

Student Summer Scholars

Summer Showcase

August 6, 2009
Perry Room, Alumni House
4:00 PM – 7:00 PM

Welcome to the 2009 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.

2009 Student Summer Scholars

James Bozung	Corey Kapolka
Rebecca Brittian	Nicolas Krzywonos
Lisa Burson	Elizabeth LaRue
Sarah Clark	Patrick Loudon
Corey Davis	Todd Major
Kaitlin Downey	Shane McGrath
Ryan Enck	David Merryman
Steven Gauthier	Amanda Mitchell
Adrienne Gibson	Ryan Nelson
Anel Guel	Nikki Powers
Bradley Houdeck	Juan Rango
Samantha Howard	Kaitlyn Ratkowiak
Embriette Hyde	Sarala Sarah
Karen Ickes	Donna St. Louis
Lee Jackson	Jarrett Zeman

Order of Events

4:00 PM – 5:00 PM Poster Presentations and Hors D'oeuvres

James Bozung	Karen Ickes
Rebecca Brittian	Lee Jackson
Lisa Burson	Corey Kapolka
Sarah Clark	Nicolas Krzywonos
Corey Davis	Elizabeth LaRue
Ryan Enck	Patrick Loudon
Steven Gauthier	Todd Major
Adrienne Gibson	Shane McGrath
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Bradley Houdeck	Ryan Nelson
Samantha Howard	Kaitlyn Ratkowiak
Embriette Hyde	

5:00 PM – 5:15 PM Remarks by Steve Schlicker, Co- Director, Student Summer Scholars

5:15 PM Dinner

5:30 PM – 7:00 PM Oral Presentations

Kaitlin Downey	Sarala Sarah
David Merryman	Donna St. Louis
Nikki Powers	Jarrett Zeman
Juan Rango	

James Bozung
Faculty Mentors: Colleen Lewis and Mary Schutten,
Movement Science

Where Have All the Physical Educators Gone? (Hint: Its NOT Higher Education)

The purpose of this study is to determine why so few K-12 physical education teachers who are required to take graduate courses for teacher certification do not continue in higher education beyond the mandatory requirements. In a study by Boyce and Rikard, it is stated that the shortage of teacher educators may have a negative impact on the amount of public school educators produced in colleges and universities. K-12 physical education is a very important aspect in schools today. If physical education teacher education positions are not filled, the future of physical education in K-12 schools could be grim. This project is designed to identify the barriers as well as opportunities related to physical education teacher education.

The student scholar performed an in depth literature review related to the topic. With these readings, the scholar identified key words to use in categorizing the articles and developed questions for a survey. Examples of key topics included finances, university location, and incentives. The topic of finances includes issues related to having the money to afford the higher education. The university location is defined by the location of the university in proximity to the student's needs. The incentives pertain to scholarships, assistantship, k-12 school financial support, and grants that will cover the tuition of the prospective graduate student. These topics are important to prospective graduate students because they are important when it comes to deciding if they go on to a master's or doctorate degree. With the key topics, the student scholar and his mentor professors developed statements in the creation of a survey.

The student scholar placed the survey he and his mentors created into Survey Monkey in preparation to have it sent out to be tested. The student then sent the completed survey to his peers to have it beta tested. The survey was then sent to experts to check the content validity of the survey. The survey was edited based on this feedback. Following IRB approval the survey will be sent out to K-12 physical educators using the Michigan Department of Education listserv and Indiana. Indiana is a state that requires a master's degree to continue certification in K-12 instruction. Michigan requires 18 credits of continuing education. This data will be compiled in order to get those considering moving on to a master's or doctorate degree aware of the barriers and opportunities that other K-12 educators experienced when they were attaining their physical education teacher education degrees.

Rebecca Brittain
Faculty Mentor: Judith Corr, Anthropology

The role of individual personality in the successful formation of new social groups with aged chimpanzees in a sanctuary environment

Personality research in humans has been ongoing for decades. The importance of individual differences (i.e. personality) within human social relationships has been acknowledged by many disciplines (Dutton, Clark, & Dickens, 1997). The insight that can be gained from personality research extends far beyond that of human social relationships. Personality research can provide information about: an individual's subjective well-being (Weiss, King, & Perkins, 2006; King & Landau, 2003), the heritability of behavior traits (Weiss, King, & Figueredo, 2000), the evolutionary nature and origins of personality (Gosling & John, 1999, Uher, 2008a), the prediction of future behavior (Capitanio, 1999; Gosling & Vazire, 2002; Pederson, King, & Landau, 2005), or even one's physiological response to infectious disease (Capitanio, Mendoza, & Baroncelli, 1999).

Personality research is not limited to humans, as individual personality is well noted in many species including: nonhuman primates, many other mammals, and even octopuses and guppies (Gosling & John, 1999). Researching animal personality for comparison can be beneficial. By comparing human personality with other animals, any commonalities and/or differences that emerge will inform what humans are and are not as a species. Moreover, these patterns highlight evolutionary relationships between organisms through behavior.

