a structural level. Research in this area will continue after this summer, but early data suggests that EDTA's binding is nonuniform, depending on either distance to the end of a strand or the nitrogenous base beside which the EDTA must bind.

Joselle McCracken Personal Statement

In many ways MUSE research fosters great independence. There is much to be said about how the ability to freely plan experiments, run samples, analyze data, and pursue new ideas enriches confidence and awakens aspirations. This summer I learned how to use many new instruments, such as the UV-VIS, reverse-phase HPLC, Spectropolarimeter, and the EPR. I also learned how to prepare DNA samples, and how to operate liquid nitrogen tanks. Though I have researched before, this was the first time that I needed to investigate scholarly articles to reach forward into new intellectual directions.

However, during my research it was not the independence that I valued most. It was the collaboration and camaraderie between all participants that made this summer outstanding. Dr. Hirsh is a great guide and resource, constantly devising creative directions but always allowing and encouraging his students to be enterprising problem-solvers. I have made many new friendships too, by sharing a fresh and demanding experience with other students. It is the combination of all these factors that makes MUSE so rewarding.

Phosphorescence of Covalently Attached EDTA-Tb(III) on DNA Duplexes

Marielle Smith, Chemistry
Faculty Mentor: Dr. Donald Hirsh

2009 MUSE Project

Working with Dr. Hirsh as part of the Mentored Undergraduate Summer Experience, I examined more closely the behavior of DNA forming a duplex when an EDTA-Tb(III) group is covalently attached to a DNA strand. The DNA strands that were used consisted of a 19 base sequence with the EDTA chelate attached to a thymine base. The strands that were used for the phosphorescent experiments had this modified base, dT-EDTA at the 9th position on the DNA strand (E9T19mer). Four new DNA duplexes were synthesized containing the EDTA moiety with Terbium metal attached: E9(Tb)T19/ 5'A9_3'A9, E9(Tb)T19/5'A8_3'A10, E9(Tb)T19/C3A19 (acetylmido), and E9(Tb)T19/SL-A19.

Terbium is a lanthanide metal that has luminescent properties. The phosphorescent intensity measures how well energy from the EDTA-Tb(III) can be transferred through bases on the DNA strand. The Terbium metal is also 9- coordinate. It has the ability to bind the EDTA chelate, the DNA strand itself, and can it also bind water. Therefore, by measuring the phosphorescent intensity of the DNA duplexes, we can see how well the EDTA-Tb(III) moiety will bind to the complimentary strand of the DNA. The more intense the phosphorescence, the less waters bound to the Terbium so it will bind to the complimentary strand more efficiently. The four DNA single strands (E9T19mer) were paired with the shorter complimentary strands to produce a "gap" at different positions in the DNA duplex (ie: missing base). By measuring the phosphorescent intensity of the duplexes, we conclude that phosphorescence varies with gap position. Phosphorescence measurements were made on the Luminescence spectrometer to observe the phosphorescent intensity of the duplexes at various temperatures, specifically 10°C and 25°C to show that the coordination of the EDTA-Tb(III) occurs at the complimentary strand at a position four bases away in the 5' direction from dT-EDTA.

Personal Statement

MUSE has truly been an outstanding opportunity. I learned many valuable laboratory techniques this summer, which I would not have been able to learn in a semester during class. It was a good experience to set up experiments, run instruments, analyze data, and keep accurate records of my work independently while under Dr. Hirsh's guidance. These skills I will be able to take with me into the working world when I graduate next year. Not only did I acquire the skills to work independently and with others when needed, but research has also helped me to think more critically about things. I am better equipped to think about the big picture, as well as the little steps needed to get to the desired results. I was also able to enhance my problem solving skills and troubleshoot when things did not proceed as expected. Researching in the lab with Dr. Hirsh this summer has indeed been an exceptional experience that has helped me gain real world perspective working in the field of chemistry.

