The College of New Jersey

TCNJ SURP

Summer Undergraduate Research Program

2007 Project Summaries

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Gasoline consumption and its taxation

Sean Isakower, Economics
Faculty Mentor: Dr. Subarna Samanta

2007 SURP Research

Recent increases in the price of petroleum products as well as the adverse impact on the environment from its use as a fuel has forced policy makers to search for alternative sources of energy. Unfortunately, the true cost of oil use is higher than its market price. Other hidden costs, such as increasing defense outlays, possible economic instability and the negative ecological effects increase the cost of oil use for our entire society. If the current use of petroleum products remains unchecked, it will lead to severe climatic change and/or catastrophic economic instability in future. The main focus of our research is to study the gasoline and diesel markets, and how changing fuel prices may affect consumers' vehicle preferences. We intend to analyze the impact of taxation in this regard and hope to prescribe a revenue-neutral tax plan that would shift consumer choice towards diesel automobiles capable of using bio-fuel, which is not only renewable and easily produced locally, but also friendlier on the environment.

We are conducting this study by gathering data on important economic variables related to the personal transportation market, such as the price of gasoline, the price of diesel, the number of vehicles sold and their average mileage, as well as other variables related to the industry. We intend to use multiple regression analysis to measure and identify the relationship that exists among these variables. Almost all of the data is being gathered from numerous government sources, such as the Energy Information Administration and US Department of Energy. After the data collection is complete, it will be compiled into a singular dataset that can be used in the regression analysis. We are also collecting data on vehicle properties, to determine whether a shift in consumer preference will have unwanted consequences, such as more fuel efficient, but less safe cars.

Currently, we have constructed some of the determinants of the price of gasoline and how they affect the end-user price of gasoline, and are working on how these changes can affect the purchases of vehicles. For example, historically low gasoline prices in the late 90's caused consumers to purchase a higher proportion of fuel-inefficient SUVs than they would have otherwise, leading to increased gasoline consumption and ecological damage. This research will be ongoing after SURP.

Personal Statement

I feel that I have learned much from the SURP experience. First and foremost, it has been my first experience in collecting and compiling data, instead of using pre-made datasets. I feel this experience will be useful to me, not only for my senior thesis but also for my future graduate work, as data collection and compilation is a cornerstone of econometric analysis. I felt that the weekly discussions that were held were very interesting, and some areas of study overlapped mine on a theoretical basis, such as biological trade-offs. Overall, I feel the program fostered a great academic environment, which I enjoyed and learned from.

Economic determinants of child abuse and maltreatment

John Young, Economics
Faculty Mentor: Dr. Michele Naples

2007 SURP Research

My research began with a thorough review of the existing literature on determinants of child abuse. Nearly a million reports of child maltreatment occur in the United States each year, but the vast majority of instances go unreported, especially for sexual abuse. Child abuse and neglect can have long-lasting effects for survivors in adulthood including depression, anxiety, loss of self, and post-traumatic stress disorder. These disorders will have negative consequences in the workplace. I encountered both physiological and economic studies describing either individual or aggregate data analysis. The literature pointed to socioeconomic status as being correlated with child maltreatment. Specifically, persistent poverty, family size, mental health, and condition of employment were significantly related to child abuse rates.

The data that this project is utilizing is pooled cross-section time-series (panel) data. I searched various governmental sources for information on unemployment, poverty, business failures, substance abuse, unemployment benefits, and average income. Each data set was compiled into Microsoft Excel to include all fifty states for over ten years. With some of the data, I constructed a variable to show the reduction in an individual's annual standard of living due to unemployment, the cost of job loss. Preliminary findings show that the cost of job loss lags behind the condition of the economy which will hopefully capture an abuse trigger and will be more significant than unemployment rates alone.

The future of the project will include using statistical software to determine if the data collected are significantly related child maltreatment rates. Although panel data does not show direct causality, conclusions can be drawn from the analysis. Specifically, public-policy implications from the research could find more cost effective ways of reducing the prevalence of child abuse and neglect.

Personal Statement

The SURP program has been an insightful and important experience. I have learned much about conducting economic research and how the field of economics extends into psychology and sociology. Working with the statistical and data-management software this summer will be an important skill for my future as an economist. I also have increased my ability to survey the existing literature on a specific subject using many of the resources available in print and online.

SURP has shown me possible career opportunities in economic research and has prepared me for further study in graduate school. The knowledge that I have acquired through the program is invaluable and will be of great use to me. The discussions with faculty offered unique insight into continuing education and careers in research. This program was an important part of my undergraduate studies.

Biology

The role of *ptp-3*, a protein tyrosine phosphatase, in the modulation of GLD-1 protein levels in the *Caenorhabditis elegans* germline

Mackenzie Esch, Biology
Faculty Mentor: Dr. Sudhir Nayak

2007 SURP Research

The expression of the *Defective in Germline Development 1* (*gld-1*) gene in *Caenorhabditis elegans* is restricted to cells entering and progressing through meiosis. Visible expression of *gld-1* tagged with green fluorescent protein declines rapidly in the oocytes as meiosis nears completion. It is believed that *gld-1* is expressed throughout the germline and is regulated by rapid degradation of the newly transcribed protein; consequently, it is inferred that some sort of signal initiates this degradation process. Thus, when the activity of the proteins that regulate the signal is interrupted, abnormal *gld-1* expression should result.

Post-translational modification of polypeptides is common, where alterations are made to certain amino acids after their linear sequence has been assembled. These modifications may be used to bring the protein to an active form or serve as signals for interactions with other proteins, localization to a certain area of the cell, or a plethora of other processes. *Protein Tyrosine Phosphatase 3* (*ptp-3)* is one such modifier; it removes a phosphate group from the amino acid tyrosine, a change that can serve as a signal for a certain pathway to begin. Because it is expressed in the germline, *ptp-3* may be a modifier of *gld-1* activity or levels. Since phosphorylation is a common degradation signal, it is possible that *ptp-3* is involved in ensuring adequate *gld-1* expression before the loop; conversely, *ptp-3* may remove a phosphate group integral for the stabilization of *gld-1*, thus expediting its degradation beyond the loop.

We use a technique called RNA Interference (RNA*i*) to reduce the activity of *ptp-3* and observed its affect on GLD-1 protein expression. Preliminary findings indicate that interrupting the activity of *ptp-3* leads to misexpression of *gld-1*, suggesting that *ptp-3* is involved in the degradation signal pathway of the germline protein. However, abnormal expression was not observed in the majority of worms, indicating that the RNA*i* technique requires optimization in order to bring it to its peak effectiveness for further analysis. In the future, more specific observations of the *ptp-3* RNA*i* phenotypes are needed in order to precisely deduce the function of *ptp-3* in the regulation of *gld-1*.

Personal Statement

The Summer Undergraduate Research Program has allowed me to work with my professors and fellow students in a manner that is not feasible during the academic year. I have been fortunate to have had the opportunity to further my skills and interest in research by working closely under a mentor who has encouraged me to find the answers to my own questions. The experiences in troubleshooting problems, utilizing databases for research, and presenting my findings to an audience not familiar with biological research will be taken with me as I further my academic career. Through social events, SURP granted me the opportunity to discuss my studies with other research-oriented students in an informal, comfortable setting. SURP was a unique chance to immerse myself in research and I believe it is an essential component of TCNJ's mission of promoting undergraduate research.

The role of microtubules in patterning the dorsal-ventral axis of the *Drosophila melanogaster* egg

Jing Jing Feng, Biology
Faculty Mentor: Dr. Amanda Norvell

2007 SURP Research

This summer I worked in Dr. Norvell's lab with Carolyn Gray. Our lab is primarily interested in the asymmetry of cells and how that asymmetry is established, specifically in *Drosophila melanogaster* oocytes and eggs. The most recent project I have worked on seeks to investigate how cytoskeletal elements in the oocyte cytoplasm affect the asymmetry of both individual oocytes and eggs. Within the oocyte, a polarized microtubule (MT) network is arrayed with its termini present at opposite ends of the oocyte. Several determinants, including the oocyte nucleus and specific mRNAs, are localized within the oocyte cytoplasm by transport along this MT network. Our lab has studied the localization of a specific mRNA, *gurken* (*grk*), during oogenesis. *grk* mRNA is localized to the dorsoanterior corner of the oocyte, in a perinuclear position, during the later stages of oogenesis. Several proteins are required for this localization pattern, including the RNA binding protein Squid (Sqd). My project set out to test whether Sqd protein localization within the oocyte also requires this properly polarized MT network. To do this experiment, we used *Drosophila* stocks carrying a version of Sqd protein that is tagged with Green Fluorescent Protein (GFP). This Sqd-GFP protein fluoresces and its distribution can be monitored by microscopy. Female flies expressing Sqd-GFP were fed the MT depolymerizing drug colchicine for varying times, ovaries were isolated, and Sqd protein distribution was monitored. In untreated ovaries, Sqd-GFP is found in the oocyte nucleus and in a crescent at the posterior pole of the oocyte cytoplasm. After treatment with colchicine, Sqd-GFP protein is still localized to the oocyte nucleus, but it is not found at the posterior pole. This suggests that the nuclear localization of Sqd protein does not require MTs, but the posterior accumulation of Sqd protein does. Additionally, in these experiments we also observed that the position of the oocyte nucleus in the dorsal anterior corner of the oocyte is dependent on the MT network. In oocytes from colchicine treated females, the oocyte nucleus was detached from the anterior cortex. We observed that the nucleus became detached from the cortex in many of the colchicine treated flies. In addition, it was discovered that there may be a direct correlation between time exposed to colchicine and distance in which the nucleus was displaced. In the future we plan to test how the position of the oocyte nucleus affects *grk* mRNA localization.

Personal Statement

This experience has not only taught me to manage an experiment over the course of several weeks, but also to plan and divide work between my partner and me, and to troubleshoot unforeseen problems in the lab. My participation in research has given me a new found appreciation for the time and effort that goes into producing usable data. In addition, I now have the confidence to seek other lab positions in the future. Finally, as a participant for a second time, I really enjoyed the new interdisciplinary aspect of the program. It was very interesting to listen to the variety of studies each department had in progress, and the lunch discussions were a great opportunity to learn more about the world of research outside of our own laboratory.

The role of the microtubules in *gurken* (*grk*) mRNA localization during *Drosophila* oogenesis

Carolyn Gray, Biology
Faculty Mentor: Dr. Amanda Norvell

2007 SURP Research

My summer research focused on oogenesis in the fruit fly, *Drosophila melanogaster*. We were specifically interested in studying factors leading to normal eggshell asymmetries. The signaling protein, Gurken (Grk), is critical in establishing the dorsal-ventral axis of the developing *Drosophila* oocyte. The restricted distribution of Grk protein is achieved through the localization of its mRNA. *grk* mRNA is normally localized in the dorsoanterior corner of the oocyte, just behind the oocyte nucleus. Several factors are required for the correct localization of *grk* mRNA, including the proteins Squid (Sqd) and fs(1)K10. In flies carrying mutations in these genes, *grk* mRNA is mislocalized to a ring at the anterior cortex of oocyte. To test the role of microtubules and nuclear positioning in *grk* mRNA localization, we disrupted the microtubules by treatment with colchicine (50μg/mL), a microtubule-depolymerizing drug. Female flies were fed colchicine for varying times and their ovaries were isolated. *grk* mRNA localization was measured by *in situ* hybridization after 18 hours of colchicine treatment. In colchicine treated ovaries the position of the oocyte nucleus was affected, with the nucleus falling away from the anterior cortex of the oocyte. However, despite the incorrect position of the oocyte nucleus, in wild type flies, *grk* mRNA remained associated with the mispositioned nuclei. In contrast, however, we found that in *squid*^{1} and *fs(1)K10* mutant flies, *grk* mRNA did not stay with the oocyte nucleus but was spread diffusely throughout the oocyte cytoplasm. This novel experiment reveals the requirement of Squid and Fs(1)K10 in *gurken* localization to the nuclear cortex, which thereby properly establishes the dorsoventral axis of developing *Drosophila* oocytes. Future studies will examine the presence of a microtubule basket surrounding the nucleus and determine whether or not nuclear attachment to the anterior corner is required for proper translation of *grk* mRNA into Grk protein; different isoforms of the Squid gene will also be studied for their specific role in the rescue of the mutant phenotype found in this work.

Personal Statement

The Summer Undergraduate Research Program at TCNJ has been very rewarding. It provided a solid introduction to laboratory research in a comfortable environment. The Biology staff has been amazing and played a key factor in the success of this program. Student-faculty breakfasts were held once a week, where our progress was discussed; we also had faculty barbeques, which lent an opportunity to personally get to know professors in the department. Chances to interact with the faculty on various levels and perform independent work under their instruction allowed students to mature as not only scientists, but as individuals as well. The relationships formed through collaboration with faculty and peers foster a greater understanding of scientific research; this is the hallmark of the summer research program at TCNJ. I am a rising senior at The College, and this program has inspired me to pursue a graduate degree in Biology. I am grateful to Dr. Norvell for such an enlightening experience.

Determining genetic variation of white-tailed deer populations in New Jersey throughout time

Krysta Johns-Harris, Biology
Faculty Mentor: Dr. James Bricker

2007 SURP Research

The population of White-Tailed Deer in New Jersey was close to extinction around 1900 due to excessive hunting. To replenish the deer population, deer were brought from Pennsylvania and released in New Jersey. Since then, the deer population has increased greatly. The purpose of this study is to determine the genetic variability between deer from before 1900, during the 1960's and presently in New Jersey. We are determining genetic variability between populations using microsatellite loci. Microsatellites are segments of DNA with repeated sequences. Over a period of time, a population will develop a variety of characteristic microsatellites that are specific for that are distinct from other populations.

This summer my research partner and I successfully extracted DNA from 69 present day White-Tailed Deer samples. All samples were amplified using Polymerase Chain Reaction (PCR) and then agarose gel electrophoresis was used to determine the size of the amplified DNA from each sample. Each sample had a PCR product of around 160bp. We are in the process of using a DNA sequencer to discover the sequence of the PCR products. These results will be compared to samples from before the 1900's and during the 1960's. Deer skulls and antlers from before the 1900's and during the 1960's will be obtained from museums.

Personal Statement

I feel extremely fortunate to be a part of the Summer Undergraduate Research Program (SURP). Being involved in research taught me things that I cannot learn from a textbook. I have become skillful in extracting DNA from animal tissue, Polymerase Chain Reaction, and gel electrophoresis. Not only did I learn procedures, but I also learned life lessons. I have become more meticulous, patient and determined. I have had to troubleshoot many times while working in lab, and I have gained so much confidence in my abilities to solve problems. SURP was my first research experience and I felt extremely comfortable in the supportive lab environment created by my research professor. One of my favorite parts of this research experience was the lunch discussions. I was able to learn about other research projects in different subjects that my peers felt passionate about. I feel the lunch discussions also provided students across different departments to socialize and build relationships with all the students who participated in SURP. Overall, I feel as if SURP was a very positive experience. I have learned many things throughout this summer that I am sure will benefit me not only in my future academic goals, but also in life.