To date, methods used in the assessment of individual personality in nonhuman animals have been limited to surveys from animal keepers and care staff. Generally, animals are scored for presence or absence of personality traits on a scale, limiting their scientific value for several reasons. The traits and scales used in these surveys can, for instance, vary from one study to the next, making it difficult to directly compare results. Moreover, these surveys are often subjective because some keepers may know specific animals better than others, some keepers may rate an animal based on first impressions, how an animal acts toward a keeper can vary depending on the individual keeper, and, furthermore, an animal may act differently towards humans than conspecifics.

In contrast to the problematic survey assessment method, Uher (2008) proposed a behavioral repertoire 'bottom-up' approach in the assessment of nonhuman animal personality. This method focuses on individual variation within a species, and scores personality based on objective, observed behavior rather than subjective keeper surveys. The main goal of this study is to test Uher's (2008) methods for assessing personality in sanctuary chimpanzees. If this method works, the secondary aim of this study is to investigate the role of chimpanzee personality within groups and across age and sex classes.

Lisa Burson

Faculty Mentor: James Reed, Biomedical Sciences

Analysis of the Fusion of the Sagittal and Coronal Sutures in Humans and Apes using Computerized Tomography

Cranial anatomy has typically been characterized by visual observations. However, through the use of medical technology - specifically computerized tomography - the crania can be more thoroughly viewed. This study follows two lines of inquiry using CT technology. The first line of inquiry is the comparison of the density of the inner and outer cortical layers of the parietal bone. The second line of inquiry is an examination of the pattern of suture closure of the sagittal and coronal sutures, which is usually closes endocranially to ectocranially. A sample of 49 CT scans of crania of known age, sex, and ancestry from the Raymond A. Dart Collection from the University of Witwatersrand School of Anatomical Sciences were analyzed using the computer program *Slicer v3.5*, which clearly shows the densities of the bone table and the sutures. The sagittal and coronal sutures were divided into segments for analysis - the sagittal into S1, S2, S3, and S4 and the coronal into left and right C1, C2, and C3, as described by Acsadi and Nemeskeri (1970) and Perizonius (1984). Using these segments, the order of the suture closure and the difference in cortical bone densities were compared. The results show that the pattern of endocranial to ectocranial suture closure may vary more than previously thought. It was also found that in a significant number of cases, the outer bone table is denser than the inner bone table.

Sarah Clark

Faculty Mentor: Figen Mekik, Geology

Estimating Sea Surface Temperature for the Earth's Past

Global average temperatures are estimated to increase 2-5°C over the next century. This rate of increase is alarming because it is happening 100 times faster than the natural global warming experienced since the Last Glacial Maximum (LGM—about 21,000 years ago) which was only ~6°C. Ocean waters act as natural climate regulators over millennia. It is debated as to whether the temperature of the tropical Pacific Ocean (TPO) has warmed 3-4°C or 1-1.5°C since the LGM. The main cause of this debate is the disagreement between two independent sea surface temperature (SST) proxies. These discrepancies must be resolved in order to better understand the ocean's role in the regulation of global climate change.

One of these SST proxies is based on proteins (alkenones) produced by planktonic algae which record the water temperatures in which the algae lived. Upon death, the alkenones are preserved in deep sea sediments and used by paleo-oceanographers to estimate SST. Likewise, Mg/Ca ratios in shells of planktonic foraminifera (zooplankton) are also sensitive to water temperatures. However, the SST estimates from these two proxies rarely agree.

Investigating the cause of this disagreement requires comparing Mg/Ca ratios in the shells of the foraminifera *Globigernoides ruber* and alkenones from the same modern sediment samples. Comparing both proxy estimates to satellite readings of seasonal and annual average SST in the TPO, will likely reveal any seasonal preferences of the respective organisms, potential presence of cryptic subspecies, variations in sea surface salinity, and/or errors in proxy calibration.

Corey Davis

Faculty Mentor: Timothy Evans, Biology

An examination of speciation, extinction, and evolutionary relationships in plants from two continents

Molecular phylogenetic studies using the chloroplast-encoded *matK*, *rps16*, *psbA-trnH*, and *trnL-trnF* genes are underway to examine relationships among species of the plant genus *Aneilema* (family Commelinaceae) and to clarify the relationship of *Aneilema* to other genera in tribe Commelineae, particularly *Pollia*, *Polyspatha*, and *Rhopalephora*. The genus *Aneilema* consists of 64 species in seven sections, distributed primarily in tropical Africa and Australia. The species sampled represent all seven sections plus *Aneilema brasiliense*, whose generic position was considered uncertain. *Aneilema brasiliense* is found to fall outside of the rest of *Aneilema* and is either sister to *Polyspatha* or to a *Pollia/Polyspatha* clade. The basal grade of *Aneilema* consists of species of two sections, the Australian sect. *Aneilema* and African sect. *Amelina*. *Amelina* appears to be polyphyletic. Strong support is found for the monophyly of sect. *Brevibarbata* based on two West African and one South Africa forest species. The East African section *Lamprodithyros* is also monophyletic. *Rhopalephora* is placed within *Aneilema*. The inclusion of *Rhopalephora* within *Aneilema* and the exclusion of *A. brasiliense* from the genus would render *Aneilema* monophyletic. Sufficient molecular data to construct a phylogenetic tree for the genus *Portea* (family Bromeliaceae) were not obtained, so all analyses focused on Commelinaceae species. The Commelinaceae molecular phylogeny will be used to evaluate speciation and extinction rates in the family.

