Student Summer Scholars

Summer Showcase

August 4, 2011
Hager-Lubbers Exhibition Hall/Loosemore Auditorium
DeVos Center, Pew Campus, Grand Rapids, MI
4:00 PM – 7:00 PM

Welcome to the 2011 Student Summer Scholars' Summer Showcase!

The Student Summer Scholars (S3) Program provides funds for a student and faculty mentor to devote twelve weeks to a research and/or creative project during the spring/summer semester. Through these grants and the mentorship of a faculty member, the S3 program offers a unique opportunity for undergraduate students to do hands-on, professional research and creative practice in their chosen field. Combining academics, field work, and a reflection component provides students with a meaningful learning experience that helps to prepare them for graduate school and future careers.

For each S3 participant, the project begins with an innovative and thoroughly researched proposal. With guidance from faculty mentors, students identify a research question or an area of creative practice, and then shape the structure of their project. The value of mentorship is an important part of S3. Experienced faculty mentors act as support and a sounding board for their students.

Through S3, students begin to direct their own educational paths and familiarize themselves with the requirements and structure of professional research. Participants quickly learn that a successful project requires more than scholarship. Detailed planning, attention to budget, and creativity allow student researchers to innovate while working in a self-structured environment, and to cope with unexpected complications. By building on a foundation of academic and critical thinking skills provided by undergraduate courses, self-motivated students can use S3 to further their knowledge in a specific area while learning to incorporate academics with professional work.

The project's critical assessment component requires each participant to reflect on and evaluate his or her own project and the S3 experience as a whole. This comprehensive analysis of a self-directed project provides students with an opportunity to examine their own learning styles and academic strengths in order to shape further learning and working habits. S3 provides students with a new lens through which to view their long-term educational, work, and life plans.

We thank you for joining us for this important step in the learning process, and we know you will enjoy seeing the S3 Scholars' work thus-far.

2011 Student Summer Scholars

Eric Baumgarten
Megan DeKievit
Heidi Fegel
Eliscia Fought
Megan Glazier
Timothy Godfrey
Laura Goldsmith
Paige Goote
Justin Hackett
Brandon Harris
Noah Jansen-Yee
Amy Jenkins
Elizabeth King
Greg Kortman
Jonathan Lehmann
Kája Lill
Lauren Longo
Rachelle McLaughlin
Kevin Mittner
E. Drake Parker
Jessica Riley
David Schlueter
Kirsten Tissue
Misty Van Brocklin
Jacob Voetberg
Brittany Wildgen

Order of Events

4:00 PM – 5:00 PM	Remarks by Dr. Rachel Powers, Chairperson of Undergraduate Research Council
	Oral Presentations by: Eric Baumgarten Megan DeKievit Justin Hackett Noah Jansen-Yee Elizabeth King Kája Lill
	Introduction of Poster Presentations
5:00 PM – 5:45 PM	Poster Presentations by: Heidi Fegel Eliscia Fought Megan Glazier Timothy Godfrey Laura Goldsmith Paige Goote Brandon Harris Amy Jenkins Greg Kortman Jonathan Lehmann Lauren Longo Rachelle McLaughlin Kevin Mittner E. Drake Parker Jessica Riley David Schlueter Kirsten Tissue Misty Van Brocklin Jacob Voetberg Brittany Wildgen
6:00 PM – 7:00 PM	Dinner

Eric Baumgarten
Faculty Mentor: Matthew Lawrence Daley, History

The Sincerity of Reform: Henry Ford's Five-Dollar Day and the Ideological Underpinnings of Progressive Era Reform

The Ford Motor Company's Five-Dollar Day labor program led to a multifaceted array of philanthropic initiatives that ran between 1914 and 1921. An impetus of reform found its genesis in the Five-Dollar Day. The progressive spirit within the company led many executives to initiate programs influenced by their own connection to intellectual discourses within the public discussion of social concerns. Often, historians have sought to analyze the entire history of the company or Henry Ford himself, especially with concern for a production orientation. Contrary to this focus, this research shows that between 1914 and 1921 the Ford Motor Company utilized massive financial resources to implement intellectually motivated reforms within their employment base and the City of Detroit. Though diverse, the reforms shared a common focus in direct and immediate action. The financial capacity to employ wide and powerful reforms, coupled with a production oriented attitude demanding quick results, made these programs dangerously effective in yielding results. Through this study, a brief and intense example of welfare capitalism illustrates the implications of broad corporate reach.