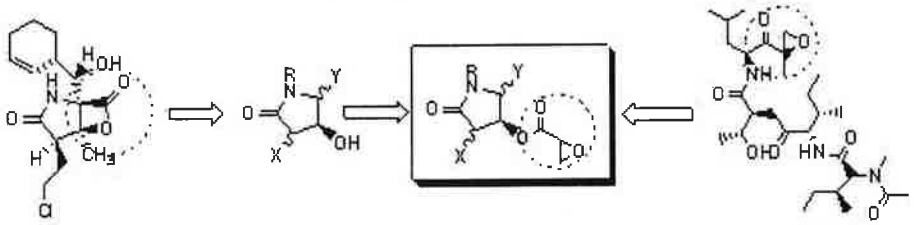
Development of Small Molecule Proteasome Inhibitors

Lyndsay M. Wood, Biology
Faculty Mentor: Dr. David A. Hunt, Chemistry

2009 MUSE Project

Recent developments in the field of cancer chemotherapeutic treatments have been closely linked to the design and synthesis of novel small molecule proteasome inhibitors. In a normal, healthy cell the proteasome is responsible for destroying any malfunctioning, misfolded, or unneeded proteins in both the nucleus and the cytoplasm. If the proteasome is inhibited, a cell will undergo apoptosis (programmed cell death) to destroy itself and eliminate its poisoned cellular components. This is of particular interest in cancer research; if proteasome inhibitors can be designed to target the already weakened cancer cells, there is a potential for these molecules to induce apoptosis, thereby resulting in targeted destruction of the cancerous cells.

By examining the natural and complex proteasome inhibitors epoxomicin and NPI-0052, there is a specific region associated with the inhibiting activity known as the pharmacophore. By examining these regions of interest in both inhibitors, small molecules have been strategically designed to mimic the functional groups of both.



NPI-0052 NPI-0052 core epoxomicin

Preliminary data have been gathered on compounds prepared as part of the MUSE program over the past two summers by Erika Tabakin (TCNJ Class of '09) using *in vivo* screens using GFP and *C.elegans*. These screens have been developed by the Nayak research lab in concert with compound development efforts. To date, biological activity has been observed with only the R- enantiomer. These results have guided this summer's synthetic work to focus on three aspects: R-stereochemistry, electron rich elements attached to the β- and γ-carbons, and, lastly, possible sites of *in vivo* oxidation. In theory, these molecules when taken up by *C.elegans* could be metabolized *in vivo* prior to reaching any potential active site and thereby be converted to a more potent compound. Since both known natural inhibitors are oxygen rich, the small molecule prodrugs designed this summer have been created with high potential for oxidation in mind.

Personal Statement

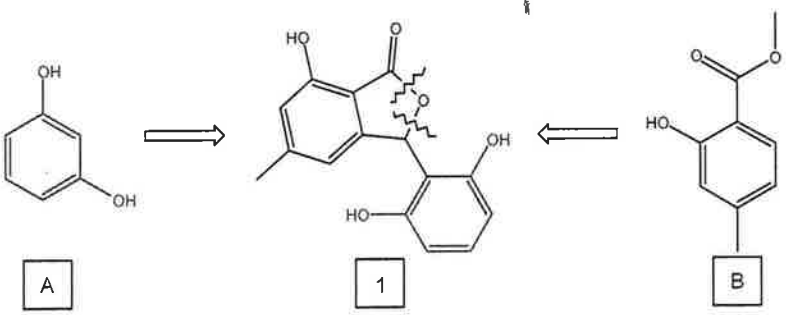
Working with Dr. Hunt through the MUSE program this summer has been especially beneficial by providing an environment for me to examine what focus I would like to take in post-baccalaureate studies. Since I took organic chemistry two years ago, I have been very interested in organic synthesis and drug design, but I was never fully exposed to either field. Knowledge obtained this summer has far surpassed laboratory skills and techniques, and has allowed me to finally pinpoint what my interests are. Being submerged into this program will help my future independent research and critical thinking abilities.