Kaitlin Downey

Faculty Mentor: Nathan Barrows, Chemistry

Modeling problem solving: Creating and evaluating student-generated screencasts

The purpose of this research project was to create novice-level screencasts and to investigate students' perceptions of peer-developed screencasts as instructional aids. To identify a starting topic, 61 general chemistry students were asked to rate 13 chemistry topics based on their 1) perceived level of difficulty and 2) ability to solve related problems without referring to external resources. The survey revealed polarity to be the topic of greatest concern; however, Lewis structures, molecular geometry, and bond polarity were addressed first to provide a strong foundation for a thorough discussion of molecular polarity. To guide the development of the screencasts, the problem-solving context of the course was characterized by 35 days of classroom observations. A total of 25 screencasts averaging 3.5 minutes each were created. Interview scripts were created for focus groups that will be conducted in the fall.

Ryan Enck

Faculty Mentor: Matthew Hart, Chemistry

Efficient Synthesis of a Truncated Ergoline: Development of TAAR Regulators

Many people are diagnosed with thyroid related disorders, and many more are unaware of their existing thyroid problems. T₁AM, a naturally occurring metabolite of the thyroid hormone (TH), has been shown to activate the trace amine associated receptor 1 (TAAR1) and exhibits effects that oppose those of the TH. It is, therefore, likely that there is regulatory relationship between T₁AM and the TH. In order to better understand this relationship, a compound must be developed that will effectively block TAAR1. Previously our lab has examined the two different mirror images of apomorphine. One of the mirror images inhibited and the other activated TAAR1. The project described herein, is targeted toward the synthesis of a truncated ergoline, which is structurally similar to both T₁AM and apomorphine. Only one mirror image is present in the naturally occurring form of ergolines, and they are known to be activators of TAAR1. To determine if the non-natural mirror image is an effective inhibitor, it is essential that an efficient synthesis be developed that will allow for the formation of both mirror images of the truncated ergoline. Several steps have been optimized using the desired system, and several other steps have been optimized using a model system. Currently the key step for the completion of the truncated ergoline is being examined using data collected from the model system.

Steven Gauthier

Faculty Mentors: Daniel Bergman, Biomedical Sciences

Sublethal exposure to two alkylphenolic compounds and their influence on development, growth and reproductive behavior of crayfish

Invertebrate animals make up the greater part of the world's biological diversity and are present in about all habitats. Their survival is fundamental to the maintenance of life and because of their ubiquitous distribution they are often used as biological indicators for pollution. Large numbers of invertebrate species are under severe threat of extinction, or are already extinct due to the extreme transformations of habitats due to human activities or exposure to various chemical pollutants. Crayfish are one such important invertebrate that is affected by chemical pollutants such as pesticide/herbicide runoff and industrial waste effluents. Crayfish are keystone species in most aquatic systems. Crayfish are often keystone species because they are an important resource for many other animals and can directly alter species diversity and abundance. Crayfish are also raised for human food consumption in the aquaculture industry. For these reasons, crayfish are important organisms to study and better understand the effects of pollution on their daily routines and ultimate survival. Alkylphenols are a group of pollutants often concentrated by organisms (bioaccumulation) such as crayfish, fish, and birds, leading to contamination in their internal organs between ten and several thousand times greater than in the surrounding environment. These chemicals are used in various laboratory detergents and in some pesticide formulations, which makes them very common pollutants in aquatic systems. They have a number of adverse effects in fish and likely have similar harmful impacts for crayfish and consequently Michigan's aquatic systems. We examined the effect of sublethal exposure to two alkylphenol pollutants (nonylphenol and octylphenol) on crayfish development, growth, reproductive behavior, and success finding food. We found numerous significant impacts on crayfish when exposed to alkylphenols.

Adrienne Gibson
Faculty Mentor: Alexey Nikitin, Biology

The Behavioral Effects of Caffeine on Freshwater Angelfish

This study was devoted to the analysis of the effects of dissolved caffeine on aquatic systems. Initially, we set out to test modifications in fish behavior in response to increased doses of caffeine. We soon found out that there are dramatic changes to the water chemistry with the addition of caffeine that prompted a switch in the experimental design. The presence of caffeine in the aquarium's environment resulted in an increase of ammonia to lethal levels, accompanied by an increase of nitrites. In addition, a biofilm-like substance appeared on the inside of the aquarium's glass. We cultured the organisms from the biofilm, as well as from the water in the aquarium. Both locations appeared to contain bacteria of the genus *Pseudomonas*. The caffeinated aquariums showed considerably larger amounts of bacterial colonies compare to the control aquariums. We hypothesize that the increased ammonia concentrations in the caffeinated aquariums are correlated with the metabolic activity of the *Pseudomonas* bacteria, making the caffeinated environment toxic for aquatic life.