Megan DeKievit
Faculty Mentor: Tim Froncek, Music

The Electric (Fender) Bass: Its Origins and Influence on the Evolution of Jazz and the Development of Contemporary Music

The electric bass was an idea born of the late 1940's, a time when jazz bands were getting larger and it was becoming more difficult to hear an upright bass over other instruments. The first commercially produced electric bass was developed by Fender and available for distribution in 1951. Also starting in the 1950s, the world of jazz was changing—it was becoming an intellectual endeavor, more about musicians, and less about dancers. After the introduction of the electric bass, the position that the bass held within an ensemble began to change as well. Before the 60's and 70's the primary function of the bass instrument in jazz was to keep time and lay down the harmony of the chord progression. It was mainly a background, supporting instrument, for other members of the ensemble. After the 70's, solo bass and especially solo electric bass, had become more acceptable, and jazz diverged even more with new innovations and styles that continued to push boundaries—even to the point where people hesitated to still call it jazz. Other forms of music, such as R&B, funk, and soul also emerged, which are similar to jazz, and often times created by jazz musicians, but characterized by different bass lines. Today the electric bass is a solo instrument and has been used for wide varieties of music. This presentation shows how the perspective of the bass has changed since the introduction of the electric bass guitar, and how this change was facilitated by differences between it and its predecessor, the stand-up, acoustic bass. It uses interviews, research, and recordings to contrast bass lines from before and after the introduction of the electric to jazz ensembles and show the difference that this instrument has made in modern jazz music.

Heidi Fegel
Faculty Mentor: Andrew Schlewitz, Latin American Studies

Exploring the Institutional and Ideological Sources of Guatemalan Military Interventionism

What explains the Guatemalan military's intervention in politics and its eventual take over of the government in 1963? One answer is ideology, and if ideology matters, than it would make sense to look at the education of interventionist officers in Guatemala. To find the link between education and militarism, we spent two months sifting through recently declassified military documents in the *Archivo Central de Centroamérica* in Guatemala City. This poster presentation describes the biggest challenges and key finds as we dug through documents, piecing together the fragments and shards of information we uncovered. It will also discuss life and learning outside the archive and how they affected the research experience.

Eliscia Fought
Faculty Mentor: Nathan Barrows, Chemistry

Do you speak Chemistry? Assessing the degree of inconsistency between expert and novice interpretations of exam questions

A prominent theme in education research today is the reliability and validity of exam questions. Educators are faced with the enormous task of writing exam questions that not only test the appropriate concepts, but also ensure that every student will interpret the questions in the intended way. There are numerous factors that contribute to the misinterpretation of exam questions. The purpose of this study is to determine what the most significant factors are, and the best to prevent them.

To help identify the differences in interpretations between experts and novices, we are looking at one specific chemistry course, CHM 116. We will be conducting a series of interviews with both faculty who have taught CHM 116, as well as students who have passed CHM 116 all within the last five years. The purpose of the faculty interviews will be to determine how faculty interpret difficulty and clarity of exam questions, and the process they go through when creating exams. The purpose of the student interviews will be to determine how students interpret difficulty and clarity of exam questions, and to explore the exam-taking experiences students have had in the discipline.

Megan Glazier
Faculty Mentor: James Christopher Reed, Biomedical Sciences

Bone Densities of the Frontal and Maxillary Sinuses, Determined by CT Scans to Aid in Limiting Complications of Endonasal Sinus Surgery (ESS)

Endonasal sinus surgery (ESS) is a common surgical procedure that is used to relieve chronic, problematic conditions associated with the paranasal sinuses of the cranium. One possible complication that can arise during ESS is damage to the bone surrounding the sinus. Complications due to this damage can include blindness, penetration into the eye orbit, periorbital injury, and dural lesions. In order to limit these complications, the least-dense portion of the bony sinus wall should be avoided. Previous research on plastinated specimens has shown that x-rays can be used to determine the areas of the sinus wall to avoid during ESS. A more accurate means of determining areas of bone to avoid during ESS is to use computerized tomography (CT), which images the body based on tissue density. Here, we present the results of an examination of 36 cranial CT scans provided by Saint Mary's, representing all age groups and both sexes. Using analytical software (Amira 3.5), the density of bone surrounding the maxillary and frontal sinuses were examined and the least-dense portion of the sinus walls were determined using Hounsfield Units (HU's). By determining the density of bone by an absolute measure (HU's), the area of bone to avoid during ESS can be delineated with accuracy.