A Novel Synthesis of Isopestacin

Kelsey VanGelder, Chemistry
Faculty Mentor: Dr. David Hunt

MUSE 2009 Project

A natural antifungal compound known as isopestacin (1) has been isolated from an endophytic fungus in Papua New Guinea. To date, a nine-step synthesis of this compound has been reported; however, the synthesis does not lend itself to a program which would permit the preparation of a variety of derivatives enabling a thorough study of biological activity. We are currently investigating a more streamlined synthesis which would be able to provide the preparation of a myriad of derivatives.



The convergent synthesis begins with two different starting materials, A and B. Compound A is modified through two steps, the latter being an ortho-directed metallation. Compound B is modified through three steps. In the sixth step, Compound B is subjected to an ortho-directed metallation and combined with the product created from Compound A. This is a cyclization step which assembles the product framework; however, the –OH groups seen on the starting materials and on the product must be protected in order to complete the reaction. Therefore, in the final step of the synthesis, the protecting groups must be removed and transformed back into the three –OH groups.

A previous research student, Sara Davis, completed the first step of the Compound A manipulations. She also successfully completed the three preparatory steps of Compound B. Over the past six weeks, the three steps related to

Compound B were completed and optimized, confirming the validity of Sara's experiments. The first step of the synthesis from Compound A was also completed and optimized. The second step, forming the necessary precursor to the convergent sixth reaction, was completed, but in lower yields than anticipated. The key sixth reaction is currently under study. Further work will focus on optimizing the second step of the synthesis of Compound A, as well as successfully completing the convergent cyclization to form the protected product. Eventually, once the synthesis has been confirmed and optimized, further research may focus on creating analogs of isopestacin in an effort to optimize biological activity.

Kelsey VanGelder Personal Statement

This summer, the Mentored Undergraduate Student Experience has given me the incredible opportunity to enhance my laboratory skills in a way that most other programs do not. I was given the opportunity to work one on one with a professor on my own project, much in the manner I can anticipate in graduate school. I was encouraged to share my own ideas and opinions and was able to learn by actually doing in the lab. I gained invaluable experience in conducting independent research that will most definitely benefit me in the remainder of my classes, as well as in graduate school.

Making Safer and More Selective Insecticides Based on Juvenile Hormone Metabolism

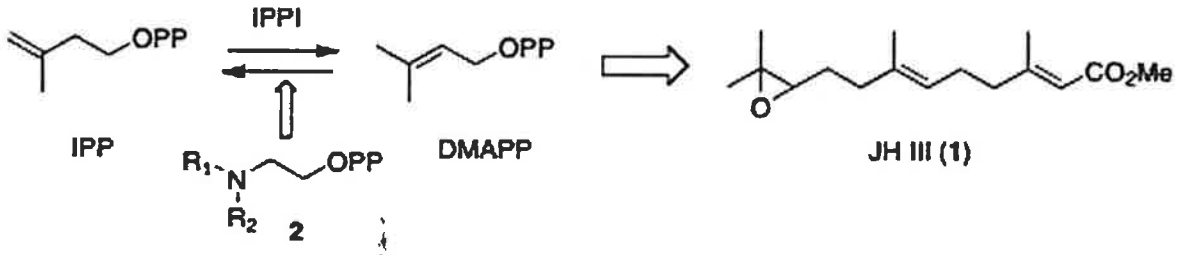
Reshma Jacob, Joseph Macor, and Ashley Tomasello
Faculty Mentor: Stephanie Sen

Selective Inhibition of JH Biosynthesis Using Ammonium Diphosphates

Joseph A. Macor, Chemistry

2009 MUSE Research

Juvenile hormones (JH's, e.g., JH III, compound **1**) are sesquiterpenoids that regulate many stages in an insect's life cycle. Because their absence causes premature pupation and prevents oogenesis in adult females, a selective inhibitor of JH biosynthesis is predicted to serve as an effective insecticide. The biosynthesis of isoprenoids and certain structures that are related of **1** and which are uniquely characteristic of the insect order Lepidoptera, requires the enzyme isopentenyl diphosphate (IPPI). This enzyme catalyzes the isomerization of isopentenyl diphosphate (IPP) to dimethylallyl diphosphate (DMAPP) by producing a positively charged carbocation intermediate. Ammonium analogues such as **2** are known inhibitors of yeast and mammalian IPPI but have not yet been considered for selective inhibition of JH biosynthesis in insects.