Anel Guel
Faculty Mentor: Jim Penn, Geography

Use of the chambira palm in rainforest communities of the Peruvian Amazon

In this study (still in progress), we researched the use of the chambira palm (*Astrocaryum chambira*) in 4 rural communities located about 100 miles from the city of Iquitos, Peru. The study examined 1: Abundance, distribution and extraction of chambira palm fibers in area forests, 2: Cultivation of chambira palms in gardens, 3: Income obtained from chambira crafts and artwork, 4: Levels of community participation in chambira artwork commercialization, and 5: Local attitudes and actions concerning chambira palm conservation and commercialization. Using semi-structured interviews, forest transect and quadrant inventories, and garden surveys, preliminary results indicate: 1. *A. chambira* has a patchy distribution and levels of extraction were high (60 to 98%) in harvestable palms located near artisans' homes, 2: Currently there are not enough harvestable palms in gardens to sustain artwork sales, 3: High variance between households and villages in income obtained from chambira, 4: Low levels of community participation in chambira trade, and 5: Changing attitudes concerning the conservation of the palm and commercialization of chambira products. A key part of this field study for the student was learning to work alongside Peruvian extension workers and with residents of rainforest villages.

Bradley Houdek
Faculty Mentors: Michael Lombardo and Patrick A.
Thorpe, Biology

Sex difference in the innate immune system of Tree Swallows

Evolutionary theory predicts that exposure to more diverse pathogens will lead to the evolution of more effective immune responses. The innate immune system defends the host from pathogens in a non-specific manner and is an important first-line of defense. We predicted that female Tree Swallows have more robust innate immunocompetence than males because females are exposed to more microbes during the breeding season than are males. This is because (a) females participate in extra-pair copulations with multiple males exposing them to sexually transmitted microbes (STMs) (e.g., bacteria, fungi, viruses), (b) the transmission of STMs during copulation is asymmetrical because ejaculates move from males to females, (c) Tree Swallow semen contains potentially pathogenic STMs, and (d) females spend more time in the nest than males. Additionally, elevated testosterone in males is a known correlate with suppressed immune function. We tested our prediction in the 2009 breeding season by conducting an assay of the innate immune system using whole-blood samples. A microbicidal assay using *E. coli* produced an index of the capacity of the blood to kill bacteria. Tree Swallow whole blood readily lyses *E. coli*, but there was no difference in mean *E. coli* lysis levels between males and females. However, females with higher lysis levels had less louse damage to feathers and older females with higher lysis levels had greater fledging success. These results suggest that while female Tree Swallows may not experience greater pathogen exposure, female innate immunocompetence may predict reproductive success.

Samantha Howard
Mentor: Ellen Schendel, Writing

What Writers Need to Write: Environment and the Writing Process

Do writers' environments affect their work and their productivity? If so, how, and why? My presentation outlines what an ideal writing space could and should be for various kinds of writers.

Presently, writing centers do not necessarily encourage writing within their spaces. I explain reasons why writing centers should remodel their spaces so that writers can write in the center, rather than simply drop by for tutoring help, as is the typical writing center practice. Writing centers already pride themselves by running on a model of active and social learning, which would only be expanded by creating spaces for writers to write together.

I conducted my research through three methodologies. First, I conducted a survey of experienced and inexperienced writers to find out what value they find in different writing spaces. Second, I visited four Michigan writing centers and conducted interviews with their respective directors to see if and how writers could use their centers as writing environments. Third, I completed extensive readings from learning center/building design and writing center scholarship to learn about cutting edge space design in order to determine redesign strategies to make writing center spaces more hospitable to writers. My findings demonstrate the importance of a good writing environment and argues that if writing centers became spaces for writers to write, they could expand their pedagogy to intervene during the writing process and build a supportive community of writers.

Embriette Hyde
Faculty Mentor: Martin Burg, Biomedical Sciences

Identification of the role that the 3'UTR plays in regulation of Hdc expression in *Drosophila*

Genomic un-translated regions (UTR's) do not code for proteins and until recently were believed to lack functional purpose in the genome. Current studies indicate, however, that 3'UTR's play a role in the regulation of gene expression. Last summer our lab conducted research on this topic, fusing the putative promoter region of the *Hdc* gene of *Drosophila melanogaster* to enhanced Green Fluorescent Protein (eGFP) to create a new transgene, pHdc-eGFP. After integration of the transgene into the *Drosophila* genome, an incomplete pattern of GFP expression compared to *Hdc*'s pattern of expression was observed. This result indicates that there is another genomic region that is required for complete expression. Therefore, we have been working to construct a new transgene that incorporates the 3'UTR of *Hdc* into the pHdc-eGFP transgene. Upon completion, this transgene can be used to analyze the effects of the 3'UTR on gene expression. Using PCR, we amplified a 1.13kb NheI-SpeI GFP fragment from the pHdc-eGFP transgene and TA cloned the fragment into the pGEM-T Easy Vector. We performed the same steps to obtain the 0.9kb 3'UTR of *Hdc* from the pCasper3-gHdc plasmid. Next, we PCR amplified two fragments from the NheI-SpeI GFP + pGEM-T Easy plasmid, one reading from NheI to the first termination codon of GFP and the other reading from the second termination codon of GFP to SpeI. Both fragments have been TA cloned and we are awaiting the results of sequence analysis before moving on to the next step towards completion of the new pHdc-eGFP-3'UTR transgene.