Timothy Godfrey
Faculty Mentors: Sheila Blackman, Biology & Pei-Lan Tsou, Cell and Molecular Biology

Identification of the LEA gene family in the Orchidaceae

With over 25,000 species, *Orchidaceae* represents one of the largest and most diverse families of flowering plants. In addition to the unique aspects of developmental reproductive biology and the specialized pollination and ecological strategies of orchids, development of new hybrids is economically important to floricultural industries. Wild orchids are especially susceptible to increasing anthropogenic disturbances, and all members of this family are threatened or endangered in their wild state. Like other threatened plant species, long-term seed storage in seed banks is crucial for the preservation of this family. Unfortunately, such storage will not be successful until the complex seed biology of orchids is understood. Our aim is to contribute to the understanding of orchid seed biology and hence the design of seed banking protocols for this family. Plant seeds are divided into two large groups. So-called orthodox seeds dry out as a natural part of development to as low as 5% (fresh weight basis) water at the end of maturation. Orthodox seeds require low water contents and temperatures for storage. On the other hand, recalcitrant seeds can not be dried without compromising their internal structural integrity and storage at low water contents would be deadly for these seeds. At present, it is unclear whether orchid seeds are orthodox or recalcitrant. While their exact role in embryogenesis is ambiguous, the accumulation of late embryogenesis abundant (LEA) proteins often has been implicated with the acquisition of desiccation tolerance in orthodox seeds. In hopes of better understanding the acquisition of desiccation tolerance in orchid seeds our short term goal was to identify members of the LEA protein gene family. Hybrids of the genus *Phalaenopsis* are among the top-traded blooming potted plants worldwide. However, despite the unique aspects of this species, relatively few molecular studies have focused on them. Using the limited genomic orchid resources available, we were able to design primers to successfully isolate cDNA clones of representatives of four unique LEA protein genes from hybrid *Phalaenopsis* plants. Using the sequences obtained from this work, we hope to utilize quantitative-PCR to monitor the expression of these 4 LEA gene transcripts at varying stages of seed development and drying conditions. This work will hopefully help to elucidate the function of LEA proteins in orchid embryogenesis and contribute to the construction of a successful seed banking protocol for orchids.

Laura Goldsmith
Faculty Mentor: Michael Henshaw, Biology

Don't spray the wasps! Using *Polistes* paper wasps for pest management in the home garden

Pest control poses a challenge to all gardeners, especially those using organic practices. We examine the possible potential use of *Polistes* paper wasps as a bio-control agent in the organic backyard garden. *Polistes* are important predatory insects which may potentially consuming thousands of soft bodied pest insects per season. We set up 8 garden plots measuring 3ft by 8ft each. In each plot we planted a small garden with leaf lettuce, cabbage, pole beans and tomatoes. In 4 experimental plots we established 8 *Polistes dominulus* nests by transferring wasp nest from the surrounding area. In the 4 control nests, there were no wasps. We measured the extent of damage from insect pests, the abundance of pest insects, and the dry weight of the plants at harvest. So far, we have harvested the leaf lettuce. The lettuce matured before the colonies where established, so as expected, we detected no differences between the plots with wasps and the plots without wasps. While it is still too early to have results from the other three vegetables, there seems to much more damage and caterpillar activity on the cabbages from the plots without the wasp boxes. Based on our preliminary work so far, it appears that *Polistes* wasps may prove to be effective in controlling pests for some but not all crops common to the backyard garden.

Paige Goote
Faculty Mentor: Daniel Bergman, Biomedical Sciences

Crayfish as a Potential Control for Zebra Mussel Populations

The expansion of zebra mussel distribution into inland waterways of North America has created significant abiotic and biotic challenges. Zebra mussels foul a wide array of submerged substrates including rock surfaces, plants, native bivalves, dock walls, and watercraft. Fouling of water intake pipes and associated installations can severely impair water delivery to hydroelectric, municipal and industrial users, necessitating proactive or reactive control measures. Mussels increase water clarity by removing suspended clay, silt, bacteria, phytoplankton, and small zooplankton, which focuses nutrients into the bottom of lakes away from much of the food chain and also causes increases cyanobacterial toxins due to increased growth of blue-green algae. However, mussels are exploited by a host of predators, most notably waterfowl, fish, and crayfish that can return some of the nutrients to the food chain, but unfortunately even with predation much of the nutrients remain at the bottom of lakes. We have tested one crayfish species (*Orconectes propinquus*) for feeding responses when given an opportunity to interact with zebra mussels (5 consecutive days). Crayfish did ingest zebra mussels and currently we are ascertaining any size-related selection preferences that may be exhibited by the crayfish.

Justin Hackett
Faculty Mentor: Dawn Clifford Hart, Cell & Molecular Biology

Regulation of the scaffolding protein Mid1 in fission yeast cell division

Cell division is an integral process in all biological organisms for growth and reproduction. Yet this process is shrouded in mystery because of its complex and poorly understood mechanisms. Discovering the secrets of these processes will lead to a greater understanding of the unregulated cell division characteristic of cancer and even possible treatments for this disease. Many of the genes that are involved in human cell division are conserved in many other organisms and offer a simpler way to observe and learn about the cell division process. The fission yeast *Schizosaccharomyces pombe* provides an excellent model organism for such research. The conserved annilin homolog, Mid1, is shown to be a key regulator in cell division and mutants of Mid1 show many mitotic defects. For example the septa that forms the new cell wall between dividing cells is often malformed or angled. Mid1 delete cells also show a misplaced division site that causes unequal division of the daughter cells. The regulation of Mid1 has been shown by previous research to be dependent on several enzymatic proteins. The goal of current research is to examine the interaction between Mid1 and an essential mitotic enzyme, polo kinase, and examine the mitotic phenotypes associated with this interaction.