Preliminary studies in the Sen lab, in conjunction with computational studies, suggest that the lepidopteran IPPI active site can accommodate compounds such as **2** that bear significantly larger R groups than are known to interact with the corresponding mammalian, *E. coli* and yeast enzymes. To test this hypothesis I have synthesized library of ammonium diphosphates which we are currently testing against lepidopteran and mammalian IPPI. Thus far, *C. fumiferana* IPPI has been prepared using recombinant protein methods by expression in *E. coli* followed by extraction and purification by affinity chromatography. To quantify the inhibitory potential of the ammonium diphosphates, *Cf*IPPI has been incubated with various concentrations of several **2**, then assayed for IPP to DMAPP conversion using a radiochemical assay. The synthesis of the ammonium diphosphate library and most recent IC_{50} determinations using CfIPPI will be presented.

Joseph Macor Personal Statement

The MUSE program this summer has provided a unique experience, even when compared to independent research during the semester. As a Chemistry major, it is rare to find the time to take a biology class or opportunity to experience biological research. With more available time at my disposal, I completed my synthetic library and began unfa-

miliar biochemical assays. Working under Dr. Sen has revealed numerous fields of chemical studies that were unknown to me. Although biochemical work is not my intended career path, experiencing various forms of research ultimately enhances my chemical background as a whole, which is a rare opportunity.

Development of a Computational Model for Farnesol Oxidase
Reshma Jacob, Chemistry

2009 MUSE Research

The focus of our summer MUSE project was to develop a computational model for farnesol oxidase, an enzyme involved in the biosynthesis of insect Juvenile Hormone (JH). JH, a structurally unique acyclic sesquiterpenoid, produced only in insects, regulates insect growth and development. As inhibition of the JH biosynthetic pathway is an effective method for controlling insect population, we consider farnesol oxidase a potential target for insecticide development, especially since this enzyme is very substrate specific.

Using previously obtained biological data related to the *in vitro* inhibition of farnesol oxidase in the agricultural pest, *Manduca sexta*; a structural model for the active site features of this enzyme has been developed. Because we have no structure for either farnesol oxidase or its homologs, we have performed this analysis computationally. Through structure activity relationship data analysis, conformational searching, and a review of known receptor-ligand interactions, derived from distantly- related proteins, we have developed a pharmacophore model for farnesol oxidase. The model and the evaluation of two libraries of potential inhibitors will be presented.

Reshma Jacob Personal Statement

This summer, through the Mentored Undergraduate Student Experience I learned what it is like to perform computational chemistry. Learning to use the computational package MOE (Molecular Operating Environment) was a large part of my project. This integrative software system designed by the Chemical Computing Group enables pharmacophore discovery, ligand interaction analysis, protein modeling, flexible alignment of small molecules, and much more. I learned that computational chemistry requires the same approach as laboratory work, namely method development, review of the literature, control experiments, and detailed analyses of the results obtained.

Automorphisms of Rank 2 Subgroups of Free Groups
Matthew Davis, Math
Faculty Mentor: Andrew Clifford

2009 MUSE Project

Our research bridges two fields of Mathematics, Group Theory (an algebraic field) and Topology (a geometric field). We have used geometric objects, called *manifolds*, to describe elements in and automorphisms between free groups which are algebraic objects. The rank of a free group is the number of elements needed to generate the group. For a free group of rank $n \geq 2$, this manifold is a three dimensional set containing n two-dimensional spheres which comprise a sphere basis. Elements of the free group, called words, are represented by closed curves in the manifold. Automorphisms are represented as a change from the original sphere basis to a new sphere basis which also consists of n spheres.

The starting point of our work was a recently published algorithm that determines, given a word in the rank 2 free group, whether or not there is a positive word in its orbit. We asked whether we could determine the smallest positive word in an orbit. In answering this, we developed a new way of modelling automorphisms of rank 2 free groups. Our new model is two-dimensional—a punctured torus. This is significant as it is known that there is a three dimensional model which captures all automorphisms of any given free group. Moreover, if the rank is three or more, three dimensions are required. This shows that the rank two free group is *geometrically* distinguished from free groups of higher rank.