Development of small molecule proteasome inhibitors

Jim Hayes, Biology
Faculty Mentor: Dr. Sudhir Nayak

2007 SURP Research (funded by a Merck/AAAS grant)

Merck and AAAS have funded a three year grant at The College of New Jersey to develop small-molecule inhibitors of the proteasome. The proteasome is a large multi-protein complex which is found in the nucleus and cytoplasm of eukaryotes and whose main function is to break down damaged and unneeded proteins. Past research using RNA mediated interference (RNAi) in *C. elegans* has shown that certain genes, such as *pbs-4* (*Proteasome Beta Subunit*), are vital in the normal function of the 26S proteasome. Disruption of such genes results in a proteasome with altered function, therefore leading to improper breakdown of proteins and abnormal gene expression patterns. We are working to get similar divergent phenotypic expression by exposing *C. elegans* to various synthetic small-molecule proteasome inhibitors, rather than inactivating their proteasomes via RNAi.

My project focused on identification of small molecules that result in the mis-expression of a germ-line protein GLD-1 (defective in *Germ Line Development*) tagged with GFP (green fluorescent protein). GLD-1 is an RNA binding protein that is integral in development of the germ-line in *C. elegans*. The GFP allows us to visually observe where the tagged protein is being expressed throughout germline development. The GLD-1 protein is normally degraded prior to oocyte development, releasing the bound RNA and allowing for the formation of oocytes. However, when the proteasome is inactivated by means of RNAi, GLD-1 is not broken down at the proper location and is expressed beyond its normal range, resulting in the production abnormal oocytes.

As a first step towards our goals, a detailed analysis of phenotypes that result from loss of proteasome function is required. Consequently, I have worked this summer to document the divergent expression patterns of GLD-1 when the proteasome is inactivated via RNAi. Future work on this project will use my findings to gauge the efficacy the new, synthetic proteasome inhibitors developed by the Chemistry Department.

Personal Statement

I have greatly enjoyed working in the Summer Undergraduate Research Program and I am convinced that this was one of the most beneficial things I could have done with my summer. This program was an excellent opportunity to be immersed in the world of research, including doing actual lab work, conducting background research, troubleshooting problems, presenting current progress, and working collaboratively with other researchers. One of the best aspects of my summer experience was building and strengthening the relationships with the faculty in the Biology Department. I felt as though we were all treated as research colleagues, having valid thoughts and opinions. My work was not trivial and irrelevant, but rather it had worth and merit and was respected by the department. I can honestly say that my participation in SURP has been one of the most valuable experiences I have had while at The College of New Jersey. It has shown me that I seriously do enjoy research, but more importantly, it has strengthened my resolve to continue my studies for a post-graduate degree.

Genetic variation within and among species of freshwater mussel, *Elliptio complanata*, in the Delaware, Raritan, and Susquehanna Watersheds

Jaclyn Kahn, Biology
Faculty Mentor: Dr. Curt Elderkin

2007 SURP Research

The preservation of genetic variability is imperative to the long-term survival of freshwater mussel populations. The absence of genetic variation has been linked to extinction and limits a population's ability to adapt in the face of changing environments. Worldwide, freshwater mussel families *Margaritiferidae* and *Unionidae*, diverse components of North America's freshwater ecosystems, are imperiled. In North America, 70% of mussel taxa are either endangered, threatened, or of special concern. Genetic variability is pertinent to analyze because the absence of genetic variability would suggest that habitats in the Susquehanna River and its tributaries are vulnerable to a loss of biodiversity. Collecting and analyzing genetic data from *E. complanata* could lead to an informed conservation recommendation for the habitats. Currently we have collected genetic data from 32 individuals and from three watersheds (Susquehanna, Delaware, and Raritan). Sixteen DNA samples were randomly selected from the thirty individuals found at each of the sampled sites. The cytochrome oxidase subunit one (CO1) mitochondrial gene (~600 base pairs) was amplified due to its proclivity to genetic variability within populations. Subsequent to PCR amplification, individuals were sequenced using CEQ-800 (Beckman Coulter Inc.) protocols. The objectives of my current project were: 1) to locate and document existing populations of *E. complanata* and all other mussel species populations found in the area of the Susquehanna Watershed; 2) to take a 100mg sample of mantle tissue extracted from 30 individuals at each site for further genetic study; 3) to randomly select 16 individuals from each of the sites to be analyzed and compared to the genetic data on *E. complanata* populations of the Delaware and Raritan Watersheds. These objectives will enrich our understanding of the biodiversity of freshwater mussel populations in the in the Northeastern United States and will provide genetic support to generate possible conservation decisions for the Susquehanna, Delaware, and Raritan Watersheds.

Personal Statement

The SURP program here at TCNJ has expanded my horizons in the field of scientific research. The program not only allowed me to interact with my fellow researchers, but it also supplied me with fun activities and forums for academic discussion. Wednesday breakfasts were a great opportunity to discuss research goals and get to know the other biology researchers. Field research was also introduced to me this summer, providing me with a deeper understanding of my research and adding a prospective to my research goals. I hope that this firsthand look at the rivers we sampled will help me better understand my research results. Troubleshooting was one of the most important skills I learned this summer in both field work and lab work. In both aspects we encountered difficulties, yet we were able to work together to get around them by employing new techniques or simply trying another sampling site. Overall, I loved being here this summer and would love to be a part of the program again in the future.

Phosphorylation regulates Barrier-to-Autointegration Factor (BAF) function during nuclear assembly

Jason Lei, Biology
Faculty Mentor: Miriam Segura-Totten

2007 SURP Research

During cell division, the nucleus is initially disassembled (taken apart), and later reassembled (put back together). Barrier-to-Autointegration Factor (BAF) is a DNA-binding protein that is involved in the process of nuclear assembly. BAF also binds to the LEM domain family of inner nuclear membrane proteins. Thus, BAF mediates the interaction between our genome and the nuclear periphery. A phosphate group is attached to BAF at three different amino acids (threonines 2 and 3 and serine 4) by a protein called VRK-1. Phosphorylation blocks BAF's interaction with DNA and weakens its binding to LEM proteins.

We hypothesize that BAF is phosphorylated at the start of mitosis, resulting in the release of both chromatin (the complex of DNA and the proteins that package it) and LEM proteins. Furthermore, we propose that release of DNA and LEM proteins by BAF facilitates the dismantling of the nucleus. We hypothesize that during reassembly of the nucleus, phosphates are removed from amino acids 2, 3, and 4 in BAF, which allows it to bind DNA and LEM proteins. This, in turn, leads BAF to recruit membranes (through the LEM proteins) to chromosomes. To test these hypotheses, we added mutant BAF proteins that could not be properly phosphorylated to *Xenopus laevis* nuclear assembly extracts. Using this system, nuclei can be assembled independently without the need for a cell. We found that nuclei assembled in the presence of a BAF protein in which all three phosphorylation sites are blocked (MAAAQ) did not grow to full size and had condensed chromatin. These results suggest that phosphorylation of BAF is necessary to allow nuclei to grow and chromatin to decondense (or open up) during nuclear assembly. Assembly of nuclei in the presence of low concentrations of wild type (normal) BAF leads to enhanced nuclear growth and chromatin decondensation. Blocking BAF phosphorylation at threonines 2 and 3 results in a loss of these activities, suggesting that modification of these amino acids is important in the regulation of BAF activity during nuclear assembly. Currently, we are using transmission electron microscopy to examine the effects of assembling nuclei in the presence of our BAF mutants in more detail.

Personal Statement

The summer undergraduate research program was a fantastic experience because it combined the excitement of science, discovery, and lab work with the enjoyment of exchanging ideas with researchers from other disciplines. For instance, I enjoyed the social aspect of SURP because these activities gave me the chance to interact with other students and faculty from my department as well as from other departments. The SURP research program broadened my horizons and made me a better research student. The most rewarding aspect of the program was working with my faculty advisor full time because I learned so much in such a short period of time. For example, I learned many techniques commonly used in molecular biology including PCR, mutagenesis, and SDS-PAGE. For all of the above reasons, I highly recommend SURP to TCNJ students.

Assessing the impact of the Assunpink Creek Greenway Project

Andrew Máthé, Biology
Alex Rass, Biology
Faculty Mentor: Dr. Curt Elderkin

2007 SURP/NCUR Research

The Assunpink Creek bisects Trenton, N.J., a post-industrial city that is having difficulty raising its economy following the collapse of its industrial base. The creek itself wanders westward into the city through some highly developed areas, but also has designated wildlife areas, and is even dammed to form a recreational lake. However, within the city limits of Trenton it is lined with brownfield sites, and its natural surrounding habitat (the riparian zone) is non-existent inside the city. Bioremediation is a cost-efficient method for rehabilitating contaminated soils and groundwater. Therefore, remediating brownfields can help improve the quality of aquatic systems as well as their surrounding terrestrial habitats. A recent report by the Delaware Valley Regional Planning Commission revealed that within the city of Trenton, water quality was extremely poor probably due to industrial and wastewater contributions. Specifically, the report finds the presence of chemicals that are pharmaceutical in nature, along with high levels of lead, nitrates, phosphates, and fecal coliform bacteria. While pH and dissolved oxygen levels were within acceptable range, wide swings in the dissolved O_2 poses a threat to aquatic organisms. This led to the institution of the Assunpink Creek Greenway Project, a multi-township project which aims to restore the Assunpink riparian zone in Trenton and in surrounding townships, the goal being to subsequently provide natural protection from flooding, improving water quality, and create recreational opportunities for local residents. Although three-quarters of the streamside land is undeveloped, urbanization still threatens the twelve rare or endangered species that inhabit the area. Additionally, flooding continues to be a problem in Trenton. Despite the relative success of the Greenway Project, it has unfortunately failed to encompass the city of Trenton, which is the most distressed region of the stream. Although the project initially succeeded in improving local water quality, visible progress has since declined significantly.

Personal Statement – Andrew Máthé,

During the summer research experience I have been part of two very different projects. First and foremost, in the project targeting issues in Trenton I participated in a cross-disciplinary forum that is seldom encountered by undergraduates—or most professionals. I enjoyed the opportunity to apply my critical thinking skills to the present circumstances of the city. I became involved in the restoration of urban aquatic habitats, and absorbed an enormous amount of information about the causes of urban poverty. Second, field sampling has provided a clearer context for the investigation into the population genetics of freshwater mussels, which I will be continuing with Dr. Elderkin throughout the course of the upcoming academic year. I can now conceptualize the expansive geographic region that constitutes the foundation of our work, and envision the passage of thousands of years and the countless geological events that have contributed to the structure of the populations we encountered. These locations are no longer merely

names—they are identified with vivid memories that inspire rumination over the intricate mechanisms underlying the evolutionary process.

Personal Statement – Alex Rass

Starting my first summer after finishing freshman year working with a professor on a research project was a great way to begin my college career. The NCUR/Lancy project put together several different disciplines, mine being the biology portion, to see where Trenton was going and it turned out to be a great opportunity to learn about what was happening with a city so close. Being with other professors that love their work so much and students that are also very interested in it helped me understand Trenton's problems. The Assunpink Creek, being the main concern of my own part of the project, turned out to be an extremely polluted waterway from our research. When we went to see the actual creek, the concern was even greater, as we saw everything from shopping carts to pieces of scrap metal on the river bottom. Part of our summer project included the sampling of freshwater mussels, my research mentor's main area of research along with my following year's independent study. During our field studies, we learned to identify and sample populations of mussels in several streams and tributaries. By comparing the DNA of these mussels, we may be able to provide some conservation suggestions to help improve many river systems.

Investigating homologs of the *squid* gene during zebrafish (*Danio rerio*) embryogenesis

Anjali Mone, Biology
Faculty mentor: Dr. Marcia O'Connell

2007 SURP Research

Our lab is interested in early embryogenesis in zebrafish. In particular we are investigating maternal factors because these are responsible for regulating early patterning events before embryonic genes are activated. In order to identify important regulatory factors, one approach that has been successful has been to identify products of genes that are important in invertebrates and find homologs of these genes in vertebrates. One maternal factor that is important in *Drosophila* is the product of *squid* gene. *Squid* is responsible for forming the dorsal side of the embryo in *Drosophila*. Since *squid* has been found to be critical in early patterning events in flies, it is possible that a homolog of *squid* could play an important role in zebrafish development. We started by attempting to clone a homolog of *squid*. Subsequently, we began experiments to determine the function of the *squid* homologs in zebrafish. Through RT-PCR we have found that this homolog is expressed in fish. Restriction digest was performed in which the gene was cut at a specific point in its sequence. We are also testing to see if *squid* protein is present in fish through western blots. Currently we are trying to assess the function of *squid* in zebrafish with morpholinos in which we essentially "knock out" a particular gene. In future experiments we would like to clone the *squid* homolog and sequence it. We will also determine if *squid* is strictly expressed during embryogenesis or if it is also present in the adult as well.

Personal Statement

As I introduced myself to the summer research students for the third summer, I am asked the difficult question of why I keep coming back. I thought back to my first summer in the summer undergraduate research program and how nervous I had been. Although I had some understanding of PCR and gel electrophoresis, I found that nothing in my genetics book would prepare me for the excitement that came with seeing bands on a gel. I found that as a learning student I was bound to have my fair share of broken beakers and hardened gels, but the few times that I was able to figure something out on my own made the experience worthwhile. What I really enjoyed about the research was not the science aspect of the research but the friends and contacts I made. I thought back to my birthday and how they had surprised me with a trip to Philly. I also remembered all of those trips to the beach, canoeing, berry picking, movie nights, barbeques, bowling and even those times we made dinner together. After a long pause, I smiled and answered the question about what aspect of SURP kept my interest with the short but complete answer, I knew it would be another productive and more importantly, an enjoyable summer.

Changes in Na^+-K^+, ATPase expression and activity in the blue crab *Callinectes sapidus* in response to an increase in environmental salinity

Stacey Novello, Biology
Faculty Mentor: Dr. Donald Lovett

2007 SURP Research

The blue crab *Callinectes sapidus* lives in an estuarine environment and must be able to adapt to the changing salinity of the seawater in this habitat. The crab adjusts to this changing salinity through osmoregulation, the maintenance of a constant blood salinity. Osmoregulation takes place mainly in the crab's gills via an enzyme called Na^+,K^+-ATPase. Na^+,K^+-ATPase actively pumps salt from the surrounding seawater into the crab's blood. This summer we have been studying how the gene expression and activity of Na^+,K^+-ATPase is affected when a crab is transferred from a low salinity environment to a high salinity environment. We have studied crabs that were acclimated to low salinity and were then transferred to high salinity seawater for varying time periods ranging from 12 hours to 18 days. In order to study these changes, we first extracted and homogenized gill tissue from the crab. The RNA content and enzyme activity of each sample were then analyzed. The RNA samples were reverse transcribed and the DNA was then amplified using primers specific for the gene coding for Na^+,K^+-ATPase. In order to measure the expression of this gene we used quantitative polymerase chain reactions. The enzyme activity was measured using a spectrophotometer in order to determine the activity level of the enzyme through the comparison of two samples, one with the Na^+,K^+-ATPase inhibitor ouabain, and one without the inhibitor. We hope to determine the specific effects of the transfer from a low salinity to a high salinity environment on the expression and activity of Na^+,K^+-ATPase and over what time period these changes take place.