Brandon Harris
Faculty Mentor: Carl Ruetz, Annis Water Resources Institute

Comparing two methods for estimating stream fish abundance

Unbiased estimates of stream fish abundance are critical for sound fisheries management. Most studies investigating bias associated with stream fish population estimates primarily focus on salmonids, yet non-game fishes often comprise a major portion of stream fish assemblages. We evaluated mark-recapture and removal methods for estimating the abundance of mottled sculpin (*Cottus bairdii*), a common non-game fish found in streams. Specific objectives were to: (1) compare abundance estimates using mark-recapture and removal methods, (2) assess potential removal method bias by comparing estimated abundance to known abundance, and (3) evaluate assumption that the population is closed (i.e., no additions or deletions during sampling). Fish were sampled via backpack electrofishing at eight streams, and each stream was sampled over a 2-day period. On day one, fish were batch marked in three sections of a 90-m reach in each stream. On day two, fish were captured and temporarily removed from the stream during four electrofishing passes, and the number and marking status was recorded during each pass. Thirty individuals were then held in cages overnight to assess survival and loss of marks. We found removal estimates generated by program CAPTURE were typically lower (38%-44%) compared to mark-recapture abundance estimates. Removal methods also consistently underestimated (39%-48%) known mottled sculpin abundances. Minimal movement of marked fish (mean=4.4%; range=0.96%-17.5%) was observed in all but one of our study streams. Survival of mottled sculpin after capture was 100% (n=405 fish), and no marks were lost among fish held overnight. Our preliminary results suggest that the closed-population assumption was valid and the removal method yielded negatively biased estimates of mottled sculpin abundances in small streams. Consequently, we recommend that fisheries managers use mark-recapture methods to estimate abundance of small, non-game fishes.

Noah Jansen-Yee
Faculty Mentor: Eric Snyder, Biology

Food webs and rivers: Importance of floodplain connectivity

In recent years, ecological research in the study of trophic interactions between contiguous ecosystems and microhabitats has begun to develop; however, this topic remains not entirely understood. These interactions are important because they contribute to healthy ecosystem structure and function. The focus of this project was to more fully understand and document the dynamic interactions and flow of energy between stream and riparian zones in both a wetland and a cedar (*Cedrus spp.*) dominated reach. We hypothesized the base of the aquatic food web would be autotrophic in the wetlands with energy derived mainly from in-stream processes; whereas the cedar-dominated reach would be more heterotrophic due to riparian shading and limited sunlight. In this reach, energy that sustains the food web should be largely derived from riparian leaf litter inputs. Because leaf litter enters the stream in the fall, there is a time delay (termed a reciprocal subsidy) such that energy transfers between stream and riparian zones are asynchronous. We predicted that there would be a stronger energy flux in the cedar reach due to the increased area conferred by the larger and more complex tree structure relative to the wetlands. We are using stable isotopes of carbon and nitrogen to measure food web structure and to estimate energy transfer rates. In addition, we are measuring organic matter content of various trophic levels, comparing phosphorous uptake rates and spiraling, and comparing physical habitat between reaches. Finally, we have conducted extensive sampling of aquatic macrophytes, macroinvertebrates, and fish. Preliminary results indicate that the cedar reach has more tree cover and significantly higher amounts of leaf litter, with more diverse and abundant macroinvertebrate and fish communities compared to the wetland reach. Two possible explanations for this include (i) high leaf liter inputs provide significant energy to the stream, and/or (ii) increased tree-fall into the stream has increased physical habitat complexity. Further results and details are being analyzed as sample processing is still being completed.