Matt Davis Personal Statement

Working with my mentor, Andrew Clifford, this summer through the MUSE program has taught me what Mathematical research consists of. I learned how to collaborate with others and use their differing viewpoints to further my understanding of Mathematics. Furthermore, I have learned how to share my ideas to aid in my mentor's constantly

changing view of our topic. This collaboration helped prove to me that my ideas were worth sharing. This made me feel less like a student, with insufficient knowledge in comparison to my Professors, and more like a true researcher of Math. I am tremendously pleased with this experience as I aspire to be a research Mathematician in the future. Participation in this program has confirmed my belief that I would enjoy this field of work, which alone makes it a success in my opinion.

Has Subduction Ended in Northern Italy?: A 3-D Tomographic Investigation of the Upper Mantle Beneath Tuscany

Megan E. Torpey, Physics
Kelly M. Liszewski, Biology
Faculty Mentor: Dr. Maggie Benoit

2009 MUSE Project

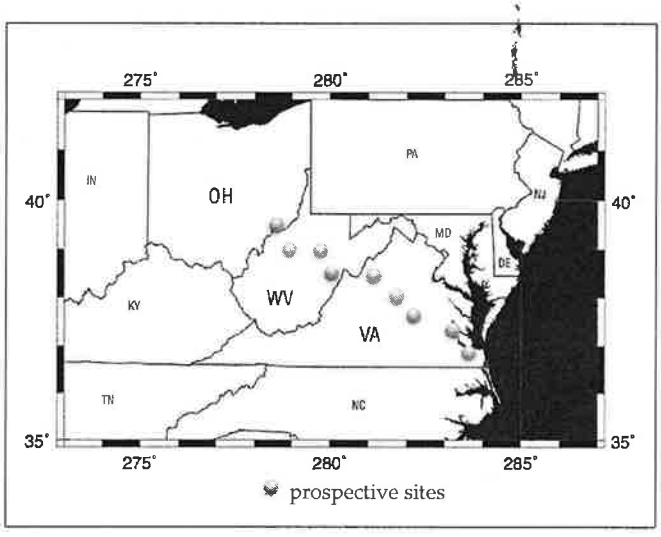
The plate tectonic framework of northern Italy is confusing to geologists. Though it is clear that a portion of the African plate once subducted beneath this area, no earthquakes deeper than ~100 km occur beneath the northern portion of the country, as would be expected if subduction were ongoing. Some geophysical studies have suggested that a slab of oceanic lithosphere extends beneath this area into the upper mantle, while other studies suggest that subduction has ceased and propose that the old slab broke off and foundered into the mantle. To further examine the existence of a subducting slab, we tomographically imaged the P and S wave seismic velocity structure of the crust and upper mantle beneath this region. We used data collected from the RETREAT PASSCAL experiment, a temporary deployment of over 40 seismometers that recorded earthquakes from 2003-2006. Overall, we incorporated 10,473 P wave travel time measurements from 551 events and 10,850 S wave measurements from 501 events into our study. Our P and S wave maps clearly show a vertical high wave-speed feature that is ~50 thick extending into the upper mantle to approximately 350 km depth. Though vertical smearing is present in the model, resolution tests for both P and S wave models confirm that the feature most likely only extends to ~250-300 km depth. Because the feature is vertical and does not extend deeper than 300 km, our results suggest that a subduction is no longer ongoing in northern Italy. This feature is most likely the upper portion of the broken off slab or a lithospheric drip. These results have important implications concerning seismic hazard analysis for the region, since subducting slabs produce much larger earthquakes than any other geophysical phenomena.