Personal Statement

This experience with summer research has been very valuable to me because it has allowed me to get first hand practice with real scientific techniques and procedures. It has provided me with a better look at what it means to do real research and has allowed me to personally contribute to the ever growing body of scientific knowledge. These are experiences that one cannot gain from just passively learning about biology in the classroom. It has also allowed me to gain helpful insight into what I would like to do after completing my undergraduate degree. In addition to the academic opportunities the SURP program has made available to me, it has also allowed me to interact with the faculty on a more personal level through weekly breakfasts and the occasional barbeque.

Optimizing direct polymerase chain reaction (PCR) for germinated *Sporisorium ellisii* teliospores, mycelial ball cultures, and fragments

Emily Nowicki, Biology
Faculty Mentor: Dr. Janet A. Morrison

2007 SURP Research

This summer my lab group continued our study of the grass *Andropogon virginicus* and the smut fungus *Sporisorium ellisii*, which infects populations of *A. virginicus* on the east coast. On the west coast, this plant has eluded infection by *S. ellisii*. The plant is classified as introduced in California and invasive in Hawaii. In order to analyze the differences between *A. virginicus* populations, data must be recorded from each plant previously collected by Dr. Morrison. This summer, I continued with this large scale project of processing each plant. In addition, I collected data for an ongoing experiment in the greenhouse, studying the Evolution of Increased Competitive Ability hypothesis.

One of the primary goals of our lab is to study the genetic differences of this fungus within a single plant, within a population of plants, and among populations of plants. Currently, in order to obtain a genetic marker whose DNA can be sequenced, *S. ellisii* DNA must first be extracted from the teliospores of infected plants. This process is very time consuming, requires a large sample of spores, and could potentially become costly when done on a large scale. Designing and optimizing a new method (direct PCR) to use genetic markers without first extracting *S. ellisii* DNA is very desirable, and this effort has been my primary focus this summer.

The protocol I have developed begins with spreading sterilized teliospores on plates of agar. Germinated teliospores are then plucked from the plate after 24 hours, using an inverted microscope and a platinum tipped tool, and placed directly into PCR reaction tubes to amplify a specific sequence of DNA. The reaction products are run on agarose gels and bands of DNA are visualized with a computerized imaging system. Replicates of single spores, three spores, and six spores were run multiple times to test this procedure, with a 50 to 60 percent success rate. Germinated teliospores also were transferred to new plates and incubated for seven to ten days and then transferred into flasks of nutrient broth. These mycelial ball cultures were grown for a week, individually centrifuged, diluted and used in PCR. Mycelial fragments were also centrifuged and diluted and used in PCR. Both of these procedures yielded bands of DNA nearly 100 percent of the time. This research will continue throughout the next academic year. Ultimately, Dr. Morrison and I hope to publish a note about these new techniques of direct PCR on fungal spore germlings and mycelium.

Personal Statement

This program has been a very positive and educational experience for me. I learned new and extremely useful lab techniques, such as PCR and electrophoresis, and ways to troubleshoot the many problems a research scientist encounters. I have also built stronger relationships with the Biology professors, as well as my colleagues in my department. I feel that the many social opportunities, including the frisbee games and the bi-weekly lunches and tea hours really ameliorated this program.

Mapping the binding region for histone H3 on Barrier-to-Autointegration Factor (BAF)

Kimberly Parks, Biology
Faculty Mentor: Dr. Segura-Totten, collaborating with Dr. Hirsh, Chemistry Department

2007 SURP Research

A cell's genome, or its DNA, is organized within the nucleus to determine what genes will be "expressed" to produce proteins, the molecules that perform most of the work inside the cell. The complex formed by DNA and the proteins that attach to it is called chromatin. Barrier-to-Autointegration Factor (BAF) is a DNA-binding protein that helps to organize chromatin and regulate gene expression. BAF binds to histone H3, one of the proteins that bind to DNA and compact it to form chromatin. There are five types of histones: H2A, H2B, H3 and H4, which work together to wrap the DNA into a structure called a nucleosome, and H1, which "links" different nucleosomes to form the thick DNA fibers that make up chromatin. The specific region on BAF where histone H3 binds has not been clearly determined. Mapping where on BAF histone H3 attaches will shed light into the nature of the interaction between these two proteins, and will help us form hypotheses about the implications of BAF binding to histones on chromatin structure and gene expression.

To determine where on BAF histone H3 binds, a marker called a spin label is attached to the amino acid cysteine in particular regions of BAF. This spin label rotates freely in solution but its movement is restricted if it is found near a protein. If the spin label is located in a region of BAF where histone H3 binds, then the spin label rotation will be slower than that of the free label in solution. To ensure that BAF only contains one site for spin label attachment, the DNA encoding for BAF must be changed (or mutated) to remove all the endogenous cysteines. Then, the BAF DNA is mutated once more to insert a cysteine amino acid at a particular region. This process is repeated to produce DNA encoding for different BAF proteins, each with a single cysteine in a different region of the protein. We then introduce each DNA into bacterial cells, which are induced to produce BAF protein. The BAF protein purified from bacteria is used in spin-label studies of BAF binding to histone H3. This summer, I designed the mutations to remove endogenous cysteine amino acids in BAF and to introduce new cysteines. I also purified wild type (non-mutant) BAF for preliminary spin labeling experiments done by Dr. Hirsh's research group in the Chemistry Department. I am currently creating the mutant BAF DNA for protein expression. Once purified, this protein will be used in spin-labeling experiments to determine the binding region on BAF of histone H3.

Personal Statement

Though textbooks are irrefutably one of the most important tools in education, the skills and knowledge essential in the laboratory can only be grasped through experience. I have learned lab techniques that I will be using throughout my career, from electrophoresis, to mutagenesis, to chromatography. Faculty and students alike have also enlightened the path that an undergraduate needs to take to prepare for graduate school. The summer research program has undoubtedly enabled me to familiarize myself with laboratory protocols and interact with faculty and peers in a manner far removed from the strict guidelines and limitations of a classroom.

Isolation and amplification of microsatellite loci in white-tailed deer

Dipen Patel, Biology
Faculty Mentor: Dr. James V. Bricker

2007 SURP Research

Microsatellite DNA is short tandem repeated sequences of DNA (ex: CGCGCG) found in the non-coding regions of DNA. This DNA is then passed onto future offspring of an organism. Diploid organisms will each hold two homologous copies of a certain microsatellite DNA. A female with 13 and 12 repeating units mated with a male with 14 and 11 repeating units may produce offspring with a variation of genotypes. Each offspring will inherit one of the repeating unit alleles from each parent. Sometimes the replication of such repetitive sequences may cause DNA polymerase to slip, which results in the deletion or addition of extra repeating units. Over time, a diploid population may contain unique microsatellite DNA sequences as compared to a population of the same species that do not interbreed. This change in microsatellite frequency allows for the analysis of population changes over time.

Microsatellite DNA can be detected through the process of polymerase chain reaction (PCR). This summer my partner and I were essentially in charge of extracting DNA from 69 deer samples. At this point all 69 deer samples have been extracted. These procedures can be used to observe the changes in deer populations in the northeast. About a century ago the deer population in New Jersey was almost extinct due to the actions of humans. To resolve this problem, 100 deer from Pennsylvania were imported into New Jersey and released throughout the state. Only until recently has the deer population bounced back from such a low. Observing microsatellite DNA samples from various deer specimens from different time periods can truly show the change the deer population has gone through in the state of New Jersey. Specimens from the 1900s, 1960s, and present day have been obtained in order to extract and analyze the various microsatellite DNA sequences of each population of deer. During the school year I will be locating these specific microsatellite sequences.

Personal Statement

Research at TCNJ has taught me many things. First, I learned about basic lab techniques such as DNA extraction and amplification through PCR. I have learned about these procedures in Genetics and other biology classes, but never had a chance to perform these procedures first hand. Furthermore, I have learned how to solve problems in an investigative manner. When something went wrong all possible areas had to be analyzed to indicate the exact part of the procedure that was performed incorrectly. This experience has led me to be more a more attentive person to all things in which I partake. Overall, I feel that this experience has trained me to learn from previous failures. Several times, extracting DNA would not work and would have to be redone. This has helped me learn that not everything can be done to work out 100% efficiently, but through meticulous analysis of what I did I realized my mistake and did not make the mistake again.

Investigating homologs of the squid gene during zebrafish (*Danio rerio*) embryogenesis

Swapnil Patel, Biology
Faculty Mentor: Dr. Marcia O'Connell

2007 SURP Research

Our research is based on the gene, *squid* (*sqd)* found in fruit flies (*Drosophila melanogaster*). Innovative research conducted by Dr. Amanda Norvell and her colleagues has demonstrated the integral role of *sqd* and its resulting protein products on fly embryogenesis. The gene *sqd* is alternatively spliced yielding three different isoforms called SqdA, SqdB, and SqdS. Sqd is a heterogeneous nuclear RNA-binding protein, hnRNP, a class of proteins that bind to RNA to carry out their functions. Specifically, Sqd proteins bind to gurken (*grk)* mRNA and influences the localization and translation of it. The production of Grk protein, which acts as a ligand to the epidermal growth factor receptor (Egfr) of follicle cells surrounding the oocyte, stimulates the generation of a distinctly dorsal side. In the context of our research, we are investigating whether a gene similar to *sqd* exists in the zebrafish genome. We are currently investigating potential homologs, their sequence, function, in what tissues they are expressed and their role in vertebrate development.

This summer we examined two zebrafish genes that most closely matched *sqd* in nucleotide sequence. These gene sequences are called *hnRNP A/B* and *Predicted Protein* and we hypothesized that their proteins must function similarly to Sqd. To test our hypothesis and gather evidence to support it, we conducted a series of experiments. First, we extracted and purified mRNA and demonstrated through RT-PCR that both genes are expressed during embryogenesis. We also extracted proteins from the embryos and are currently examining the collected protein via Western Blots. In addition, we are investigating the function of the Predicted Protein and hnRNP A/B proteins via morpholino injection to prevent their synthesis in live embryos.

Personal Statement

The Summer Undergraduate Research Program (SURP) has been a truly inspiring experience for me as a rising Sophomore Biology student at The College of New Jersey. Just stepping into the lab and becoming adjusted to its atmosphere is advantageous for those students who are likely to pursue graduate school. After obtaining unexpected results and attempting to troubleshoot, I learned how to approach a problem and using my knowledge, find the solution. Of course, the SURP experience is more than just the laboratory work, it is also an opportunity to meet other students who share my interests. The social aspect of the program not only makes the experience more enjoyable but also instills a sense of camaraderie among the participants especially with the relaxing weekly get-together events offering free food. So, for me SURP was intellectually stimulating, fun, and not to mention the personal gratification of contributing to a worthwhile endeavor where my efforts can make a difference.

Development of PCR markers for diagnosing *Sporisorium ellisii* infection within populations of *Andropogon virginicus*

Artur Romanchuk, Biology
Faculty Mentor : Dr. Janet A. Morrison

2007 SURP Research

Natural populations are not found as collections of individuals, but rather as complex communities based on mutual interactions. One class of such interactions is the relationships established between pathogens and their hosts. We work to understand such interactions between a parasitic smut fungus, *Sporisorium ellisii*, and its grass host, *Andropogon virginicus*. These species are native to the eastern United States, where *A. virginicus* occupies old fields undergoing early succession. *Sporisorium ellisii* infects the ovaries of its hosts, replacing the plant's future seeds with its own progeny (teliospores). Infection is asymptomatic until it can be identified by inspecting the host plant during early autumn, when healthy plants normally display seeds.

In order to continue our work regarding interactions of *A. virginicus* and *S. ellisii*, we needed to develop a reliable method to diagnose infection. Polymerase chain reaction (PCR) is used routinely to amplify known segments of DNA, and this ability can be used to identify trace amounts of specific DNA sequences within a larger sample of DNA. We seek to use PCR technology along with suitable primer markers to identify fungi-specific DNA within a host plant's DNA extract, which would prove to be a reliable diagnostic tool.

During Summer 2007 we concentrated on primer design and optimization of PCR reaction conditions. Initially we screened fungal and plant DNA samples with universal ITS primers, which identify a particular stretch of moderately variable non-coding DNA within the gene for the small ribosomal subunit. These initial screens proved to be unproductive. We also screened fungal and plant DNA with a version of the ITS primers that are more specific for the group of fungi to which *S. ellisii* belongs, the Basidiomycetes. This proved to be much more successful. We have shown that the basidiomycete-specific primers produce a signal from fungal DNA template, and do not produce one from *A. virginicus* DNA template. Future investigation will focus on further narrowing the signal producing range of this molecular marker to amplify only with *S. ellisii* DNA and not other fungi. This will allow rapid and accurate diagnosis within field conditions, and promote further investigation of host-pathogen interactions within this study system.

Parallel to the molecular work, I shared in the care of experimental and stock plants in the greenhouse, and collected size data on plants from a US-wide sample of populations.

Personal Statement

Summer SURP 2007 has proved to be an invigorating experience into the world of real research. I have been able to further understand how academic research is carried out on day to day basis, and fine-tune my own hopes and desires for the future. As well as receiving great guidance from my mentor, other faculty members, and my undergraduate colleagues, I also was able to foster my independence in developing and testing ideas.

Analysis of GLD-1 Protein Turnover in the Germline of *Caenorhabditis elegans*

Natalie Stabenow, Biology
Faculty Mentor: Dr. Sudhir Nayak

2007 SURP Research

The purpose of this summer's research is to study germline development in the nematode *Caenorhabditis elegans (C. elegans)*. The two sexes of *C. elegans* are hermaphrodites and males. Hermaphrodites produce both sperm and oocytes and can thus self-fertilize, while males produce only sperm and must mate with a hermaphrodite. We are interested in an RNA binding protein called GLD-1, which stands for *defective in Germ Line Development*. This protein is expressed in the germline and is part of a multi-protein complex that controls various aspects of reproduction and cell proliferation in hermaphrodites. A transgene of green fluorescent protein (GFP) coupled to the GLD-1 coding region allows us to study altered levels of GLD-1 expression under UV light.

The focus of my project is to determine how GLD-1 protein levels are regulated in the germline. A particular area of interest is the mechanism of degradation, which may possibly be by the addition of ubiquitin to GLD-1. The 26S proteasome, a complex that degrades tagged proteins, would then recognize the ubiquitin and degrade the protein. In normal worms, degradation of GLD-1 occurs prior to the onset of oocyte development, and the expression of GLD-1 drops after this stage. However, in worms that have mutations in proteins in the same complex as GLD-1, expression continues past this stage and results in decreased or no production of offspring. I have focused on optimizing techniques necessary to study these interactions and modifications this summer, and am preparing to conduct experiments to explore these possibilities. My research will be continued throughout the year as an independent study, and I look forward to collecting data.

Personal Statement

Summer research with Dr. Nayak in the Summer Undergraduate Research Program has been one of the most valuable experiences I have had. Guidance from my mentor allowed me to explore my project independently, and strengthened my laboratory skills and knowledge. The overall atmosphere in the program was very conducive to learning, and professor-student interaction reached a level that is rarely achieved in the classroom. Several SURP luncheons allowed students from different departments present their research and to interact outside of the labs. Within the biology department, activities such as ultimate frisbee games, berry picking, dinners at professors' houses, miniature golfing, and trips to the movies all contributed to a friendly environment. Although we worked very hard on our projects, we also had a great deal of fun. This experience allowed me to explore research as a career possibility. I regret not participating in this program earlier in my college career, and given the chance, would apply again in a heartbeat. It has further renewed my interest in the field of biology, and I look forward to continuing my research in the fall.