Amy Jenkins
Faculty Mentor: Martin Burg, Biomedical Sciences

Identification of tissue-specific mRNA expression from the Hdc gene of Drosophila

The Histidine decarboxylase (*Hdc*) gene of *Drosophila melanogaster* is responsible for the synthesis of histamine in both the brain and peripheral tissues. Recently, two mRNA isoforms of the *Hdc* gene were identified, which differ at either end of the mRNA molecule. The goal of this project is to determine whether Hdc mRNA isoform expression is tissue-specific, potentially reflecting the difference in histamine distribution in the adult fly. For this project, two regions of the *Hdc* gene are being used for anti-sense riboprobe synthesis: one probe should bind to all *Hdc* mRNAs, and the other probe should bind specifically to a unique mRNA isoform. Using PCR, we amplified a 230 base pair fragment from the *Hdc* gene that is unique to only one mRNA isoform and used TA cloning to insert this fragment into the pGEM-T Easy vector. Then, the DNA from the transformant cells was isolated, sequenced, and linearized using specific restriction endonucleases. The linearized DNA template was subsequently used with the Invitrogen FISH Tag RNA kit to synthesize an amine-modified RNA that should bind to all *Hdc* mRNAs. Then, the amine-modified RNA was labeled with the fluorescent dye Alexa fluor 488. We are currently synthesizing the 230 bp isoform-specific riboprobe with Alexa fluor 594, so that double labeling experiments with both mRNA probes may be accomplished. To complete this project, both RNA probes will be hybridized to adult *Drosophila* tissue sections and the resultant signals can be detected using fluorescence microscopy. Results are expected to demonstrate that one mRNA isoform is solely expressed by histaminergic neurons in the CNS, while the other is only expressed in the peripheral tissues, such as photoreceptors. In the future, we plan to expand this project by using tissue sections of flies at different developmental stages.

Elizabeth King
Faculty Mentor: Merritt Taylor, Biomedical Sciences

Mapping Neural Stem Cell Domains in the Ventral Midbrain of the Chick Embryo

Markers expressed in the developing embryo can distinguish different areas of the nervous system. Specific areas can be associated with neural progenitors that give rise to specific types of neural cells including GABAergic or dopamineric neurons. These markers have been used to map the midbrain of the developing mouse, however the midbrain of the chick embryo has not been mapped in detail.

In order to identify markers associated with dopamine neurogenesis in their endogenous locations, we used in situ hybridization and immunofluorescence techniques. We identified the normal expression pattern of Nurr1, Nkx6.1, and Nato3 in chick midbrain after 5 days of development. We then compared expression of these markers after 6 and 7 days in order to identify changes in their expression at different developmental time points. These data suggest that many markers for dopamine neurogenesis are consistent between the chick and mouse embryos. Using overexpression studies of neurogenic genes we were able to observe effects on markers for dopamine neurogenesis.

Greg Kortman
Faculty Mentor: Randy Winchester, Chemistry

Resonance and the Carbon - Silicon Double Bond

The allyl anion is a primary carbanion attached to a carbon-carbon double bond. It has fundamental significance, because it is the smallest organic molecule that displays resonance between two possible Lewis structures which gives the molecule added stability. The allyl anion is also of practical interest because of its similarity to the intermediate in anionic butadiene polymerization, which is important in the production of rubber. One measure of the extra stability due to resonance for the allyl anion is its rotational barrier, which has been found to be 10.7 kcal/mol for allyllithium.

The silaallyl anion is what is formed if one replaces a carbon atom of the allyl anion with a silicon atom. Like the allyl anion, the silaallyl anion has both practical and theoretical significance. Practically, the silaallyl anion could be useful as a ligand on transition metals or as an intermediate in the formation of new polymers. Once the silaallyl anion has been synthesized the rotational barrier can be measured in a manner similar to that for the allyl anion, which will be useful for determining the significance of the resonance structure of the silaallyl anion.

The steps that lead to the silaallyl anion have been optimized and a convenient method for modifying the substituents at silicon has been developed. Previously chlorodiphenyl(vinyl)silane was reacted with lithium which should form the anion through a radical pathway, but the diphenyl system proved to not be sterically hindered enough to inhibit polymerization so larger protecting groups needed to be explored. We are investigating the use of the chlorodimesitylvinyl silane as one route to the silaallyl anion. A second route we have studied involved synthesizing 1,1,1,3,3,3-hexamethyl-2-vinyltrisilane and then studying its reaction with tert-butyllithium. We observed a color change which is indicative of the formation of the silallyl anion, but because prior steps lead to products that are difficult to isolate, we did not have enough anion to fully characterize it. Currently the 1,3-di-tertbutyl-1,1,3,3-tetramethyl-2-vinyltrisilane system is being synthesized which should solve the issues involved in the synthesis of 1,1,1,3,3,3-hexamethyl-2-vinyltrisilane and give us more of the product anion to study.