Karen Ickes
Faculty Mentor: Paul Keenlance, Natural Resource Management

Bobcat Population Size in Central Michigan

The ability to identify individuals of several wild felid species by pelt characteristics has been verified through various studies. Researchers in Texas examined images from remotely triggered automatic cameras and confirmed that individual bobcats could be identified. Given adequate numbers of images, traditional capture-recapture based population estimates could also be calculated. This technique allows the calculation of population estimates in situations where physical capture and marking are undesirable. We examined whether this same technique could be used in an area with lower bobcat density and differing coat patterns than similar studies in the past. The study area was in northern Kent and Montcalm counties. We evaluated bobcat habitat suitability using GIS, sign at track stations and visits to potential camera sites. Cameras were only placed in locations deemed to contain suitable habitat. Visual and olfactory lures were placed to attract cats into range of the cameras. To date inadequate numbers of bobcats images have been collected to develop a population estimate. Images are still being collected and refinements to camera placement are being developed. We are also increasing effort on publicly owned land which typically contains higher quality habitat but also presents a greater risk of theft of cameras. Experience during the summer has led to increased confidence in our ability to place cameras on public land without losing them to theft. Collection efforts will continue through the fall in an attempt to increase our sample size and more fully evaluate the effectiveness of this technique in Central Michigan.

Lee Jackson

Faculty Mentor: Toni Brown, Chemistry

Synthesis of functionalized benz[\pm]anthracene-7,12-diones as DNA-interactive agents and inhibitors of telomerase as potential anti-cancer agents

Each year, 6.7 million people worldwide are diagnosed with cancer and 22.8% of annual deaths are as a direct result of this disease. Cancer cells are immortal and this is a major reason for the difficulties encountered in treating this disease. In human bodies, an enzyme (telomerase) has been discovered in over 80% of all human cancer cells and is thought to contribute to this observed immortality. Telomerase works by copying specific sequences of DNA that are found in all cells. These sequences of DNA can fold into three-dimensional structures. Once they are three-dimensional, the enzyme cannot copy the DNA and so the cell eventually dies. The purpose of this research is to synthesize a number of novel compounds that will bind to the three-dimensional DNA and so prevent telomerase from copying it. The long-term goal of this project is to try and prevent cancer cells from becoming immortal. The attempted synthesis of two different, but related, groups of compounds will be described, along with the successes and challenges of the research.

Corey Kapolka

Faculty Mentor: Neil MacDonald, Natural Resource Management

Establishing a diverse assemblage of native grasses and forbs on a knapweed-infested site in the Bass River Recreation Area, Ottawa County, Michigan

Extensive areas of degraded lands and remnant natural areas in the upper Midwest have been invaded by the non-native perennial, spotted knapweed (*Centaurea maculosa* Lam.). Reestablishment of native plant communities requires the application of effective control measures. The objective of our study was to examine the interactive effects of mowing and chemical site preparation treatments (herbicides) combined with hand pulling on spotted knapweed control and native plant establishment on a knapweed-infested site in western Michigan. Initial mowing and herbicide treatments were applied to forty-eight plots in the summer of 2008, and we seeded these plots with a mixture of native grasses and wildflowers in the spring of 2009. We hand-pulled seed-producing knapweed from selected plots in mid-summer, 2009, and determined residual knapweed densities and native plant occurrence on all plots in late July, 2009. All site preparation treatments began to reduce the knapweed soil seedbank, while both Round-Up and Transline herbicides substantially reduced mature spotted knapweed densities. Hand pulling effectively reduced seed-producing knapweed densities to less than 1 plant per m² on mowed and Round-Up treated plots; hand pulling was unnecessary on Transline plots because mature knapweed were totally absent. Only Transline, however, reduced juvenile and seedling knapweed densities significantly. Planted native warm-season grasses were present on all treatment combinations, but full development of a diverse native plant community is expected to take several years. Some combination of herbicide treatment and hand pulling of knapweed is recommended to facilitate reestablishment of a native plant community on knapweed-infested sites.

Nicholas Krzywonos
Faculty Mentor: Feryal Alayont, Mathematics

Rook polynomials in higher dimensions

A rook polynomial counts the placements of non-attacking rooks on a board. One of the applications of rook polynomials is in matching type problems. Consider for example having three sandwiches and three packets of condiments, each of a different kind. We create a board in such a way that the available sandwiches would correspond to the rows of the board while condiments would correspond to the columns. If one does not want to put a certain condiment, such as ketchup, on a peanut-butter sandwich, we can place a restriction on the tile at the intersection of the corresponding row and column to replicate this restricted pairing. Each placement of a rook on the board will be interpreted as the corresponding condiment is used for the corresponding sandwich. Hence using the rook polynomial we can count the total number of ways to use one condiment per sandwich. In our research we generalized the definition and properties of the rook polynomials to three dimensions. We also define generalizations of special two dimensional boards to three dimensions, including the triangle board and the board representing the problème des rencontres. The number of rook placements on these three dimensional families of rook boards are shown to be related to famous number sequences, such as central factorial numbers and the number of Latin rectangles with three rows.