Changes in Na^+-K^+, ATPase expression and activity in the blue crab *Callinectes sapidus* in response to an increase in environmental salinity

Jansen Weaver, Biology
Faculty Mentor: Dr. Donald Lovett

2007 SURP Research

The purpose of the study is to determine how the enzyme Na^+, K^+-ATPase in blue crabs is affected when the crabs are acclimated to very low salinities and then transferred to high salinities. This enzyme is crucial to osmoregulation because it actively pumps salt from the surrounding seawater into the crab's blood. In this summer project blue crabs were tended daily because they must be acclimated to the low salinity for at least three weeks before they could be used for the study. Changes in gene expression and activity of the Na^+, K^+-ATPase enzyme in response to changes in salinity to try to explain how Na^+, K^+-ATPase is regulated in the crab. In order to study these changes, gill tissue was extracted and homogenized from the crab after acclimation to high salinity and at different times after there was a transfer to low salinity. RNA was extracted from the gill tissues and was investigated by using reverse transcriptase and amplification of cDNA using primers specific for the gene coding of Na^+, K^+-ATPase. The enzymatic activity of Na^+, K^+-ATPase was measured via a spectrophotometer. It was also necessary to measure the osmotic concentration of both the water the crabs were living in and the crab blood. This is an ongoing project that still does not have definitive results. I hope to continue working on this project during the academic year.

Personal Statement

The Summer Undergraduate Research Program was a very positive experience for me. I learned so much about different lab procedures, which I would have never been exposed to in a classroom lab. The "hands-on" science really helped me understand the correlations between the knowledge that I gained in the classroom and the procedures performed in the lab. The real benefit of this program however were the relationships made between our science majors and with this institution's science faculty. I have become very close with several professors which will only enrich the rest of my time here at The College of New Jersey. I strongly believe that this experience helped mold my undergraduate science education in a way that will allow me to best choose my eventual career path. This type of exposure is unusual for a sophomore or junior in college, and that is what makes this program such a phenomenal opportunity.

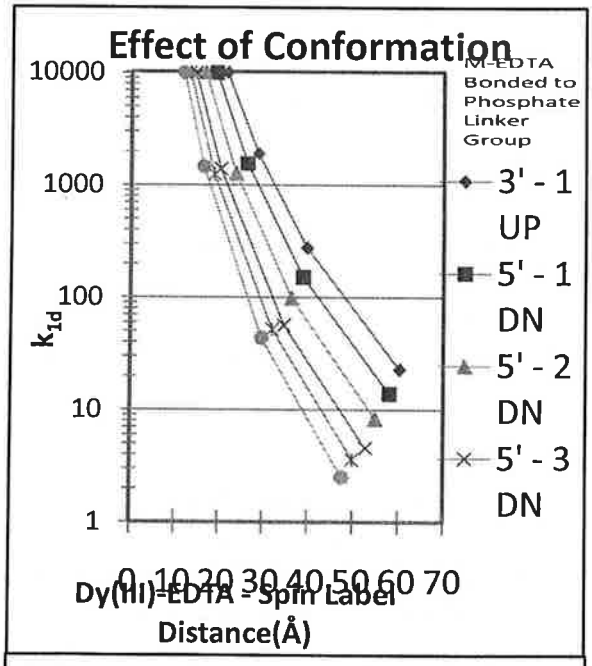
Chemistry

Molecular modeling for distance measurements

Ryan Biczo, Chemistry
Faculty Mentor: Dr. Donald Hirsh

2007 SURP Research

The main goal of this project is to create a model which can predict the structure of biological macromolecules which contain a metal ion and stable radical. The model is duplex DNA that contains a metal ion bound by EDTA to a thymidine base on one strand and a stable nitroxide radical on the other. One of my projects was to recreate this experimental model in a molecular modeling program called HyperChem in order to predict the distances between the metal ion and the nitroxide radical. I modeled four different DNA structures (each with the same base pair sequence but with different distances between the metal-EDTA complex and nitroxide radical). Different conformations of the thymidine-EDTA conjugate were tested in HyperChem to see which had the lowest energy. These different conformations also yielded metal ion-nitroxide radical distances. As illustrated in the figure, this affects the strength of the interaction k_{1d}, between unpaired electrons on the metal ion and nitroxide radical.



*When experimental values of k_{1d} are determined and compared to this chart we will know which model (4 point curve) is the correct form (which Phosphate Linker group that the Metal binds to) and then we can use this model to predict distances inside biological models.

My other project was to recover the metal-EDTA DNA strand from previous experiments; this DNA required a custom synthesis and is very expensive. The goal was to find a method to separate the double helix DNA and collect the metal-EDTA DNA strand. High pressure liquid chromatography (HPLC) was performed at high temperature to denature the double helix, which is held together by hydrogen bonding, and separate each strand. A reverse phase column, which separates molecules based on their hydrophobicity was used and the gradient and pH were adjusted to give the best separation possible for the two DNA strands. Only the metal-EDTA strand had the resolution needed for collection, thus the other could not be recovered. After collection of the one strand it was checked for purity and then concentrated and stored for later use.

Personal Statement

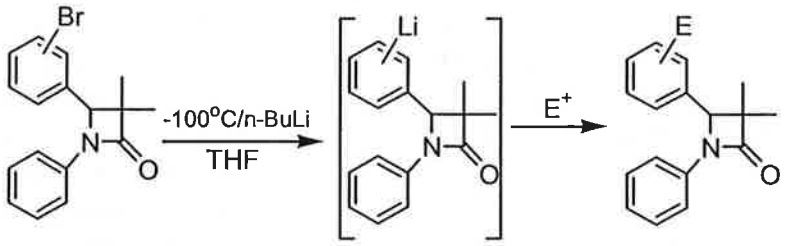
This summer I have learned much about instrumentation (HPLC, UV-Vis, and EPR), and about problem solving in the lab. Just listening to my peers projects proved to be an insight; helping me learn more about chemistry then I did before. Both the independence (from following set instructions) and teamwork (with peers and faculty if needed) seemed to balance out the learning experience and helped me grow as a researcher. There was always a positive learning environment and good times to be had.

Investigation of halogen-metal exchange in the presence of a ß-lactam

Keith Chomsky, Chemistry
Faculty Mentor: Dr. David Hunt

2007 SURP Research (Funded through a grant from Bristol-Myers Squibb)

Antibiotic compounds such as penicillin contain what is known as a ß-lactam ring system. It is well-known that this ring system is the source of the compound's biological activity in combating bacteria. The focus of this project is two-fold: 1) to use a halogen-metal exchange reaction to determine if the 4-membered ring can withstand these conditions, and 2) to create derivatives of a bromoaryl-substituted ß-lactam system. This reaction will be conducted at significantly low temperatures due to the high reactivity of the ß-lactam ring system. The entire procedure consists of the construction of the bromoaryl-substituted ß-lactam system followed by the halogen-metal exchange reaction and subsequent electrophilic substitution reaction.



As seen in the reaction scheme, there is no set electrophile (E^+) for this project. During the summer, many electrophiles have been tested for this reaction scheme. Also, a new line of interest in this study is currently under investigation involving 3-bromobenzaldehyde as the starting material. The goal is to study several substitutions in that position in order to possibly create a new line of compounds that can be used in the same way other ß-lactam compounds are used today.

Personal Statement

This program has been a greatly valuable experience for me. Not only have I learned and become confident with many laboratory techniques, but I have gained new friendships that I plan to maintain in the future. Although I have been working by myself on my project, I have learned how to work well with others in a lab area. I was also challenged to think independently and solve problems that arose during the process of the study. Overall, this program has been a huge benefit. I now have this great experience under my belt to take with me to graduate school and beyond.

Forensic examination of inkjet inks

Trevor Cornell, Chemistry
Faculty Mentor: Dr. John Allison

2007 SURP Research

This summer I am investigating the composition of different inks used in popular inkjet printers, with special attention to the inks that utilize pigments as their color component. The main method through which this is being accomplished is analysis via a time of flight (ToF) mass spectrometer. The end goal of this research is to develop a repeatable method using ToF mass spectrometry to consistently and accurately identify unknown samples, with the intended real-world application being a method that can link a questioned document back to a suspect printer. Throughout this project, our group has gathered printers and examined samples from both dye-based ink cartridges and pigment-based cartridges. We have examined both pure ink samples taken directly from the cartridges, as well as printed pictures, which, upon microscopic examination, prove to be substantially more complex than they initially appear. In addition, we have attempted to separate and identify the components present in different inks. These components can include the colorant itself, surfactants, humectants, biocides, and protective resins. Since the program began, we have made a good deal of progress towards our goals, and in doing so, we have developed a much wider scope of interest in exactly what goes into inks in general, as well as how ink behaves when it is printed onto different types of paper.

Personal Statement

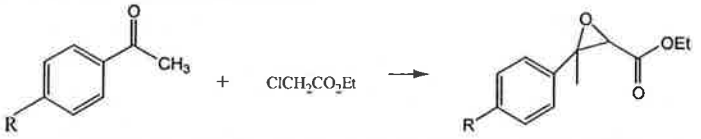
Having the chance to conduct research with the Chemistry Department at TCNJ has been a fantastic experience. It has given me a much better understanding of how the scientific community works, and has given me the chance to make my own contribution as well. I first applied to the summer research program because I was looking for something different to try this summer, instead of trying to find a typical summer job. I was particularly interested in hearing about Dr. Allison's research because of my own interest in forensic science. Being able to work with him on this project has been a wonderful learning experience. This has been my first venture into serious research, as well as my first experience with examining a forensics related problem. Part of what has made the research exciting, and at times frustrating, is that there is no set of instructions for what we're trying to accomplish. In true experimental style, we're taking ideas and running with them, without knowing if what we're doing is going to work or not. The uncertainty of the results is part of what makes the research exciting, because when things do turn out well, the sense of accomplishment is much greater than the feeling that results from following a set procedure. This summer research has also helped me to become more accountable for my work, and has helped me to improve my laboratory skills as well. It has been a great experience, and one that I would definitely repeat.

Novel synthesis of styryl ethers

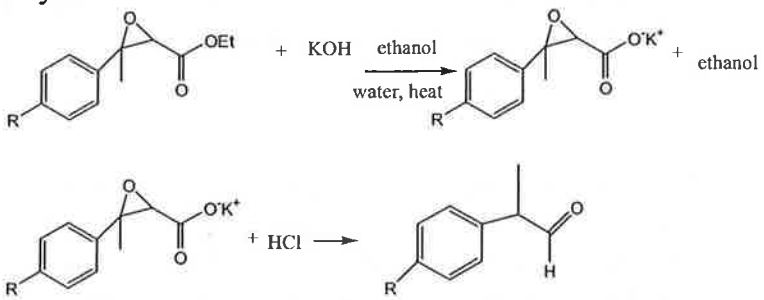
Katherine Davis, Chemistry
Faculty Mentor: Dr. David Hunt

2007 SURP Research

I am researching a novel synthetic method for forming styryl ethers, key intermediates in the synthesis of biologically active compounds. The goals of this research are to discover a method which involves a minimal number of steps while producing the desired product in high yield. Throughout the program, I tested and perfected a procedure that was proven to form a substituted aryl acetaldehyde, which would then be converted to a styryl ether. I have made significant progress with this project as a whole. The complete process of converting each starting material to a pure styryl ether includes a series of five reactions. The first step converts an aryl ketone to a glycidic ester via a Darzen's condensation.



The ester is then hydrolyzed to form a carboxylate salt which, upon acidification, provides the aldehyde.



The aldehyde reacts with methanol and an acid catalyst to form an acetal. From seven ketone starting materials, I have successfully created five acetals, which, when heated, will eliminate methanol to provide the desired styryl ether.

Personal Statement

Participating in the Summer Undergraduate Research Program at TCNJ has been both enjoyable and meaningful. I decided to apply for the program in order to gain lab experience and to help me evaluate my options for after graduation. The research program has introduced me to the type of work I may encounter working in a professional research lab. It has given me experience with various lab procedures, and it has helped perfect my laboratory techniques. Also, taking part in this program has made me more independent in my work and skilled at solving problems and determining improvements based on my results. This program has brought me closer with professionals in the chemistry department along with other students. I have decided to continue doing research during the academic year with my faculty advisor, and working with upperclassmen has helped me strive to advance my skills. Aside from the interdepartmental closeness that comes with working in a research lab, the weekly SURP events helped the entire group of students and faculty share progress and experiences gained from this program.

Forensic analysis of ink jet inks

Shawn Donnelly, Chemistry
Faculty Mentor: Dr. John Allison

2007 SURP Research

During the summer of 2007, I have been studying the various components of ink jet inks with Trevor Cornell, with the help of Dr. John Allison. The research has centered around, though was not limited to, Time of Flight Laser Desorption Mass Spectrometry. Using this technique we intend to show that any questioned document made with today's increasingly complex ink jet printers can be analyzed for particular combinations of components with spectroscopic signatures belonging to a specific manufacturer's blend of ink. There are many other tools at our disposal. Documents were also examined microscopically for dot assignment along with any trends that may belong to an individual printer or manufacturer. As the research progressed, our group slowly started to arrive at the conclusion that the initial assumption that the ink inside of ink jet printers would be similar to that of ink found in pens and other writing utensils was not actually the case. What our research group did find was that as the number of samples from the different printers increased, so did the number of components along with the complexity of the project. Similar to LD MS, Matrix Assisted Laser Desorption (MALDI) mass spectrometry was also used to detect multiply-charged dyes found in some of the ink cartridges. Currently the research is evaluating alternative MALDI approaches along with TLC examination of the various dyes belonging to the number of printers we are testing.

Personal Statement

Participating in the Summer Undergraduate Research Program at TCNJ has really been an invaluable experience in that it has shown me two fields of chemistry that I have found to be not only immensely interesting, but are also viable possibilities as career paths. I will continue to work for the duration of the summer and also plan to continue the project while working with Dr. Allison during the academic year.

Optimizing the spin labeling reaction of proteins for use in protein-protein and protein-heterochromatin binding characterization

Alexander Fuchs, Chemistry
Faculty Mentor: Dr. Donald Hirsh

2007 SURP Research

Barrier-to-autointegration factor (BAF) is a protein found in the cell's nucleus that, by binding to proteins in the nuclear membrane and DNA, assists in gene expression and in the integration of HIV into the host genome. The goal of this research is to characterize binding between BAF and the LEM domain of Emerin, a protein of the inner nuclear membrane and binding between BAF and heterochromatin (Figure 1). To do this, a stable radical or "spin-label" will be attached to BAF and its Electron Paramagnetic Resonance (EPR) spectrum will be recorded in the presence and absence of its binding partners. *S. cerevisiae* iso-1-cytochrome c is relatively inexpensive and was used to optimize spin-labeling conditions, as described below.

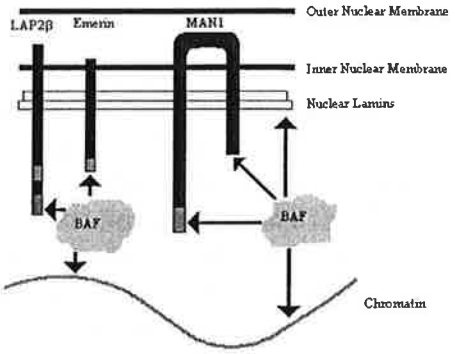


Figure 1. Typical BAF-protein and BAF-chromatin binding interactions. Based on Figure 1 of M. Segura-Totten. *Trends in Cell Biology* Vol. 14 No. 5. p. 261. 2004.