Jonathan Lehmann
Faculty Mentor: Matthew Hart, Chemistry

The Synthesis of Modified Chromenes

200 million people worldwide are living with a thyroid disorder related to a hormonal imbalance. Symptoms of this imbalance include deviations from normal heart rates and metabolic rates. Recent discoveries have shown that a compound known as T1AM is capable of affecting some of these same physiological conditions. The receptor that T1AM activates, TAAR, has been the subject of much current research. Our approach to learn more about TAAR involves the synthesis of compounds that regulate its activity. These molecular targets resemble T1AM, but include some key structural differences. For example, the molecular scaffold that is the basis of our target compounds (known as chromenes) is more rigid than T1AM due to the incorporation of a six carbon ring. To date, our research has focused on optimizing the reactions that produce this scaffold. The successful production of a panel of these chromenes has set the stage for subsequent reactions that will allow us to generate many T1AM analogues. By understanding the regulation of TAAR we may gain a greater understanding of its role in biology and human physiology.

Kája Lill
Faculty Mentor: Kurt Ellenburg, Honors College

Stylistic Divergences in Jazz: Comparing the European and American Mainstream Jazz Traditions

Jazz is a musical genre which historically has thrived on the evolution of music by challenging and changing normative musical practices. However, the later half of the of the 20th century saw a development within the musical community of the jazz conservative, as represented today by **Jazz at the Lincoln Center**, who maintain a tradition of performing jazz in a style developed prior to the 1960's. This presentation will illustrate what these traditions are, in context to rhythm, melody, harmony, form, improvisation, and song selection, and how artists, such as those of the **ECM** record label, continue to evolve and break these traditions. The intent is not to display that there exists in jazz a strict schism between an american and european tradition, but that their is a continuum along two extremes in which most artists lie closer to the center.

Lauren Longo
Faculty Mentor: Thomas Walker, Political Science

Woodrow Wilson's Personality and his Struggle: A Case Study and "Counterfactual Thought Experiment"

This project investigates the curious decision-making of President Wilson during the debate over American membership into the League of Nations. One scholar referred to Wilson's decision as "radical irrationality." Wilson failed to follow a standard rationality—utility based preference orderings—and pursue his best interest. Rather than making modest compromises and join the League with reservations, Wilson threatened to veto US membership with any reservations, ultimately ensuring failure to join the League. Many scholars have pointed to how peculiarities of Wilson's personality led him to this sub-optimal outcome. Even Sigmund Freud turned his considerable analytic skills to this question. Most of these works emphasize how Wilson's intransigence can be rooted to his subconscious hostility toward his father. In this study we critique those works emphasizing the subconscious and look to Social Learning Theory (SLT) as developed by Albert Bandura. SLT leads us away from the subconscious-hostility-toward-one's-father approach. Instead, SLT emphasizes observational learning. Such an emphasis leads us to explore how the stern Calvinistic approach of his minister father instilled in Wilson the idea that compromise over fundamental issues of right vs. wrong, good vs. evil is simply impossible. Drawing from the early volumes of "The Papers of Woodrow Wilson", published well after Freud's study, we have found little support for Freud's subconscious-hostility thesis. Instead, there is significant evidence to support expectations of Social Learning Theory. We argue that Wilson's decision had little to do with subconscious hostility toward his father and everything to do with his upbringing in a stern, Calvinist household where compromise over fundamentals was never tolerated.

Rachelle McLaughlin
Faculty Mentor: Shaily Menon, Biology

Another Silent Spring? Analyzing Patterns in an Emerging Epizootic in North America

Birds with beak deformities have been documented throughout the literature, although occurrences are rare and not usually extensive within populations. Sudden emergence of deformities in large clusters of animals may indicate a dramatic change in the environment. Recent reports of unprecedented proportions of birds with beak deformities in Alaska caused alarm in the scientific community and prompted this study. We analyzed data on locations of bird beak deformities in North America to detect spatial patterns and correlations with environmental and natural history traits. We used a meta-analysis and statistical techniques to determine significant relationships and strength of effect between deformity and several variables that make certain species more susceptible to deformity, including migratory behavior, diet, age of deformed bird and habitat characteristics. We expect to find higher levels of deformity in species with fish-based diets, which serve as a pathway for biomagnification of toxins. Point locations of deformities were georeferenced and overlaid with data such as land use, environmental contamination and species range to determine spatial patterns. Our study focused on the Great Lakes and Pacific Northwest regions due to high rates of deformity found within populations in those areas. We expect a strong relationship between rates of deformity and levels of environmental contamination. Results from this study can be applied to assist future research efforts focused on determining the etiology of beak deformity.