TEENA: A Pilot Seismological Study of the Passive Continental Margin in the Eastern US

Megan E. Torpey, Physics
Kelly M. Liszewski, Biology
Faculty Mentor: Dr. Maggie Benoit

2009 MUSE Project

Many questions about how the surface geology of an area reflects the deeper earth structure of the region remain unanswered by geologists. The lithospheric structure of the eastern portion of the US has been greatly modified through plate tectonic events over the last 2 billion years, and is largely unexplored by geophysicists. To gain further insight on the structure of the lithosphere beneath this area, and to elucidate further understanding of the lithosphere in general, we will deploy 9 seismometers across Virginia, West Virginia, and Ohio in a partnership with students and faculty at Yale University. These seismometers will record earthquakes from all over the world, and will help us to image the structure of the earth beneath this region. The network of seismometers will cross several geologic provinces, including the coastal plane, piedmont region, the Appalachian valley and ridge province, Grenville Front, and the Allegheny plateau. By examining the data recorded by these stations, we can gain further insight as to how the surface geology in this region reflects variations in the deeper earth structure. This summer, we have helped to scout out the field sights, con-



tacted potential landowners for permission to deploy our stations, and learned how to set up the seismometer and other field equipment. Field work for this project will formally commence July 25, 2009 (just after the MUSE program officially ends) when we will construct and deploy our seismic stations. The data from this project will be analyzed by undergraduate students at TCNJ and graduate students at Yale University.

Kelly Liszewski Personal Statement

The Mentored Undergraduate Summer Experience has allowed me to delve into a realm of science that I had never explored before. As a biology major, I had little to no experience in geology research prior to this summer, but while working with Dr. Benoit I have acquired many tools and I now have a much greater understanding about geophysics in general. Through this program, I was able to collaborate with others, think critically, improve my understanding of scientific literature, learn the basics of computer programming, as well as gain knowledge of the fundamentals for geology research and fieldwork. The work that I have performed this summer has been extremely interesting and enlightening, and has also opened me up to many new possibilities for my future as a scientist.

Megan Torpey Personal Statement

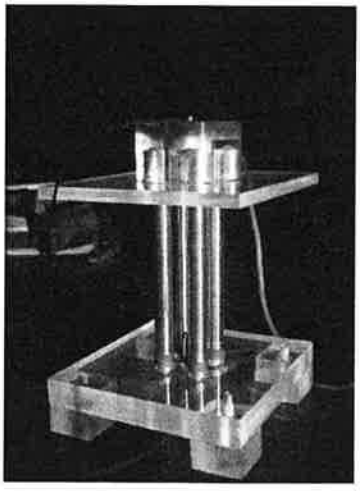
I had the opportunity to work with Dr. Benoit in the Mentored Undergraduate Summer Experience 2009 program and experience the research side of the geological sciences, a side to which I had not been formerly exposed. Gathering, analyzing, and interpreting seismic data are only a few techniques that I gained proficiency in with the MUSE program. Additionally, I had the opportunity to expand my knowledge of certain disciplines pertaining to my field of study, computer science for example, in which I have had limited instruction. Students are not restricted, however, to laboratory training. An understanding of scientific literature, the publication process, and many other valuable lessons are geared towards students. In addition to MUSE being academically enriching, it also is a nice way to become closer to faculty members and meet other students in similar, if not the same, departments. Ultimately I came to realize that this mentored learning program provides students with an experience that is not comparable to classroom practices; you can gain so much more.