The spin-label MTSL forms a disulfide bond to cysteine residues of peptides. The concentration of iso-1-cytochrome c was quantified using its known molar absorptivity at 410 nm. The concentration of spin-label in the same solution was determined by EPR spectroscopy. A standard curve of the EPR signal v. concentration was made using TEMPOL, an inexpensive spin-label (Figure 2). EPR spectra collected from spin-labeled protein were then used to quantify the concentration of spin-label. Approximately 100% of iso-1-cytochrome c was spin-labeled using 1 mM DTT reductant and 5.62 mM MTSL solution. Studies with Human BAF have been initiated, but mutants with accessible cysteine residues are not yet available.

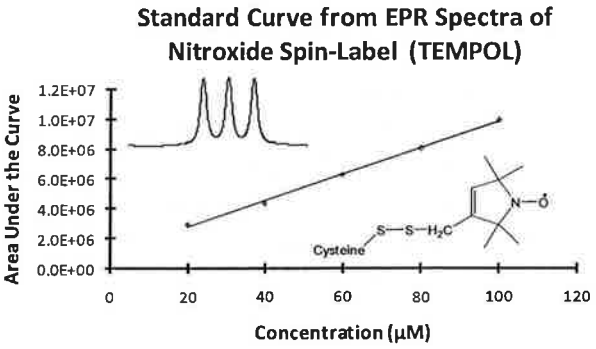


Figure 2. Standard curve of TEMPOL used to quantify spin labeled protein
Top insert: EPR Spectrum of MTSL
Bottom insert: MTSL attached to cysteine residue

Personal Statement

The SURP has provided me with an excellent academic environment for independent biochemical research with assistance from and collaboration with students and faculty in both the biological and chemical fields. I have gained exposure to instruments such as the EPR instrument that I would not otherwise have access to at this point in my studies.

Expedient preparation of 2-(5,6-Dihydro-4H-1,3-oxazin-2-yl)anilines

Michael Rosana, Chemistry
Faculty Mentor: Dr. David A. Hunt

2007 SURP Research (Funded by a grant from National Starch Corporation)

The research conducted this summer at the College of New Jersey is based on previous work from the Hunt lab which focused on a novel two-step, one pot synthesis of aryl-substituted oxazolines, a 5-membered heterocyclic ring system containing nitrogen and oxygen ($n = 1$), from isatoic anhydrides under mild, non-acidic conditions. Previously, the standard method of synthesis called for harsh acidic reaction conditions requiring two separate steps.

This summer, we have utilized this method to successfully prepare a series of oxazines (the corresponding 6-membered ring system) and are currently investigating the amenability of this method to make seven- ($n = 2$) and eight- ($n = 3$) membered heterocyclic rings.

n = 1,2, or 3

These compounds are of interest due their potential to function as metal chelating agents. These can be used to remove metal ions from water for purification or from biological matrices, as in heavy metal poisoning. Based on a myriad of possible substitutions, these compounds may also have other properties which could prove useful.

Personal Statement

Working in the research laboratory with Dr. Hunt and the other students and with the others involved with the SURP program has been a great experience. I have made friendships that I am sure will carry on through into the new school year. Along with friendships I have made, I have also learned a lot about lab procedure and lab techniques. These will prove to be helpful in whatever profession I choose. The lab work has also solidified my thinking that I would like to attend graduate school, which consists mostly of research towards a thesis. The research experience itself also gives us the background that many graduate schools like to see, as those with prior research experience are more desirable.

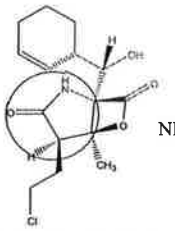
Development of small molecule proteasome inhibitors

Erica R. Tabakin, Chemistry
Faculty Mentor: Dr. David Hunt

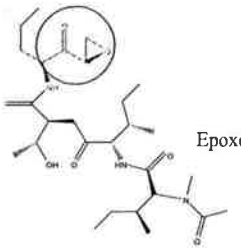
2007 SURP Research (funded by a Merck-AAAS grant)

Proteasomes are cellular organs which break down regulatory proteins that are no longer needed in a cell. However in a cancerous cell, when the proteasome is blocked, the cell undergoes apoptosis, or programmed cell death, since it is poisoned by waste products which cannot be eliminated. This is a significant area of research because it could assist in the development of new chemotherapeutic agents toward a relatively new biological target.

The strategy towards the development of synthetic proteasome inhibitors originates from the combination of specific functional groups located at pharmacophoric sites of naturally occurring proteasome inhibitors. More specifically, the target molecule utilizes the pyrrolidinone structure from NPI-0052 and the carbonyl adjacent to the epoxide from epoxomicin.



NPI-0052



Epoxomicin

Reactions carried out this summer included: acylations, Mitsubobu reactions, epoxidations, and second order nucleophilic substitutions. Similar to medicinal chemistry research in an industrial setting, all reactions were performed twice, once with each enantiomer because one stereoisomer may be active while the other is not. Each compound synthesized was purified by flash chromatography and was characterized by proton nuclear magnetic resonance, carbon nuclear magnetic resonance, infrared spectroscopy, and gas chromatography/ mass spectroscopy. To date, seven compounds have been synthesized and are currently being tested for proteasome inhibition on *Caenorhabditis elegans in* Dr. Sudhir Nayak's lab of TCNJ's Biology Department. Positive signals will provide a basis for the development of a SAR (structure-activity relationship), thereby providing a rationale for modifying certain sites on the molecule to maximize the effectiveness of inhibition.

Personal Statement

The Summer Undergraduate Research Program has provided me an invaluable opportunity to work in a laboratory, gain knowledge in the area of organic synthesis and medicinal chemistry research methods, and develop good laboratory technique. This experience has opened my eyes to the approaches used in research and development labs in pharmaceutical companies. Having a strong chemistry background, I feel that I am a step closer to pursuing a career in medicine, where I can do medical research and clinical trials. Working on an independent project in part of a larger research group has helped me become more confident with my experiments, but still confer with other students. The SURP lunch gatherings have allowed me to meet other students outside of my courses and learn about other types of research which is not scientifically based.

Communication Studies

Comparing coverage of AIDS in African newspapers

Genevieve Faust, Communication Studies
Faculty Mentors: Dr. Paul D'Angelo and Dr. John Pollock

2007 SURP Research

This summer, I worked with Dr. D'Angelo, Dr. Pollock, and three other students to explore African newspaper coverage of AIDS in Africa. Studying the coverage of AIDS in African newspapers allows one to analyze the variations in topic and issue framing across different major, international newspapers and explore what community characteristics are associated with this variation. This was a cross-national comparative study in which "community" refers to "national" characteristics, such as GDP, infant mortality rate, and literacy rate.

During our summer session, we examined AIDS coverage in thirteen Anglophone newspapers, each from a different African nation, from January 1, 1999 to January 1, 2007. We coded each article for prominence, topic, direction, and frames, thereby blending the community structure approach with a framing approach to news analysis. An article's prominence score was determined according to its placement within the newspaper, headline size, length, and presence of photos or graphics. Topics were derived inductively, and included medical, media, money/spending, personal/public attitudes, and social education. Frames are the by-product of more subtle journalistic approaches to covering topics. Using both an inductive (i.e., reading AIDS stories) and a deductive approach (i.e., consulting the literature, including some of Dr. Pollock's previous work), we identified two main frames: progress/development and decline/irresponsibility. We also coded for article direction, which examines responsibility in regards to either frame. Responsibility may lie with either the community, such as a medical establishment, government, or political party, or with individual people, such as doctors or citizens not directly connected to the government or particular politicians.

The coding instrument was quite complex, and we carefully checked for intercoder reliability on a ten percent random sample of the roughly 1,800 articles in our database by using techniques that correct for chance agreement. The next step will be to code the remaining stories and conduct data analysis using SPSS.

In sum, we are examining a public health issue by merging two robust communication approaches, community structure and framing. The implications for public opinion and policy making are enormous.

Personal Statement

My experience this summer has given me a better understanding of the theories and techniques used in mass communication research. It has shown me how two communication approaches can be used together to form one cohesive study. In my opinion, the merging of these approaches expands the scope of the work and yields more data to help us examine the issue. I have also gained practical experience in research techniques, such as database retrieval and data analysis. Finally, I have learned the importance of conceptualizing, working, and troubleshooting as a team.

African newspaper coverage of HIV/AIDS in Africa: a community structure and framing approach

Meghan Higgins, Communication
Faculty Mentors: Dr. Paul D'Angelo, Dr. John Pollock

2007 SURP Research

The HIV/AIDS epidemic is rapidly spreading, with nearly 2/3 of the world's population with HIV living in Africa. During the 2007 Summer Undergraduate Research Program, three other TCNJ students, myself, and two TCNJ faculty mentors, conducted research on newspaper coverage of HIV/AIDS in Africa. Reading both academic literature and initial newspaper samples, we inductively identified several AIDS-related issues throughout Africa, including government inaction, poor education, lack of medical treatment, stigma, and monetary issues. From these issues, we developed a list of five topics covered: medical, media, money/spending, personal/public attitudes, and social education. We are examining newspaper coverage in Africa to measure variation across different major newspapers, further exploring which community/national characteristics (such as GDP, infant mortality rate, longevity rate, literacy rate) are associated most strongly with that variation.

Utilizing the Newsbank and Factiva databases (and using both the TCNJ and Princeton Public Library), we sampled thirteen newspapers, each from a different African nation, between January 1, 1999 and January 1, 2007. A sample frame included substantial coverage of AIDS since the formation of the UNAIDS agency in 1996. In addition, a coding instrument was developed to code the articles based on prominence, topic, and frames. Articles were coded for prominence according to placement, headline size, length of the article, and the presence of photos or graphics. Each article was coded for the five topics mentioned previously. We discovered two main framing polarities used to measure the direction of AIDS coverage: progress/development or decline/irresponsibility, and community or individual responsibility. We tested for reliability and took a 10% random sample of approximately 1800 articles collected to compare coding for all four student researchers. The next step in our research is to code the rest of the articles, enter the data into SPSS, and analyze the results.

Ultimately, we are trying to combine communication approaches (framing and community structure approach) in order to increase awareness of the epidemic in Africa and how it is covered. By drawing attention to this epidemic, others will see the need to raise funds, increase foreign aid, improve access to treatment, etc. All of this, in turn, will help contain the epidemic. In the future, we may interview policy makers and look at attention cycles, spikes in coverage which may help us understand critical events that could alter how AIDS in Africa is being covered.

Personal Statement

I am truly honored to have participated in SURP. Since I have completed previous projects on HIV/AIDS, it was truly rewarding to continue working on this issue. Our project was especially interesting because we combined the community structure and framing approaches, which made our research extremely innovative. The students and professors I worked with on this project made the experience that much more rewarding and I look forward to participating in future projects.

African newspaper coverage of AIDS: a community structure and framing approach

Brian Keefe, Communication Studies
Faculty Mentors: Dr. John Pollock, Dr. Paul D'Angelo

2007 SURP Research

The research being done this summer by myself, three student colleagues, and two faculty advisors empirically examines how AIDS is covered by African newspapers. This project blends two approaches with a natural affinity towards each other, framing and the community structure approach, in order to understand how journalistic practice affects public opinion and policy making regarding this vexing public health issue.

Framing maintains that journalists use certain statistics, scripts and language in order to re-formulate the arguments of elites in the public policy arena. While remaining ideologically impartial, journalists' frames of topics and issue add to the considerations that readers and viewers of news have when considering how to think about, and act upon, these topics and issues. For example, an article in our data set dealt with statistical information on AIDS prevalence in Uganda. Coding this article on the basis of source and journalistic framing led to the conclusion that the government was acting *irresponsibly* regarding AIDS policy. Alternatively, other articles in our data set framed AIDS in terms of progress being made by individuals and/or governments.

The community structure approach links structural characteristics to article direction to find a media vector score. The media vector is a positive or negative combined prominence and direction score that examines the strength between coverage and characteristics. National structural characteristics such as GDP, infant mortality rate, and literacy are linked to article direction, which in our case is community, individual or balanced neutral responsibility for AIDS. Community responsibility implies government organizations, NGOs and the medical community as a whole, while individual responsibility implies specific politicians, doctors or citizens. Framing research fits nicely into the community structure approach because, while the community structure approach attributes responsibility, framing signals the depth of this responsibility.

The work we are doing in the summer is only a small part of our total research project, which will be continued in the fall. The group's main goal for the summer was to finish intercoder reliability work on a rather complex coding instrument, and to finish coding roughly 1800 African newspaper articles from 13 separate African nations that comprise our population of texts. With this goal met, our work this fall will be devoted to writing papers and expanding our research into journalist interviewing.

Personal Statement

This research experience has taught me one incredibly valuable lesson which I will carry with me the rest of my life, the value of consensus in every aspect of research. If you cannot agree on methodology or on how to approach a topic, your research will flounder and fail. In our case we are trying something completely new and with that in mind it is difficult to come to agreement a lot of the time. You cannot move forward if your group is not 100% dead set on every aspect of the project. Overall, our group has done a good job at attaining consensus. I have also forged strong social bonds in my group, ones that will help me greatly in the upcoming semester.

HIV/AIDS in Africa: Framing using a community structure approach

Dominique Sauro, Communications
Faculty Mentors: Dr. Paul D'Angelo, Dr. John Pollock

2007 SURP Research

Our summer research project focused on the growing HIV/AIDS epidemic in Africa. We developed our research around two modern communication theories: framing and community structure. These theories have never been used simultaneously, so our work this summer was very unique and we are looking forward to seeing the results. We began our research by searching through several databases. We used the time frame of Jan. 1, 1999 – Jan. 1, 2007 and the keyword "AIDS," to collect articles from a variety of countries in Africa. After gathering roughly 1800 articles from 13 newspapers, we read through them and developed a list of topics and frames that were common throughout. We then developed a coding instrument that would be used to indicate the prominence, main topics, and frames in each article. The prominence was based on the placement, headline size, article length, and number of photos. The topics included: Medical, Media, Money/Spending, Personal/Public Attitudes, and Social Education. The frames could be coded as either Decline/Irresponsibility or Progress/Development, and Community or Individual Responsibility. Each member of the group read and coded the same 10% of the articles. After comparing our results, we calculated the reliability to ensure that each coder was accurate, and we split up the remaining 90% of the articles to finish coding.

We are not yet finished coding every article, so we plan on continuing this research project. In the future, our goal is to input all of the data from each article into SPSS and analyze it using characteristics that are common to the different areas of Africa. It is expected that areas with similar community characteristics will yield similar coverage of HIV/AIDS. It is important to study the newspaper coverage of HIV/AIDS because newspapers play a key role in raising awareness about critical issues, creating agendas for other media, keeping historical records, and are read by influential political and economic leaders. By studying the frames and topics in the different areas with similar characteristics, we hope to gain important information that can be used to help stop the stigma and spread of HIV/AIDS in Africa.