Kevin Mittner
Faculty Mentor: Georgette Sass, Biology

Rescue of the delorean phenotype in Drosophila melanogaster

Drosophila melanogaster homozygous for the *delorean* mutation exhibits a phenotype with wings that are extended away from the body and noticeably curved downward. This is in stark contrast to wild-type flies with wings that are not curved and are held straight back over the body. This recessive phenotype is thought to be due to a change in *protein kinase N* gene expression during morphogenesis. Along with the wing defect the *delorean* mutation also causes sterility in males and reduced fertility in females. To prove that the *delorean* mutation is in fact a disruption in *protein kinase* gene expression, the addition of wild type PKN should restore the wild type phenotype. Further more this approach will determine the nature of the *delorean* mutation as either a loss of function or gain of function mutation. To rescue the mutant phenotype of the delorean flies we constructed a transformation vector using the pCasper-HS vector containing wild-type PKN cDNA. We will use this transformation vector to generate transgenic flies in which all cells will contain the PKN cDNA under control of a heat shock promoter that activates under elevated temperatures. To activate expression of PKN in specific tissues, we generated an additional construct using the transformation vector pUAST. This vector will give us the opportunity to express PKN in wing tissue and thus address the wing phenotype, specifically. To construct the above transformation vectors we used a technique where by the largest open reading frame of the PKN gene can be generated using a polymerase chain reaction. The resulting PCR product was then cloned directly into the pCasper-HS and pUAST transformation vectors. The transgenic flies that carry the pCasper-HS-PKN and pUAST-PKN constructs will be examined for their phenotype when they carry the *delorean* mutation. In addition our construct will be tested for the ability to rescue a loss of function mutation in the PKN gene known as 06736, a gene that has already been rescued.

E. Drake Parker
Faculty Mentor: David Austin, Mathematics

The Concept of Infinity in Ancient Greek Mathematics

Study over the past decade by the Archimedes Palimpsest Project of the *Method of Mechanical Theorems*, recovered in 1998, has produced evidence that the ancient Greek mathematician Archimedes may have made informal use of actual infinity in his method of discovering geometric theorems. This runs contrary to the Greek tradition of rigorous proof which allows only for the use of potential infinity. We will examine the relevant argument, Proposition 14, compare it with the more traditional Greek infinitary argument known as the method of exhaustion, and consider the questions arising about the Greek attitude toward infinity.

Jessica Riley
Faculty Mentor: Alexey Nikitin, Biology

The Genetic Profile of Early East European Farmers

The study of human genetics continually sheds new light on the understanding of human migratory patterns while inferring cultural and technological exchanges throughout the past and in doing so enriches the fields of anthropology, archeology and history. By analysis of the first hypervariable segment (HVS1) of the maternally inherited mitochondrial genome (mtDNA) phylogenetic relationships between geographically distinct populations can be deduced through region-specific mtDNA lineage (haplogroup) assignment. Following all precautions to avoid tissue contamination, HVS1 sequencing of seven specimens from three pre-historic burial mounds in southern Ukraine has given us greater understanding of the affiliation among ancient inhabitants occupying a region connecting Europe and Asia during a time of cultural, technological and ecological change. By piecing together the age of the artifacts, the details of individual burials, and the geographic origins of mtDNA lineages extracted from the bones, we are attempting to re-create the life histories of individuals interred in these ancient burial plots. On first examination, our results suggest a dynamic continuum of long distance human travel to the Black Sea from as far as Siberia and Central Asia, likely precipitated by a cooling environment and sustained by stockbreeding and the new power of copper trade.

David Schlueter
Faculty Mentor: Jiyeon Suh, Mathematics

Modeling Social Networks with Random and Fuzzy Graphs

Since the introduction and widespread utility of the internet and World Wide Web began in the latter part of the twentieth century, the mathematical modeling of web-based networks has been of interest to mathematicians, physicists, and computer scientists hoping to model such systems in a methodical way. Social networks, made popular by websites like Facebook and Twitter, present a particular challenge to modeling as the result of their specialized growth patterns that reflect human interaction. These patterns include non-trivial clustering and assortative mixing, or positive correlation between degrees of adjacent vertices.

Current modeling attempts of social networks have involved the utilization of random graphs as the primary methodology. Here, the network is simulated by generating a graph using a stochastic process. Despite a number of results in the current literature using binary random graphs, weighted network models, or models that take into account the strength of connection between members, have not been thoroughly studied.

In this project, random weight graph models are extended to the fuzzy case, where fuzzy probability theory drives the stochastic process. To illustrate, suppose that an edge in a weighted graph is known to exist between two particular vertices but the strength of that edge is unclear. To determine the strength of this edge, we find the conditional expectation of a fuzzy random variable conditioned on the strength of mutual friends shared by the two vertices. This conditional expectation is based on an underlying joint probability distribution that implicitly characterizes the expected growth pattern of the individual network. The calculation of expected weight in this manner drives the stochastic process as a new vertex is connected randomly to the graph with each iteration. We discuss the efficacy of our approach as a modeling tool, interesting growth characteristics of the model, and possible modifications to the process.