Sublimation of Electrodynamically Levitated Ice Crystals at Low Temperatures

Yi-Hsuan Cindy Lin, Physics
Faculty Mentor: Dr. Nathan Magee

2009 MUSE Project

This research utilizes a five-electrode quadrupole levitation system to recreate the conditions of the upper troposphere and to study the behavior of cirrus clouds, which are made of ice crystals. The rate of ice particle sublimation is a subject of recent controversy in atmospheric science literature. Theoretical sublimations rates do not appear to match aircraft and satellite observations of cirrus clouds. This work strives to contribute controlled experimental data to this question. The outcome of the research could potentially affect parameterizations within cloud and climate models, ultimately affecting climate change predictions. By encasing the levitation apparatus in a -70°C freezer chest and vacuum, we recreate the upper troposphere pressure and temperature. We spent the first part of MUSE program constructing the custom apparatus in the physics machine shop and implementing the electronic, pressure, and temperature control systems. In this experiment, an ice crystal is charged and launched from a solid particle ejector at the top of the apparatus. As the charged crystal falls, it enters a region where a vertical electric field balances its weight. To simultaneously ensure the trap in the horizontal plane, four vertical rod electrodes symmetrically enclose the bottom center electrode. A trickle of dry nitrogen gas is channeled into a vacuum vessel to ensure a defined water vapor density. Once a particle is trapped we continuously monitor electrical and optical data to determine changes in particle size as the ice crystal slowly sublimates. We are presently in the process of taking initial sublimation rate data. The continuing project will compare these new experimental measurements with theoretical and observational benchmarks.



Yi-Hsuan Cindy Lin Personal Statement

The MUSE program has presented me with an opportunity to collaborate with a mentor, which proved to be a valuable experience. I was encouraged to voice my opinions and questions throughout the eight weeks, during which I learned the difference between an assistant and a collaborator. My work with Dr. Nathan Magee has given me great insight into meteorology, which is a field of applied physics that is often not included in the liberal physics curriculum. This opened up yet another option for me after I finish my four years here at TCNJ. Throughout the research, I also accumulated useful workshop skills such as milling, drill pressing, and lathing; the designing and building abilities will enable me to stand out as the stronger candidate for different industrial or laboratory jobs. This summer experience has really provided me with a sense of what life for a scientist is like upon graduation.

Broadening Participation in Computing via Community Journalism for Middle Schoolers
(Funded largely through a grant from the National Science Foundation's Broadening Participation in Computing (BPC) program)
Student Collaborators:
Chris Hallberg, Interactive Multimedia and Computer Science
Michael Milazzo, Interactive Multimedia and English
Kelli Plasket, Interactive Multimedia and Journalism
Julius Reyes, Computer Science
Timothy Sanders, Computer Science
Brett Taylor, Interactive Multimedia
Faculty Collaborators:
Kim Pearson, Journalism
Monisha Pulimood, Computer Science
Ursula Wolz, Computer Science
Mary Switzer, Gender Equity Specialist (Project Manager)

2009 MUSE Project

Throughout the summer, six students across various disciplines collaborated with three professors and a project manager to continue the three-year, National Science Foundation-funded Interactive Journalism Institute for Middle Schoolers (IJIMS) program. The faculty—journalism professor Kim Pearson, computer science professor Monisha Pulimood, computer science professor Ursula Wolz, and gender equity specialist Mary Switzer—designed the project to introduce middle schoolers from underrepresented populations to opportunities in computing through the use of interactive, community-oriented journalism. Several teachers and students from Fisher Middle School collaborated with the TCNJ faculty and undergraduates on a one-week summer Interactive Journalism Institute. Through the institute, the Fisher Middle School students and their teachers create an online magazine to learn computational thinking via interactive graphics, digital media, animation, video, text-based journalism and database design in a collaborative setting. Similar work is continued through an after-school program during the school year.

The six student collaborators—Chris Hallberg, junior interactive multimedia and computer science major, Michael Milazzo, interactive multimedia and English major, Kelli Plasket, senior interactive multimedia and journalism major, Julius Reyes, senior computer science major, Timothy Sanders, senior computer science major and Brett Taylor, junior interactive multimedia major—helped prep for the summer institute by significantly enhancing Café (Collaboration and Facilitation Environment, the content management system that supports the online magazine), analyzing data, creating tutorials, preparing workshops and much more. Each student also individually researched a topic of interest related to the disciplines and the project.

Kelli Plasket Personal Statement

As a double major in interactive multimedia and journalism, I appreciate the importance of understanding computer science concepts as a journalist; journalism, computers and the Web are now nearly inseparable in the digital age. In fact, the same can be said for many professions today. This project, which seeks to encourage middle school students to pursue computing-rich fields by introducing them to interactive journalism, allowed me to both contribute my own skills and learn a lot from my fellow collaborators. Some of my responsibilities during the eight weeks of the MUSE program included organizing a workshop on video editing, developing paper tutorials for the students to follow on various programs, updating the IJIMS Web site, evaluating pre and post-test data and researching the use of journalism to engage young people in the news. In particular, this summer taught me a lot about project management, collaboration and teaching/mentoring young students.