Elizabeth LaRue
Faculty Mentors: Carl Ruetz III and Ryan A. Thum, Annis
Water Resources Institute

Population structure of the invasive round goby in Lake Michigan

The recent establishment of the round goby (*Neogobius melanostomus*), an invasive fish in Lake Michigan, provides a unique opportunity to view fine scale evolutionary processes, such as gene flow, that can create genetic structure within a population. We captured 1,388 round gobies by angling and minnow traps from 12 sites that span the entire shoreline of Lake Michigan. The number of round gobies captured at a site ranged from 20 to 451 individuals. Caudal fin clips were collected from 20-52 fish at each site for genetic analysis. Additionally, total length, weight, and sex were recorded from 20-74 fish from each site. Significant differences were found between pairwise comparisons of mean weight and catch per unit effort at each site. We are currently extracting genomic DNA from round goby tissue samples and eight nuclear microsatellite loci are being amplified by polymerase chain reaction. We will use this genetic data to determine whether: 1) there are significant patterns of genetic population structure among sites along the shore of Lake Michigan (e.g., a correlation between genetic diversity and geographic distance), 2) and patterns of population structure in Lake Michigan are stable, developing, or degrading, 3) whether common shipping and ferry routes create strong deviations from normal population structure observed to occur around the lakeshore.

Patrick Louden

Faculty Mentor: Christopher Lawrence, Chemistry

Water Evaporation From Atmospheric Aerosols

With the recent discovery of the ubiquity of organic material in tropospheric aerosols, it has been postulated that the rates of water evaporation and condensation into the aerosols could be affected by thin surfactant films, which could ultimately affect cloud formation. Nathanson et al. have begun to study the effect of water evaporation from sulfuric acid solutions through the short-chain surfactant, butanol. They have found that a nearly full monolayer of butanol fails to reduce water evaporation from the acid. This unexpected result raises many questions about the mechanism of water evaporation. We used of molecular modeling to help answer some of these questions as it allowed us to examine the trajectory by which a molecule leaves the liquid at the molecular level. We also were able to study this problem under conditions closer to that of the troposphere because we are free of certain experimental limitations.

Todd Major

Faculty Mentors: Stephanie Schaertel, Chemistry

Measurement of fundamental physical constants of molecules via laser-based vibrational spectroscopy

A fundamental understanding of chemical reactions requires a detailed knowledge of energy transfer during molecular collisions. Like measuring blood pressure in order to determine heart health, measuring the pressure broadening coefficient for a gas immersed in a collision gas furthers the understanding of the energy transfer between two molecules. The goal of this research is to develop a diode-laser-based technique to measure the pressure broadening coefficient. The measurement of the pressure broadening coefficient requires a non-linear least squares fit of a complicated function. In order to facilitate the fit, experimental techniques were developed to estimate parameters that can not be directly measured. Under normal circumstances, the pressure broadening coefficient of carbon dioxide in air can be obtained successfully. We have measured a pressure broadening coefficient of carbon dioxide in air of 0.094 ± 0.003 wavenumbers/atm. The literature value is 0.0952 wavenumbers/atm, according to the HITRAN database [1]. We are currently exploring the reproducibility of our measurement.

Shane McGrath
Faculty Mentors: Dalila Kovacs and Jim Krikke,
Chemistry

Conversion of Biomass to Value-Added Chemicals

We are a nation dependant on non-renewable fossil fuels to satisfy our immense energy needs. Developing pathways towards fuels from renewable feedstocks is important to bridge the gap between fossil fuels and the ultimate conversion of our nation into one that runs entirely off of renewable energy. Recently, much work has been done on cellulose and starch to produce renewable fuels. Starch, a water soluble biopolymer made up of 1,4- α -glycosidic bonds, is the main component of food sources, like potatoes, rice, and most famously corn (the main feedstock for the controversial E-85 fuel). This is the lead in to a massive and on-going debate regarding food vs. fuel. Cellulose on the other hand is another biopolymer that is not only renewable, but abundant. Unlike starch it is made up of the hardy 1,4- β -glycosidic bonds that are unable to be processed by humans, circumventing the food vs. fuel debate. Herein we explore the conversion of cellulose to various sugar alcohols in "green" reaction conditions, using low energy, metal catalysts, and mild conditions. Our work uses a model system of cellulose called cellobiose which is two units of glucose bonded in a 1,4- β -glycosidic fashion in a 50 mL Parr autoclave reactor with a Ru metal catalyst in water. Our results demonstrates that there are accessible pathways from cellulose to two very important sugar alcohols, sorbitol and mannitol, both of which have potential to be industrially important starting materials towards renewable biofuels or other viable chemical compounds.

David Merryman
Faculty Mentor: Heather Tafel, Political Science

Civil Society and Transitional Justice in Post-Communist Central Europe

Since the third wave of democratization swept the globe beginning in the 1970's, how states deal with their authoritarian pasts as well as civil society's contributions to democratization have been extensively studied. The transitional justice literature initially emphasized the supply side of policy formation, focusing on structural factors such as previous regime type, mode of transition, and balance of power between regime and opposition, while later work incorporating actors examined elite preferences and strategic considerations. Recent scholarship has begun to examine institutional factors and how demand from the public influences policy choices of actors. This project studies transitional justice from the demand side by examining the role in which civil society played in the adoption of these policies. While some analysts have made note of the role that civil society played in transitional justice policies in South Africa and Latin America, there has been little explicit examination of the relationship. The post-communist states faced unique challenges because the nature of their former totalitarian regimes' destructive impact on civil society, which makes the existing analyses less applicable to states in this region. This project attempts to fill a gap in the literature by examining the role that civil society played in transitional justice policies in Poland, Hungary, Slovakia, and the Czech Republic, all states in which civil society played an important role in the transition to democracy.