Personal Statement

I have really enjoyed being a part of the Summer Undergraduate Research Program. The project we have been working on was extremely interesting because we used the Community Structure Approach, which we have researched in class, and incorporated a coding instrument that included topics and frames which added a new dimension. By doing a project that had never been done before, we were able to experiment more and see what worked best. Occasionally we had to redo a certain step or we found that our ideas did not work out as planned, but each obstacle was overcome through discussion and brainstorming. I feel tremendously lucky to have been able to work with such experienced and intelligent students and professors so early in my college career, and I look forward to continuing this research project in the upcoming year. The weekly discussions were a great way to see what students and professors in other fields were researching, and the professors were able to provide a lot of information regarding graduate school and the future.

Engineering

Aerodynamics of saccate pollen and its implications for wind pollination

Matt Clemente, Mechanical Engineering
Faculty Mentor: Dr. Lisa Marie Grega

2007 SURP Research

The research done on saccate pollen at TCNJ during the summer of 2007 is part of a larger project comprised of scientists from around the country. This research looked at the possible aerodynamic effects produced by air-filled sacs on certain types of pollen. This research was the continuation of research done previously in the Spring semester of 2007. The goals of this summer were to refine the current experimental methods for analyzing the aerodynamics of pollen and probe into the significance of certain surface features pertaining to the aerodynamics of the pollen grains.

All experiments during the latest stage of research were done utilizing a drop tank. A drop tank is as simple as it sounds, it is a tank of a fluid that objects are dropped in and have only the effects of gravity to pull them down. This type of apparatus is useful in studies where a low Reynolds number is desired. A Reynolds number is a dimensionless number that describes the ratio of inertial to viscous forces on a object using the characteristic length of the object, the relative velocity of the object to the fluid, and the viscosity, how thick or thin, of the fluid the object is flowing in. Reynolds numbers are used to scale from a real life situation to something producible in a lab. There has not been much research done at low Reynolds numbers beyond spheres and spheroids. The experiments done this summer created background information on spheres to determine whether or not roughness or texture of an object affects its coefficient of drag at low Reynolds numbers. Coefficient of drag is another dimensionless number. It is useful in comparing drag forces among different geometries. This information will then be used to further refine the models of pollen that are to be used in drop tests. Repeated drop tests will reveal the coefficient of drag of saccate pollen. This value will then be compared to the coefficient of drag for saccate pollen without their sacs.

Personal Statement

This research has made me realize many of the troubleshooting skills needed to be successful in a lab. I used many lab tools this summer including some that were actually made in house by my research partner and myself. These tools have furthered my skills in accurately determining mass, volume, density, specific gravity and velocity. Troubleshooting was a key factor in determining these values because certain apparatus are not readily available. Troubleshooting was also important in the refining of drop tests to be sure our results were significant.

The SURP Program also opened my eyes to various other fields of study. Weekly meetings allowed for fellow undergraduate researchers to describe what they were researching and where they were going to take it. These weekly meetings provided a break from the monotony that can be experienced when running an experiment repeatedly for hours.

Aerodynamics of saccate pollen and its implications for wind pollination

Alex Colletti, Mechanical Engineering
Faculty Mentor: Dr. Lisa Grega

2007 SURP Research

The pollen grains of conifers vary in many significant structural ways. Three extant pollen grains, including *Pinus*, *Falcatifolium* and, *Dacrydium*, were studied to determine the effects of air-filled bladders on their settling velocities. In previous research at Truman State University stroboscopic photography was used to create mathematical models of various grains from each of the three species and settling speeds were mathematically calculated based on prolate spheroids.

The current research goals are to determine, experimentally, the effects of the air-filled bladders and refine drag coefficient estimates. Mathematical computer based solid models have been created of the pollen grains, with and without sacs, at 400 to 600 times the scale of the actual grains. The models were printed three dimensionally using stereo-lithography with their largest dimension reaching approximately 1 inch. These models can be used to represent the actual pollen grain by dropping the models through a fluid more viscous (thicker) than air. Settling velocities of the models are fine tuned to match Reynolds numbers (the ratio of inertial to viscous forces) with the actual pollen. Then mass ratios, taken from measurements of the actual grains, of the pollen will be used to create a similar model without sacs. Their settling speeds will be compared.

Before a direct comparison between sac and sac-less pollen can be made the effect of roughness factors on the pollen needs to be examined. This was done experimentally by first comparing spherical models which are smooth to those with added roughness features. Dropped at the same Reynolds numbers at which the pollen grains fall, these spheres represent a similar physical flow situation. Preliminary results show that roughness features have little effect on the drag coefficient of spheres at low Reynolds numbers. Results from experimentation will determine if the fine surface ornamentation on the actual pollen grains needs to be incorporated into the models.

Personal Statement

The summer undergraduate research program has introduced me to many aspects of experimental research. As a potential mechanical engineering graduate student, the skills obtained over the summer should provide a solid foundation for future doctoral work. Interdepartmental collaboration with the Math department at Truman State and the Biology department here at TCNJ, fine tuning control of independent variables in lab experiments, and the need to come up with creative solutions to problems as they arise are all skills which could not be developed as extensively in the classroom setting. Additionally, much was learned though the experimentation process regarding making fine measurements of viscosity, density and volume. These properties, which would normally be given in a textbook problem, proved difficult to obtain, with high precision, experimentally. Workarounds and personally creating measurement equipment proved a valuable experience.

Quantitative analysis of cardio-respiratory control

Erik B. Hage, Biomedical Engineering
Faculty Mentor: Dr. Brett F. BuSha

2007 SURP Research

The brain regulates heart and breathing rates by integrating many input signals along with data from the recent past and the essential drive. Constant changes in any of these inputs create the inherent variability in heart beat and breath-to-breath intervals. My colleague and I are characterizing the integrative control of the brain on the cardio-respiratory system by quantifying the variability in the time intervals between successive human heart beats and breaths. The objective of our research was to refine our experimental procedure and protocol to quantify cardio-respiratory control. Subjects will be tested standing and lying down, because your heart must work harder while standing and breathing will change to compensate, and also with eyes open and closed, possibly changing the number of input signals to the brain areas that control cardio-respiratory function. Various sensors for recording the electrical activity of the heart and breathing rates were tested. The methods evaluated included an airflow transducer, temperature transducer, respiratory band, and surface electrodes (each in multiple orientations). Each device measured a correlate of brain activity controlling the lungs or heart. Experiments were conducted on ourselves, each with different orientations of sensors. We compared the results of each method and found which gave the most reliable data. The time intervals between successive heart beats and breaths were calculated with a locally-designed software algorithm. Other programs were designed to quantify the variability of the interval data. Standard statistical measurements were made, including average and standard deviation. Non-linear mathematical techniques were used to quantify the variability in each data set. The method of data collection chosen to be used in the experiment to record electrical activity of the heart is electrodes placed on the surface of the skin. The method to collect breathing data is still undecided between the temperature transducer and the respiratory band. Before testing can begin, our protocols must be approved by the College of New Jersey Institutional Review Board, after which we intend to initiate human experimentation.

Personal Statement

Being involved in the student undergraduate research program at the College of New Jersey has given me insight into my future career of biomedical engineering. It is a huge step towards my goals of designing new procedures and techniques to improve the non-invasive practice of medicine. Working in the program improved my team working skills, my problem solving, and my computer coding knowledge. I have become more proficient at analyzing physiological signals, and using equipment and software that is standard throughout the industry. I also got to know my professors a lot better, as there was much easier to access to speak with them. However, I learned how frustrating research can be, and all the little things that need to be done before you can even start your experiment. But the feelings you have when you get good results make you realize it was worth all the trouble.

Quantitative analysis of cardio-respiratory control

Cory Hofmann, Biomedical Engineering
Faculty Mentor: Dr. Brett BuSha

2007 SURP Research

The brain controls cardio-respiratory activity by combining past information with feedback mechanisms from the body to define a present state. Our aim was to gain an insight to this integrative process by quantifying the behavior of cardio-respiratory controllers through the use of heartbeat and breathing. Physiological inputs to the brain result in cardio-respiratory variability; the quantification of variability serves as a correlate to the integrative effects of inputs to the brain with past information. The objective of our summer research was to define the procedures and protocols with which we collected and analyzed data to begin future experimentation. The time interval between successive heartbeats was determined by measuring the electrical activity of the heart using surface electrodes. Breathing data were collected through measurement of the expansion of chest circumference. Time intervals were collected from different body positions (standing upright and lying supine) and different levels of visual stimulation (eyes opened and eyes closed) in order to determine how the control of cardio-respiratory function would change with different conditions. The time intervals between successive heartbeats and the points of maximal inspiration were calculated using locally designed computer algorithms. Throughout the summer program, we perfected the methods in which we collected our heartbeat and breathing data; and also became experienced with a variety of variability analyses including autoregressive power spectrum slope and detrended fluctuation analysis. In conclusion, we are hoping that this preliminary analysis will be an important tool in further noninvasive research and help the evolving understanding of the brain and cardio-respiratory activity. We hypothesize that experiments will show that body position and visual stimulation of the eyes will have significant effects on cardio-respiratory control. This summer served as an introduction to the methods of data acquisition and data analysis to be used in later experiments. We hope to continue our research by receiving approval from the Institutional Review Board and by expanding to record interval data from a larger number of subjects in the future.

Personal Statement

The College of New Jersey's Summer Undergraduate Research Program has been a valuable educational experience. Scientific research is not always simple, and this program has taught me how to be patient and learn from mistakes. This research has served as an excellent outlook into the diverse field of biomedical engineering. For the first time, I have had exposure to the application of scientific, mathematical, and engineering design aspects to physiological systems. Most importantly, this program has introduced me to a myriad of interesting topics of study in many interdisciplinary fields. Weekly meetings including presentations from other programs have helped spark intellectual discussions and open a new world of educational topics. I feel this program has been a success because I have discovered a substantial wealth of information, not only in my specific field of study, but throughout many different educational programs throughout TCNJ.

Face recognition using multispectral random field texture models, color content, and biometric features with neural network classification

Matt Pettineo, Electrical and Computer Engineering
Faculty Mentor: Dr. Orlando Hernandez

2007 SURP Research

Computer-based face detection has become an increasingly popular field of study over the past 20 years, due to its numerous practical applications for security and police work. Much of this research, however, has been with greyscale images. In Fall 2005, Mitchell Kleiman began developing a system for using color images and texture models to determine the location of facial features (eyes, nose, mouth, etc.) on a digital image. The project was successful, and has been continued and expanded upon through research and development as part of the Summer Undergraduate Research Program.

The main goal for the program was to develop a brand new neural network-based classification system, which would serve as an extension to the software previously developed over the past 2 years. In order to implement this new system, extensive research was done into both the theory behind networks, as well as papers written regarding the use of neural networks as a classification device for face recognition. Once developed, this new classification system was intended to increase the software's success rate for matching faces to 75% for 400 images and 20 individual people among these images. The current implementation has achieved a success rate of 45%, and future improvements will need to be made to both the original feature detection system as well as the new classification system in order for the original goal to be met.

Personal Statement

The summer research program has been a tremendous opportunity for myself as a future engineer. As an undergraduate, my coursework is extremely important yet still can only provide me with a portion of the skills necessary for becoming a professional in my field. In order for me to be successful, it was also important that I gain valuable hands-on experience with larger engineering projects. The Summer Undergraduate Research Program has provided me with that opportunity.

Over the course of the program, I've done research into a very complex problem normally reserved for graduate students and professors. By performing this research I not only became more familiar with the subject material, but I also gained valuable experience with research in general. I've also honed my problem solving skills through the development and implementation of my software, which is always valuable for an engineer. The particular field I've been working in is one I would like to enter when I begin graduate school, and working in this field has been a rewarding experience.

Distributed computing: a parallel programming framework

Ryan Van Antwerp, Computer Engineering
Faculty Mentor: Dr. Orlando Hernandez

2007 SURP Research

There is an increasing need for computer software to solve highly complex scientific, mathematical, and engineering problems. However, current technology can only allow computers to perform as fast as their programmed algorithm allows. More and more software developers are looking to parallel and distributed computing to break through this current speed block and allow the execution of software that would have originally took an almost infinite amount of time. The problem with current parallel technology is that a standard to allow the programming of parallel and distributed software easily does not exist, and typical multiprocessor systems do not take full advantage of their multiple cores. In order to combat this problem, my research has been focused on an open source parallel framework which can be modified with minimal coding to adapt to a prewritten program to allow it to work in a parallel fashion. My goal for this summer was to create a very flexible parallel framework which could be ultimately be adapted to a program already written by my faculty mentor, therefore proving its usefulness.

Through the use of the C programming language and low level networking calls, I was able to create a rough framework that allowed the execution of a trivial program to increase in performance by 234% across four networked computers versus a single computer. These results predict a promising future for parallel and distributed programming, however there is much work still to be done. I would like to continue my research during the academic year to further improve on my current framework to make it utilize Remote Procedure Calls (RPC) technology therefore making the code more flexible and more readable. I also intend to make the framework scalable to any size and as adaptable as possible therefore allowing the seamless integration of newly connected network computers without the modification of any code. Through research towards these goals, I hope to create a future of faster and more efficient computer processing.

Personal Statement

The Summer Undergraduate Research Program has been an absolutely fantastic and enlightening experience for me. As a prospective graduate student in Engineering, I intend to spend a large part of my graduate schooling doing research and other activities not unlike what I have done this summer. Through the help of my faculty mentor, I have learned very important research techniques involving acquiring and utilizing technical documents as well as what to do when a dead end is reached. Although my day work was challenging and exhausting, the SURP allowed me to relax after a hard day of work with some casual social experiences such as Frisbee and ice cream gatherings. Periodic seminars also imparted important research information as well as the research progress of my peers. This created a diverse experience which allowed me to learn information beyond my research focus. I am very glad that I was allowed the opportunity to participate in the SURP and I will leave it with knowledge that will help me in both my personal and academic future.

Mathematics

Calculating algebraic invariants for binary forms of degree 9 and 10

Jeff Hatley, Mathematics
Faculty Mentor: Dr. Thomas Hagedorn

2007 SURP Research

Invariant theory is an important area of mathematics that has been studied since the beginning of 20^{th} century by such giants as Hilbert, Gordan, Young, and Sylvester. Despite receiving so much attention, however, many questions in invariant theory remain unanswered. In some cases, published "answers" have been found to be fallacious. It has been our hope over this summer to correct these mistakes and finally put to rest some problems in invariant theory.

Our research has focused on the algebraic invariants of binary forms. A binary form is a degree n homogenous polynomial in two variables, and an algebraic invariant of such a form is a function of the coefficients whose value remains unchanged after the form undergoes a linear transformation. The simplest example would be the familiar discriminant of a quadratic polynomial which one learns in high school algebra class. For a quadratic polynomial of the form $f(x,y)=ax^2+bxy+cy^2$, the discriminant is given by b^2-4ac, and it turns out to be an invariant.

It has been our goal over this summer to accurately classify the minimal generating sets of invariants for binary forms of degree 9 and 10, a task which has been greatly facilitated by the invention of computer algebra systems, but which is still very difficult. We studied the many ways mathematicians have devised to represent and work with invariants, as well as creating a format of our own. Specifically, we sought to understand a classical method of working with invariants called the symbolic method. In the course of doing so, we also came up with our own way of representing and working with invariants, a form which we call H-Matrices.