Chris Hallberg Personal Statement

It was 10th grade Chemistry, playing with TI-Basic on my graphing calculator that got me hooked on programming. Since then, I have begun pursuing a double major in Interactive Multimedia and Computer Science, and developed a killer hobby. It was that moment of discovery, like a narrative hook in my life, that drew me to the IJIMS program. Working on this program at MUSE has given me the chance to get middle school kids hooked with the desire to create with their computers and hopefully begin a hobby in computing. I designed and implemented the user interface

for the new version of CAFÉ. I also had a chance to spark the logic and imagination of these kids, by creating reference and support materials written in their programming base of Scratch that will help them grasp higher level concepts should they continue to learn programming. In return, I learned valuable teaching and leadership skills, as well as personal responsibly.

Julius Reyes Personal Statement

The Mentored Undergraduate Summer Experience (MUSE) has provided me both an opportunity and experience to work in an interdisciplinary collaboration, enhancing my skills in computational thinking applied to real world topics like interactive journalism. As one of the computer science majors this summer, I held a huge responsibility maintaining and developing the CAFÉ content management system and its servers. Also, I increased my knowledge of content management systems, web platforms, web development languages, server protocols, and software design processes. My ability to work both independently and collaboratively has also increased. Additionally, I have independently researched usability of web-based interfaces through the use of CAFÉ during our IJIMS program for middle school students, which was also a technical and personal enriching experience. My summer with MUSE has helped me broaden a lot of necessary and extra skills, both within and outside of my field of study. It has given me a good idea of the type of work or research I will be getting into in the future.

Tim Sanders Personal Statement

The research I have been doing during the MUSE program has been beneficial to me, since it has allowed me to abstract my idea of computational thinking. I have been thinking about the impact of computer science on people and societies. The fusion of journalism and computer science in our research has challenged me to think about other users and their needs when I am programming a collaborative content management system. During the eight weeks of MUSE I've had various duties, which range from designing pre and post-tests for middle school students to enhancing a collaborative journalism environment. When building this environment I've had the opportunity to research various frameworks and languages that can be used to implement the system, this caused me to think about scalability and usability when determining a proper framework. This summer was a really enriching experience that has expanded my knowledge, concepts, and applications of computing, not only in regards to computer science, but also applied to other professional fields as well.

Michael Milazzo Personal Statement

My experience as a researcher for the Interactive Journalism Institute has been an incredible opportunity for me to combine my interests while collaborating with my peers. I am a double major in Interactive Multimedia and English, and this project gave me the opportunity to do things like program in Scratch or edit video footage in the same day that I had discussions about race and gender issues. I have been treated as an equal by my student collaborators and professors, who have shown that they value my ideas and opinions. Most importantly, I have been able to apply my work with technology to try to change Race and Gender issues that affect the whole world. My collaborators and I are not only trying to teach middle school students a set of skills; we are creating a model that can effectively change the fields of computer science and journalism by.

Brett Taylor Personal Statement

I am a junior Interactive Multimedia major here at TCNJ. Coming back to this project for its second year has been a wonderful experience for me. As the only returning undergraduate, I've been able to hit the ground running and help my peers quickly get up to speed for the task we've had at hand. My major responsibility was designing and implementing a protocol for doing both quantitative and qualitative analysis of media design, computational thinking skills and computer program sophistication. I have also found that working under pressure and under the increasingly tight time-crunches requires maintaining effective management of time, a good head for prioritizing, and often bringing work home just to complete tasks by their deadlines. I have loved the collaboration that's transpired in this work environment: working with my fellow five peers has been more than just part of the job—it's really become one of the highlights of the summer. I've been finding this level of collaboration less of the usual challenge (which it is so often) and more of one of the elements that makes this project so enjoyable. Everyone has been an integral part of the program, and I have enjoyed working with all of them very much.


TCNJ