Amanda Mitchell

Faculty Mentor: Donna Henderson-King, Psychology

Meanings of Education and Educational Experience

Though there is a deep literature on factors that predict college attendance and on the effects of college attendance on student development, there has been very little research on what education actually means to students themselves. This study was conducted to examine whether materialism, intrinsic aspirations, and the search for meaning in life predicted ten meanings that students associate with their education: Career, Independence, Future, Learning, Self, Next Step, Social, World, Stress, and Escape. Multiple regression analyses indicated that students who were high on materialism viewed their education as the opportunity to gain independence, a time to establish relationships, and as a source of stress. Intrinsic aspirations emerged as an especially important predictor variable. Individuals high on intrinsic aspirations were more likely to see education as a time for career preparation, gaining independence, exploring future life directions, learning, engaging in personal growth, increasing social connections, and learning skills to make a difference in the world, but they were less likely to view education as an escape from future responsibilities. As expected, the findings also revealed that individuals who sought meaning in life viewed education as a way to prove independence, explore life directions, engage in personal growth, establish relationships, learn skills that will help change the world, and escape future responsibilities. Currently, we are designing a study for the fall that will examine whether the need for cognition and religion affect the meanings that students' make of their education.

Ryan Nelson

Faculty Mentor: Andrew Lantz, Chemistry

Capillary Electrophoresis Based Microbial Detection and Separation

In the past few decades, capillary electrophoresis (CE) has gained popularity in molecular analytical separations due to its inherent advantages over other chromatographic techniques. Recently, there has been increasing interest in applying this technique to the separation and analysis of colloidal particles including viruses, bacteria, and fungi, as there is a great need for a rapid assay of these microorganisms in various branches of the food, pharmaceutical, and medical industries. Numerous challenges still exist, however, in the development of a CE-based method for microbial analysis. The focus of this work was two-fold: 1) to develop a rapid CE based technique for the detection of *Candida albicans* fungi in blood samples, and 2) to physically separate multiple microorganism species using capillary isoelectric focusing. *Candida albicans* was successfully focused and detected from a spiked blood sample by controlling the cells' mobility through the capillary using various surfactant detergents. A capillary isoelectric focusing method was also developed which isolated species of bacteria (i.e. *Bacillus subtilis*, *Escherichia coli*, and *Pseudomonas fluorescens*) into discrete zones within the capillary. Optimization of the capillary coating procedure, focusing time, and mobilization steps were also performed. Future work includes further improvements to the separation, quantitation of cells in biological samples, and developing methodology to determine the time of sample inoculation.

Nikki Powers

Faculty Mentor: Nancy Levenburg, Management

Entrepreneurship/Small Business Programming at the Muskegon Correctional Facility

Incarceration rates for U.S. residents nearly tripled between 1987 and 2007. At present, there are upwards of 2.1 million individuals being held in federal or state prisons or in local jails; it is estimated that over 93 percent of these offenders will one day return to their local communities. One of the greatest challenges they face is finding and securing employment, which is often mandated by a court as a condition of their probation or parole. This is due to a combination of factors, including a declining number of manufacturing jobs, lower skills and educational levels, the inability to secure appropriate licensures with a felony conviction, and research findings that two-thirds of employers would not knowingly hire ex-felons. Yet, reports of post-release outcomes indicate that the greater the educational opportunities offered to those in prison, the higher their desistance (and reduced recidivism). This paper explores the merits of offering entrepreneurship or small business management workshops/programs within prison walls, since becoming an entrepreneur and launching one's own small business may be one of an ex-felon's only viable career opportunities. The paper outlines issues facing ex-offenders, presents an overview of the characteristics of pre-release programs nationwide, profiles noteworthy programs, offers conclusions based on findings, and develops recommendations for future research opportunities.

Juan Rango

Faculty Mentor: David Linn, Biomedical Sciences

The combination of a selective nicotinic agonist and modulator protects against cellular damage in 2 models of glaucoma

Purpose: Our goal was to determine the neuroprotective capabilities of an alpha-7 ($\alpha 7$) nicotinic specific agonist (PNU 282987) in the presence of a selective $\alpha 7$ modulator (PNU-120596) in two models of glaucoma using adult pig retinal ganglion cells (RGCs). Also, we sought to determine the practicality of a 'single variable' controlled model of glaucoma (optic nerve cut) using adult RGCs through two methodologies (isolated RGC culture & eye-cup preparations).

Methods: Lauren Bader (S³ – 2005) found that pre-exposure of isolated RGCs to nicotinic agonists significantly reduced the excitotoxic effects of glutamate. Meagan Stewart (S³ – 2006) observed that the addition of the specific modulator (which will only enhance the activity of the receptor after activation) appeared to raise survival above control levels. Therefore we modified our culture system and did not add glutamate to the cultures. It has been suggested that isolating the RGCs (which involves cutting the optic nerve) and the addition of glutamate (to mimic excitotoxicity) changes two variables. In addition, we added the agonist / modulator to eye-cup preparations which involve cutting the optic nerve, but not isolating the RGCs.