We have implemented the computer algebra system Mathematica to aid in many calculations, and we have successfully verified previously published results on binary forms of degree 8 and below. Due to the large amounts of memory our current computer programs use, we have been unable to solve the degree 9 and 10 cases yet. That work is ongoing, as we continually refine our programs and search for faster methods of computing the invariants.

Personal Statement

The SURP has been an enlightening and intellectually exciting way to spend the summer. It has allowed me to gain experience doing research in mathematics, and it has thus allowed me to become acquainted with the joys and frustrations of doing original work in mathematics. Working with my mentor, Dr. Thomas Hagedorn, and my peer, Glen Wilson, has allowed me to work on mathematics as part of a team, and I have learned so much about thinking and doing mathematics from both of them.

Additionally, the weekly lunches were a nice chance to talk to students doing research in other disciplines and to share ideas and stories of our successes and failures. The community atmosphere made it very nice to be on campus during the summer.

SURP was an incredibly rewarding experience, one which I would recommend to any interested student.

Classical Invariant Theory

Glen M. Wilson, Mathematics and Statistics
Faculty Mentor: Dr. Thomas Hagedorn

2007 SURP Research

Since January 2007, Dr. Thomas Hagedorn, Jeffrey Hatley and I have been investigating the classical theory of invariants. Classical Invariant Theory was pursued by mathematicians all around the globe during its glory days in the nineteenth century. We see such famous names as Cayley, Gordan, Lie and Sylvester all working together on understanding invariants. A simple definition of an invariant is a function that depends on an object which has the property that its value remains the same after transforming the object in some way. The study of these invariant functions was crucial to the development of mathematics. Many of the ideas used in trying to solve problems in invariant theory subsequently created much of the modern mathematics today. As a result, the interest in computational invariant theory got redirected to developing the theories which it helped create. The computational questions have been left partially solved or incorrect since Sylvester worked on them in the late 1800's. It was our original goal to correct some of the computational questions in invariant theory and try and solve some that were not attempted. We have written a few computer programs using *Mathematica* which have verified the solutions to some of the computational questions and are working to improve them to get new results as well. In addition to the computation work we have done, we have also investigated theoretical methods which allow us to represent the invariant functions in a way that is more computer-friendly and also provides a different perspective on some old questions. We are currently working on a new algorithm and approach to calculating invariants which will be easier to implement in a computer program than those which we have been using.

Personal Statement

The Summer Undergraduate Research Program has helped me organize my goals and aspirations for a career in mathematics, as well as provided a great opportunity to get to know the faculty at TCNJ and other students. When I first began to study mathematics, I knew I loved the subject, but I didn't have any idea of what I wanted to do with it. This program gave me a great opportunity to get first hand experience on conducting research. I learned how to approach problems and what research in mathematics is all about. I really enjoy performing research in mathematics, and I think the Summer Undergraduate Research Program has definitely gotten me excited to pursue mathematics in graduate school. Not only did it help me academically, it helped me feel more at home at TCNJ. The program made it possible for me to spend time working with professors in the mathematics and statistics department at TCNJ as well as other faculty and students in the Summer Undergraduate Research Program. I really enjoyed being able to work with Dr. Hagedorn on a problem and seeing how he approached it and thought about mathematics in general as well. The Summer Undergraduate Research Program provided so many opportunities and challenges that I would not have been able to find anywhere else and I am so thankful that I was able to participate in such a great program.

Nursing, Health, and Exercise Science

The effectiveness of an alternative high school for pregnant or parenting teens: a qualitative study

Jessica Tellier, Nursing, Health and Exercise Science
Faculty Mentor: Nino Scarpati

2007 SURP/NCUR Research

I began my research with Maternal and Child Health Consortium, a non-profit agency that directs maternal and child health care services in various counties in New Jersey. I then chose to work with Project TEACH (Teens Education and Child Health), a member organization of the Consortium and an alternative high school for pregnant or parenting teenagers located in Trenton, NJ.

This research was qualitative in nature. I visited the Project TEACH site three times to observe the clients and conduct interviews. Five of six clients were interviewed one-on-one and asked questions about prenatal care utilization, the cultural and ethnic sensitivity and awareness of their health care providers, and their feelings about Project TEACH. Five of six staff members were available to fill out a survey regarding their thoughts about adolescents utilizing prenatal care services and the importance of ethnic background awareness. The findings were then compared to studies conducted in similar alternative schools.

Based on the Adequacy of Prenatal Care Utilization Index (APNCUI), a tool that measures the adequacy and timing of prenatal care visits, only one of the clients' prenatal care utilization was considered "inadequate." The most popular reasons clients chose to receive prenatal care were for the health of themselves and their baby and/or because a parent or guardian's suggestion. The clients all stated that their health care providers were considerate of their ethnic or cultural background. The clients are generally pleased with project TEACH and gave few improvement suggestions. Three staff members stated that it is important for health care providers to be considerate of a clients' ethnic background, while two staff members stated culture were more important. The curriculum, staff composition, and classes and services offered were similar between Project TEACH and the two other schools researched in previous studies. The main differences were in the sizes of the schools (Project TEACH having the fewest students) and the length of stay in the program. Unlike the two other schools, Project TEACH clients may choose to remain in the program after they have their baby or return to their normal public school.

I believe that pregnant and parenting teenagers in Trenton should be involved in the design and implementation of the program. Involving community members could encourage more teenagers to enroll in the program, give the clients' and residents a sense of contribution and importance, and improve the attendance rate at Project TEACH.

Personal Statement

The most important thing I learned during the project is the importance being persistent yet tactful with agencies or organizations one is working with. I also realized that eight weeks is a short length of time to develop and conduct a research project; but with patience and perseverance, it is possible. I am honored to have been a part of the project and look forward to such opportunities as I continue my college education.

Physics

Modeled sediment mass-balance and movement underneath ice sheets

Ian du Bois, Physics
Faculty Mentor: Dr. Byron Parizek

2007 SURP Research

My research project is mathematically modeling the sediment flow and creation underneath an ice sheet (glacier). This was done by first creating an ice sheet in MATLAB using the Shallow-Ice approximation (S.I.A). Once this was completed, the next step was to create a sediment model using the equations derived by Pollard and DeConto (2003) and Pollard and DeConto (2007, in press). These equations were taken and cast into Finite Element Form (this method utilizes calculus, as well as the computational power of computers). Once the coding was complete, the simulations could be run using theoretical data. The next step will be to include real data as well as an ice-stream and ice-shelf dynamics.

This research is important because ice sheets/shelves affect global climate change and sea level change. My research is particularly important with respect to the temporal and spatial evolution of lubricated ice streams (fast-flowing grounded ice due to melt water lubrication) as well the grounding-line dynamics of an ice sheet.

Personal Statement

This research has taught me what life is like as a theoretical researcher. I was paid through a grant by the National Science Foundation, and saw first hand from beginning to end just how a grant is written and received. I have also learned about computer programming and troubleshooting a program. Finally, I have made multiple professional contacts and relationships which will help me in my future endeavors as a student, researcher and professional.

Political Science

Evaluating the effects of deliberative forums

Elizabeth Avery, Political Science
Faculty Mentor: Dr. William Ball

2007 SURP Research

Deliberation is a way for citizens to talk to one another about politics – a way that avoids the progress-inhibiting effects of debate – and helps them refine and voice their opinions on various issues. For my research this summer at TCNJ, we have focused on a key element of this subject: deliberative public forums. My work over the summer has covered a small piece of a large project that Dr. Ball has been researching and will continue to research after the SURP program concludes. The research will eventually determine the behavioral and attitudinal impacts that deliberative forums have on participants, and whether these effects occur immediately or over a longer stretch of time. This research could then be continued to discover which aspects of forums can be adjusted to maximize the benefits to forum participants in terms of their civic education.

During the summer, my research partner, Alicia Polkowski, and I predominantly analyzed two sets of data. The first was collected at a series of forums in Mercer County in 2003. The second was collected from a set of forums that were conducted this summer in Kansas. For both sets of data we utilized SPSS, a statistical analysis program for social sciences, to perform a descriptive analysis of survey responses. We took this analysis a step further with the 2003 data and compared the demographic information with U.S. census data for each zip code in which participants lived. Our conclusions include that forum participants are predominantly middle-aged, those over 65 are underrepresented, and those with college degrees are greatly overrepresented. We also analyzed comments written by participants and found that the most common forum expectations were to hear the perspectives of others in their community and to acquire knowledge about the issues. Additionally, for both sets of data, we used SPSS to determine changes in responses to questions that appeared on both the pre- and post-tests. We found support for some of our hypotheses, including that participants would attach increased importance to finding common ground at their tables. Furthermore, we performed a correlation analysis for the participants' levels of agreement with certain statements and found a high correlation among statements indicating enjoyment of the forum, knowledge gain at the forum, and the positive views of the moderator's performance. However, it should be noted that the data set from the Kansas forums was very small and should be supplemented with data from additional forums in the future.

Personal Statement

The summer research experience has offered me a great opportunity to expand my knowledge in the field of political science. I was introduced to the topic of deliberative democracy in a course with Dr. Ball during the spring semester, and it was rewarding to be able to continue to study this important topic. I was able to refresh and increase my knowledge of statistical analysis. This was my first opportunity to conduct original research, and it was refreshing to be able to create something from scratch as opposed to reading about what others have done (although we did a lot of reading in preparation for the research, too). In sum, this opportunity to collaborate with a professor to conduct research is one that I would surely repeat if given the chance.

Deliberation: maximizing citizen attitudinal and behavioral changes

Alicia Polkowski, Political Science
Faculty Mentor: Dr. William Ball

2007 SURP Research

The research project centers on the short-term impacts on participants in National Issues Forums (NIF), or citizen forums, and their relationship to the features of the forum itself. For the purposes of the study, a forum is a group of participants deliberating together on an issue with a moderator heading the group in order to direct the discussion. Forum participation is expected to cause changes in the beliefs and behaviors of the citizens. The goal of this research is to determine the most effective methods of designing forums to effect these changes, for later use by forum organizers. The data are being collected from partner organizations that run NIF forums. Each participant is asked to fill out a pre-test survey before the deliberation begins, and a post-test survey to be completed two to four weeks after the forum.

The project is aimed at determining how this participation will result in attitudinal and behavioral changes in those who attend. Specifically, it is hypothesized that these changes will include increased interest in and further discussion about the issue, increased sense of knowledge about the issue, networking, and increased emphasis on the importance of deliberative norms. These norms include political tolerance, respect for minority views, and less desire for consensus.

It is hypothesized that different features of the forum may enhance the positive impacts of forum participation on the opinions and behaviors of participants. It is expected that the most important factors will be the diversity of views voiced and of the demographic areas represented. Features moderately correlated with outcomes include the experience of the moderator and participant evaluation of the moderator, the strength of the participants' opinions on the issue, and the length of the forum.

The project remains in the data collection phase, as forums are currently being conducted across the nation on different topics. The project will continue through the 2007-2008 academic year.

Personal Statement

Participating in this program has truly been an invaluable experience. I was able to advance my statistical analysis skills, while becoming more familiar with software such as Microsoft Excel and SPSS. The program was not all work and no fun; activities ranged from barbeque luncheons to blueberry picking, at which I enjoyed being able to share my research and learn about projects being conducted by others. I also received the opportunity to travel all-expenses paid with my professor and another student intern to a Kettering Foundation three-day conference in Dayton, Ohio, which sponsors research in deliberation. At this conference I networked with many other individuals with similar interests who have already established themselves in the field.

Psychology

Testing the relationship between positive affect and cognitive flexibility

Laurie A. Gumbs, Psychology
Faculty Mentor: Dr. Chu Kim-Prieto

2007 SURP Research

During the Summer Undergraduate Research Program I worked with Dr. Kim-Prieto in the Culture and Emotion Lab in the Psychology Department of The College of New Jersey on a project testing the effects of emotions on cognitive flexibility. During my summer apprenticeship, I prepared the data for analysis, conducted a series of data analyses, conducted an extensive review of the literature, and began collaboratively writing a manuscript for submission to a profession scientific journal.

We began by adding the results of a qualitative mood manipulation task to the data set. The data set was previously rated by other lab members, so we had to calculate the inter rater reliability of the manipulation. After checking the inter rater reliability we had to create a filter to weed out noncompliant participants before we merged the manipulation check into the main data set. Then we analyzed the data using the statistical program SPSS 14.0 to test the hypothesis. Our hypothesis was that positive affect would enhance the cognitive flexibility of those who value positive affect, but would have no effect on those who value positive affect to a lesser extent.

We also began the preparation for writing a manuscript for submission to a profession scientific journal. In order to do the write up, we had to conduct extensive research in the Library. Then we read and catalogued all of the books and articles we found. We easily read 50 primary source articles, which is very different from a watered-down version in a textbook. In fact, we often returned to the library to find articles we had noticed references to in our reading. Once the research was finished we began to write up our study.

Personal Statement

The undergraduate research program allowed me a chance to develop my research and data analysis skills. I became very adept at navigating several search databases such as PsychInfo and PsychArticles and the TCNJ Library site. I have also strengthened my collaborative writing skills. In the process of analyzing the data I learned how to create filters and perform median splits in SPSS 14.0. I also learned how and under what circumstances to conduct a multivariate analysis of variance, a two-way analysis of variance, and an analysis of covariance as we analyzed the data in from different aspects. I will have to analyze and interpret data for the rest of my career, so learning how to analyze and interpret data helped me to grow both intellectually and professionally. In the competitive world of graduate schools, I believe having a summer research experience such as the Summer Undergraduate Research Program at The College of New Jersey has given me a significant edge.

Testing the relationship between positive affect and cognitive flexibility

Rachel D. Harris, Psychology
Faculty Mentor: Dr. Chu Kim-Prieto

2007 SURP Research

Past research has found that positive affect provides a variety of benefits including better health, longer life, and enhanced creativity. Yet, there is controversy as to whether the benefits are strictly due to the presence of positive affect, or if they are due to the participant experiencing an emotion that is valued by themselves and society. We tested the hypothesis that when a person who values positive emotions experiences happiness, he or she will display more signs of creativity in the form of cognitive flexibility. Cognitive flexibility is the ability to come up with statistically unusual responses to differing stimuli, such as word associations. Our research divided participants into two groups: those whose cultures valued positive affect and those whose cultures did not. Each of these groups was randomly assigned to an experimental condition in which affect was induced through the writing of either a happy or sad story. They were then given a word association task as a measure of cognitive flexibility.

Our goals were to analyze the data from this study, which had been collected prior to the summer session, and to develop a comprehensive collection of literature to be used in the write-up of this study. To analyze the data, I ran a 2x2 analysis of variance using culture and the assigned experimental condition. When this returned no significant results, I changed the culture variable to a variable where participants explicitly rated how much they valued positive emotions. The experienced emotion variable was changed from the assigned condition to one in which participants rated how happy and sad they felt. Any participants who felt neutral were removed. I also had to remove any noncompliant participants, who, according to the manipulation check, did not write about the emotion to which they were assigned. Finally I filtered out participants whose age and age at time of immigration may have made them too acculturated to American culture. So far, we have found evidence in the opposite direction of what was hypothesized. In the forthcoming months more data sets will be analyzed. We have also collected an immense amount of literature which has been organized and is ready to be compiled into our introduction.