Kirsten Tissue
Faculty Mentor: Shannon Biros, Chemistry

Development of Novel MRI Contrast Agents

Medical resonance imaging (MRI) is sometimes performed using ionized gadolinium (Gd3+) as a contrast agent. As gadolinium is a nephrotoxin, it is important to use a chelating agent to prevent toxicity to the patient. Current chelating agents are available; however, they suffer from a lack of water solubility or by having a negative affect on water's relaxivity rates. An ideal chelating agent binds well to Gd3+ while allowing it to simultaneously interact with individual water molecules. Our lab is developing a novel class of chelating agents containing carbamoylmethyl phosphine oxides (CMPO's), which have the potential to be more soluble in water than current commercially available agents while retaining a favorable affect on water relaxivity.

Misty Van Brocklin
Faculty Mentor: Margaret Dietrich, Cell & Molecular Biology

The role of CBL10 in flowering

Almost every organism on earth depends on plants as their primary source of food energy. Many of the plants on which humans depend for sustenance are flowering plants. By understanding how flowers develop, we may be able to enhance flower development and increase crop yield. One area of flower development of particular interest is that of the stamen, the male reproductive part and source of the pollen necessary for fertilization in flowers. Multicellular organs, such as stamens, develop via specific stepwise pathways. If there is a malfunction in one of the steps, then the entire process stops and the structure and/or function of the organ is impaired. Each step in such a pathway is governed by the expression of the organism's genes. Mutations in the *cbl10* gene in *Arabidopsis thaliana* prevent the production of a calcineurin-B-like protein (CBL10) and cause a breakdown in the stamen development pathway, resulting in stamens that cannot produce normal pollen and are too short to support fertilization. We can determine where CBL10 acts in the developmental pathway by performing RT-PCR, a common technique used to track gene expression, on normal plants and *cbl10* mutants. If there is equal expression of a particular gene between these plants, then CBL10 must act in a subsequent step of the pathway. If there is unequal expression between the two plant types, then CBL10 must act in a previous step. Initially, we looked at gene expression in leaves of each plant in order to optimize reaction conditions because leaves are larger and more abundant than flowers. Once optimized, we looked at expression in the open flowers of wild type and *cbl10* plants. Preliminary data show that three of the genes studied are expressed equally in the open flowers of each plant, indicating that CBL10 acts in a subsequent step in the pathway. In the future, optimization assays will be performed on several more genes in the pathway and then their expression will be studied in various stages of flower development in both wild type and *cbl10* plants.

Jacob Voetberg
Faculty Mentor: Richard Vallery, Physics

Investigating Antimatter-Matter Interactions in Gases

A positron is the antimatter counterpart to the electron, and when they meet they annihilate converting all of their mass into energy. It has exactly the same properties as the electron, but with an opposite electric charge. When a positron interacts with matter, several things may occur: the positron may annihilate with an electron, the positron may simply scatter off of an atom or particle, or the positron may become bound to an electron. A positron binds to an electron because they are a positive-negative pair, much like in the hydrogen atom; this exotic, short-lived, atom is called positronium. There are two different states of positronium, and the longer-lived state called orthopositronium (o-Ps) offers many interesting atomic interactions to explore.

Theoretical work on the heavier noble gases, xenon in particular, has suggested that the temperature dependence of the rate at which orthopositronium decays is non-linear with increasing temperature. However, there is little experimental data on the heavier noble gases to support the theory. This is in opposition to both the theoretical and experimental work on the lighter noble gases like helium, neon and argon, which have shown a linear dependence with respect to temperature. The goal of this experiment is to investigate the temperature dependence of the decay rate of o-Ps in xenon gas. We will use a high-pressure gas cell with a positron source inside as the basic setup of the experiment. So far, design and construction has been completed on the temperature control system including the temperature controller electronics, the heaters, and the insulated housing for the gas cell. In addition, construction is nearly completed for the gas handling system. Pressure and temperature tests are underway on the seal of the gas cell. The first sets of data for our temperature range of 20 to 300 deg. C. will be collected in the near future.

Brittany Wildgen
Faculty Mentors: Roderick Morgan, Biology & Robert Smart, Chemistry

The Synthesis and Testing of GV-2 Chemical Derivatives for Antibacterial Activity

Infectious disease continues to be a leading cause of morbidity and mortality worldwide despite advancements in many areas of human medicine. Improper and excessive use of antibacterial compounds has led to the rise of resistant species of bacteria. The research project focused on developing a series of new antimicrobial compounds and testing their activity against antibiotic resistant Gram-positive bacteria, such as strains of methicillin resistant Staphylococcus aureus and vancomycin resistant enterococci. New derivatives of an antibacterial base chemical structure were created by attaching a carbon aliphatic chain of varying lengths onto methylanthrinilic acid (the base structure). These compounds inhibited the growth of S. aureus bacteria with minimum inhibitory concentration (MIC) values ranging from 16-128 μg/ml.