Personal Statement

Doing such in-depth research has prepared me for future research endeavors both in the workplace and in graduate school. I feel much more comfortable searching through the seemingly daunting amount of literature in the field of psychology. It has also been wonderful to continue looking at psychology through a cross-cultural viewpoint, and discover the robust body of research available. I have developed my organizational skills, and my skills for preparing writings for publication. Furthermore, I have become very more comfortable with the data analysis program SPSS.
The SURP program's bi-weekly lunches, during which we shared our research with others in the program has exposed me to some of the interesting research being conducted in other areas of study, and has better prepared me for presenting my own findings.

Real-world applications of the von Restorff isolation effect

Brielle Simels, Psychology
Faculty Mentor: Dr. Tamra J. Bireta

2007 SURP Research

The purpose of our summer project has been to take one of the most well known memory phenomena, the isolation effect, and apply it to the use of memory in everyday life. The isolation effect is a memory phenomenon in which items that are inconsistent with their surrounding context are well remembered. The isolation effect has led advertisers to suggest that their ads should be designed to stand out from other ads in order to take advantage of this benefit. Thus, the primary purpose of this project is to examine whether the isolation effect occurs for memory of print advertisements. This is a research project with results that will eventually have large significance to the psychology community, as well as the advertising community.

In order to meet our final goal for the summer of deciding upon a final design for our study, I have taken on a role beyond that of a typical student or intern. I have been more of a collaborator as I took on the lead of most aspects of the project. First, I researched and integrated literature in both psychology and marketing. I then aided in the design of the stimuli (print advertisements) for this project, which was challenging and time-consuming due to the precise control for numerous variables. I then recruited and tested participants for a pilot study, which is a crucial part of the research process of deciding upon a final design. Our final goal of deciding on a final design has been met through much hard work and critical thinking during discussions.

In the upcoming fall of 2007 I look forward to continuing this study, furthering my skills using data analysis software and interpreting data. Because the paper we are writing will be submitted for publication, I will learn about the process of composing and submitting a manuscript, and responding to reviewer feedback. Finally, I look ahead to giving presentations which will enhance my ability to communicate research findings.

Personal Statement

By participating in the Summer Undergraduate Research Program I have had the opportunity to integrate all of my knowledge and experience. Participation has not only spiked my interest in experimental design, rationale, and findings, but has allowed me to grow and expand as both a student and researcher. I have become more familiar with literature and the research process. I have gained an extensive amount of knowledge regarding current theories and data in both fields of psychology and marketing, which in turn has furthered my ability to search for and integrate literature within and across disciplines. Discussions have helped to develop my critical thinking skills in terms of understanding and evaluating research. I have become skilled in participant recruitment, stimulus creation, data collection and collaboration with others.

Participating in the Summer Undergraduate Research Program has also significantly contributed to my academic and career goals. I plan to attend graduate school next year to do psychological research. I have expanded my creativity by constructing this study and have expanded my ability to tackle the numerous challenges involved in research, both of which are crucial for success in a research-oriented graduate school.

Sociology and Anthropology

Social movement activism in Trenton: anti-violence and immigrants' rights initiatives

Joanna De Leon, Sociology
Faculty Mentor: Dr. Elizabeth Borland

2007 SURP/NCUR Research

Our study of social movements in Trenton, NJ focuses on anti-violence initiatives and Latino/a community advocacy. Through theory-driven archival research, participant observation, and interviews with community leaders, we examined Trenton area organizations' activities, infrastructure, and perspectives on local, as well as national, social issues. This ongoing project advanced research efforts that took place during the summer of 2006, allowing us to expand on our already existing knowledge and understanding of activism through Trenton's social, economic, and political contexts. From a preliminary analysis of the data collected thus far, we have been able to observe not only the manner in which social movement groups work within their environments, but several points of comparison between the two movements as well. Religion plays a prominent role in both movements. They are also both relatively young and small in size. However, the data also suggest that major differences exist, particularly in regards to the level of grassroots involvement in each movement, activists' perceptions of the communities they serve, and movement groups' characterization of and approach to the issues they address. Our research remains a work in progress as the findings lead us in the direction of deeper analytical work.

Personal Statement

I feel that this summer research experience has been invaluable to me in many ways. The program has given me the opportunity to practically apply what I have learned in classes, as well as further develop my interpersonal skills and confidence in my own abilities. In addition, the program's interdisciplinary nature allowed me to attain a deeper understanding of the dynamics that shape Trenton's current state. Through many of the interdisciplinary program's aspects, including discussion meetings and a tour of the city, I have gained a greater appreciation for the Trenton community.

Environmental injustice in North Trenton: the MLK/Jefferson site

Tamaria Green, Sociology and Anthropology
Regine Saintilien, Sociology and Anthropology
Faculty Mentor: Dr. Diane C. Bates

2007 SURP/NCUR Research

This summer we continued a study of North Trenton residents and their experience with a contaminated construction site on the grounds of Jefferson Elementary and Martin Luther King Middle Schools. The multi-faceted case involves the construction of a Kindergarten through 8th grade school in the North section of Trenton where the construction was halted in 2005 because of contaminated field soil found on the site. A prolonged standstill in the remediation of the construction site was caused by concerns of who would pay for the removal and clean up of the site. Because of this, demolition of the half-completed school and removal of the cancer causing contaminants on the site was not completed until 2007. Meanwhile Martin Luther King Middle School, directly adjacent to the construction site, closed for school maintenance and safety issues. Therefore, the students do not have a school in their community to attend, and are currently attending other neighborhood schools..

The research team made several strides this summer by conducting interviews, reading archival newspaper articles, researching topics such as urban schools, the Abbott vs. Burke court decision, affordable housing and gang violence. Interviews were conducted with representatives of New Jersey's Department of Environmental Protection, Trenton's school district, residents, and former students of Trenton public schools. The research assistants attended two public meetings, one school board meeting and the school district's Facility Advisory Board public meeting. They also sifted through public data which reported the housing ownership trends in North Trenton around the construction. Although the team is still at the groundwork stage of researching this case, the researchers have found that North Trenton, like many urban settings around the country, face the most disheartening challenges in the community, education, government unemployment, poverty, housing, and gang/school violence. The unfortunate case of MLK/Jefferson Elementary School construction only adds to the stresses of a troubled neighborhood like North Trenton. During the next academic school year (2007-2008) more research will be conducted on this case in hopes to find more causal changes linking these issues together and finding possible solutions that may be applied to North Trenton's dilemma.

Personal Statement - Tamaria Green

I can truthfully state that this summer has been a both enjoyable and challenging one; enjoyable because I've learned and perfected many marketable skills such as using SPSS. Challenging because there always seems to be a rough starting point at which you begin slow, trying to contact people and obtain interviews, for example, and as the program progresses, you begin to set up interviews and really start moving and before you know it, the summer program is over. This can be disappointing. Fortunately, I have the opportunity of working on this project for a full academic year and am planning on writing a senior thesis on the research and findings I have accumulated from the past

years. This will undoubtedly help me when applying to graduate programs as it will become part of a portfolio of my undergraduate work.

Personal Statement - Regine Saintilien

This summer research was a very rewarding experience for me. I got to research a project that aligned with my interests. The work helped me to refine my interviewing skills, including conducting and transcribing interviews. I also had to opportunity to hand code data in excel as well as work in analyzing data using SPSS. Applying theory and methods learned in class was the most fascinating aspect to me because it allowed me to take the knowledge that I have acquired throughout the years in order to help make a difference in the community which surrounds my school. Working with other faculty students teams helped with my public speaking as well as my interpersonal skills. The lessons and skills that I have gained from this hands on research are irreplaceable.

Analysis of the impacts of the relocation of Capital Health System Hospital (CHS) Mercer Campus to Hopewell Township, NJ on the City of Trenton.

Angel Jesus Hernandez, Sociology
Faculty Mentor: Dr. Martin Bierbaum

2007 SURP/NCUR Research

The relocation of Capital Health System Hospital (CHS) Mercer Campus is a business move; it is relocating to improve its patient mix to ensure its fiscal solvency. In 2006, CHS—Mercer Campus was uncompensated for approximately $16,399,000 in charity care. to sustain being uncompensated for such large sums of money. At the current rate of uncompensated healthcare costs, CHS—Mercer Campus would reach an economic crisis around 2015. At that time, CHS—Mercer Campus would not have the funds it needs to secure its relocation, and possibly face bankruptcy. For this reason, CHS—Mercer Campus is being fiscally responsible and strategically prudent in moving at a time when it has such funds secured. While reducing the total amount of healthcare services located in the City of Trenton is unfortunate and may have negative local impacts, it may be preferable to have the hospital relocate six miles away while having some of its services shift to CHS—Fuld Campus rather than have the hospital face possible bankruptcy and an entire loss of hospital services approximately eight years from now. While this case study on just a single hospital's relocation raises serious concerns about the way that this society delivers health care to its most vulnerable and least advantaged populations, the exploration of such concerns remains for another project that will extend far beyond the limited scope of this study.

Personal Statement

The objective of my research was to explore what impacts the relocation of the Capital Health System (CHS) Hospital—Mercer Campus will likely have; and to offer preliminary recommendations on ways to mitigate those impacts. I approached this study apprehensively, because I considered myself a novice in terms of my understanding of the United States healthcare system. Courses that I have taken at TCNJ have provided me with an overview of the system; I feared that my lack of detailed knowledge might negatively affect my work perhaps leading to unforeseen obstacles as my research progressed this summer. Fortunately, access to existing literature, including summaries of State and Federal healthcare policy, and the prior knowledge of my faculty mentor, Dr. Martin Bierbaum, proved that these fears were unfounded.

As a result of working on this study, I was able to achieve a deeper and more profound understanding of the healthcare system as a whole, and perhaps even more importantly, what factors affect a hospital's fiscal solvency. I also learned how inter-disciplinary and multi-faceted hospital administration can be. I now more clearly understand the ways that social, economic, and political factors affect the fiscal stability and general direction of a hospital. There is much more to running a hospital than just doctors, nurses, and patients. In coming to grips with the pressures experienced by hospital, I was provided with a "window" on the inadequacies of contemporary United States healthcare policy.

Exploring social entrepreneurship in the Trenton area

Valerie Koch, Sociology and Economics
Faculty Mentor: Dr. Dave Prensky

2007 SURP/NCUR Research

Social entrepreneurship is the development of a revenue generating program that matches the mission of the organization and is aimed at solving social issues. The revenue made from these types of programs is generally used in addition to donations and grant money and in turn increases the sustainability of the organization. Despite the availability of resources and encouragement by outside entities like the Economic Development Authority (EDA), organizations are still holding back. The following research project was designed to determine what non-profits in the Trenton area think about revenue generating programs and what they are or are not doing about it.

By using the Mercer Regional Chamber of Commerce non-profit membership database, we were able to complete ten interviews with non-profits and two interviews with outside entities, or capacity builders, within an eight week period. We also attended an introductory workshop on social entrepreneurship for non-profits held by the EDA and Aperio. While some had successful programs, the majority did not. Concerns included not having sufficient business skills to develop a program, lack of interest from board members and funding sources, legal concerns, lack of time or staff, unaware of sources that would cover start-up costs, and inability to brainstorm a money making idea. Overall, all of those interviewed had a positive attitude about the concept and all agreed that they would encourage other non-profits to consider it.

The non-profit world is facing decreasing sources of funding, increasing numbers of organizations, and therefore an intensified competition for needed income. The future of social entrepreneurship relies on the continued marketing of success stories and the availability of funding sources to cover pre-development costs. Non-profits could be more successful at creating and managing revenue generating programs by acquiring the appropriate business skills through training seminars. The future non-profit workforce also needs to realize that business skills are just as important as social service skills if they hope to assist in the success of their organization. Social entrepreneurship will greatly help the non-profit community if it continues in the right direction.

Personal Statement

The SURP/NCUR program was a great way to learn about issues in the Trenton area – something I knew very little about. The group held weekly discussions that covered a variety of topics and it was interesting to see how everything came together. While we may not have brainstormed an exact formula for future success, we were able to make some recommendations for where we would like to see the city go. In my individual project, I was able to apply my interest in socio-economic issues and I learned a great deal about current events in the non-profit world. I now know how I would like to acquire more business skills before entering a field in public policy. Overall the program was a great opportunity and I can only say that I wish it was a bit longer!

From the 'burg to el Barrio: Ethnic trends in Chambersburg

Johanna Soto, Sociology
Dan Suarez, Sociology
Faculty Mentor: Dr. Rachel Adler

2007 SURP/NCUR Research

The Chambersburg project started five years ago with Dr. Rachel Adler and several other students. Dr. Adler focuses on the ethnic transition of Chambersburg, a once very Italian neighborhood, which changed a little less than a decade ago into a Latino community. In her prior research she collected 150 interviews from both Italian and Latino Chambersburg residents. As this ethnic transition occurred, there was also an influx of Latino businesses. For the summer of 2007, we focused on conducting interviews with several of the Italian and Latino business owners. The interviews lasted a little over an hour and focused on the life history of the owner as well as the business history. We used a list of businesses that was compiled last summer by Johanna Calle. Because the list was a year old we took a trip into Chambersburg and made changes to the list.

The bulk of our research consisted on setting up interviews with business owners which took a greater amount of time then previously planned. In order to set up interviews we called the businesses and asked for the owner after introducing our research. Unfortunately, our method of using the telephone was not very successful. Many people were hesitant to put the owner on the telephone and usually asked us to call at a later time or a different day. The major problem I encountered with the telephone is the lack of trust Latino businesses had when I called. These Latino businesses did not know me and could not trust that I in fact was a TCNJ student doing research. With the history of raids in Trenton, it was understandable for Latino businesses to distrust me. As Dan relied on the personal contacts of Dr. Adler to confirm interviews with Italian business owners, I took a different approach. I took a trip to Chambersburg and visited the local Latino businesses. After introducing myself and the research, people were more eager to find the owner and confirm interviews.

We were able to conduct eight interviews within the eight week period. We have several participants that we wish to interview during the rest of the summer. Our research does not have definite results because it is an ongoing project with a great amount of data from previous research that need to be analyzed. We did conclude that Dr. Adler's study may need to expand and include African Americans because they seem to be a major focus when interviewing the Italian owners.

Personal Statement - Johanna Soto

Working on this summer research I improved not only my interviewing skills but I also learned different techniques for setting up interviews. It was almost impossible for me to talk to the owner on the phone which led me to personally visiting the businesses. Having to conduct the interviews in Spanish was a very interesting aspect for me because it created a connection with the owners that they might not have had with someone who could not speak Spanish. This summer research allowed me to open up more and taught me to be more insistent when trying to get potential participants, especially business

owners. All the research conducted in Trenton by other teams allowed me to learn and better understand my town, Trenton.

Personal Statement - Dan Suarez

My summer research was one of the most valuable learning experiences of my youth. As an interviewer, I've learned much about dealing with people. I've become better at establishing a rapport with new people, a skill I'll always find use in. I've learned a lot about time management, working under deadlines, being proactive, and solving problems on my own. I had to think on my feet, adapting to changing situations. Participating in the NCUR program helped me develop many important skills that I might not have been exposed to in a traditional classroom setting. I met a lot of good people, learned about myself, others, and the world around me, and *had fun doing it,* the importance of which cannot be underestimated.