Results: Through the fluorescent labeling of adult pig RGCs, the viability of the combination drug approach in question was measured. After 96 hours in culture, with chronic exposure to agonist and modulator, we observed an average of a 40% higher survival rate of RGCs exposed to the drug combination than in control culture media. Not only were there more live cells in the experimental culture conditions, but also the living cells displayed signs of greater overall viability. Specifically, RGCs exposed to the drug combination displayed more neuronal processes with branches as well as more intense staining; both of which may indicate healthier cells. Retinal slices were prepared from the eyecup preparations and cells in the RGC layer counted. Preliminary results support the concept of enhanced survival of RGCs when exposed to the drug combination.

Discussion: Although our results are preliminary in nature, the data reinforces the idea of using nicotinic compounds as neuroprotectors to prevent apoptotic cell death in glaucoma. The results also indicate that isolated adult pig RGCs and adult pig RGCs left in a partially intact eye may both act as viable 'single variable' models of glaucoma.

Kaitlyn Ratkowiak
Faculty Mentor: Daniel Frobish, Statistics

Residential Foreclosures in Kent County from a Community Perspective

The ownership, disposition, quality, availability, and affordability of housing in a community is intricately connected to the economic and social well being of that community and its residents. Given the current crisis in foreclosures and subprime lending in a large percentage of housing markets across the U.S., the potential ripple effects of this issue have become a regular staple for reporting on the evening news. Unfortunately, these discussions, in particular in Kent County, provide little in the way of knowledge that can help local policy makers and public and nonprofit organizations either (1) adapt and respond to changing local needs and conditions or (2) predict where interventions should be targeted to have the most impact and minimize further damage to families and the community.

We propose to explore the patterns of both rate *and* length of time of foreclosures in Kent County, using Survival Analysis (along with other statistical methods). Survival Analysis is an area of statistics that analyzes how long it takes for an event of interest to happen. This is a novel approach in the analysis of residential foreclosures, and can provide new methods for detection of neighborhoods subject to these risks. Further, the foreclosure of a property has negative impacts on many facets of a neighborhood, such as crime rates, value of surrounding properties, emigration of residents, etc. Knowledge of the neighborhood conditions and characteristics that are most predictive of the high failure rates and rapid paths to foreclosure and its negative impacts may be invaluable in tailoring and targeting policy and programmatic interventions where they are needed the most.

Sarala Sarah
Faculty Mentor: Merritt Taylor, Biomedical Sciences

Mechanisms of neural stem cell differentiation into astrocytes through the Notch intracellular signaling pathway

Members of the basic helix-loop-helix (bHLH) transcription factors play vital roles in multiple developmental processes. In neurogenesis, several bHLH transcription factors are responsible for guiding cells to a tissue-specific fate and initiating their differentiation. N-Twist, a bHLH transcription factor, is expressed in the developing mouse and chick CNS system, specifically in the neural tube and the mesencephalon (midbrain). Currently, published literature suggests N-Twist is a transcriptional inhibitor of the neurogenic transcription factor MASH1. Thus it was predicted that N-twist would be a negative regulator of neurogenesis.

The objectives of our study were to determine the specific population of neuronal cells that express N-Twist, a bHLH transcription factor, and if N-twist positively or negatively influences the neurogenesis by neural stem cells in the developing nervous system. To detect the presence of the N-Twist gene, the in situ hybridization technique was established and optimized to detect the expression of N-twist mRNA in the developing mouse and chick. Embryos were harvested and sectioned at different developmental stages. We found that N-twist was expressed in the floorplate region of the spinal cord and midbrain. This region is primarily composed of a group of cells that are responsible for determining the final fate of neural cells and giving rise to glia. To address the second question, N-Twist was over expressed in the developing neural tube and the mesencephalon using in ovo electroporation. We determined that N-twist overexpression was identified in mature neurons. Thus N-twist overexpression does not inhibit neurogenesis, and may actually promote neurogenesis.

Donna St. Louis
Faculty Mentor: Janel Pettes Guikema, French

La Femme Patiente: A Project in Translation

Translation seems to be a simple process: a translator with a strong command of two languages renders a phrase from Language A into Language B for the purpose of wider communication. Given her intimacy with both languages, it should be a relatively easy task to transport meaning from one language to another. Yet difficulties lay in the presentation and reception of this meaning: the structures of the individual languages affect how the message of the text is conveyed, and the translator's own interpretation of the text influences how the message appears in the translation. Furthermore, the translator's goals for translation, as well as her relationship and attitude toward the original text can determine the nature of her translation.

I explore these concerns by translating a French novel, La femme patiente, into English. One question in particular that has arisen repeatedly addresses a translator's fidelity to the source text. How far may a translator stray from the original text while remaining "faithful"? How does maintaining the original author's literary style contribute to fidelity?

The methodology employed for this project involved an initial sense-for-sense translation, followed by in-depth discussion and revision. Once the translation was complete and edited, a draft was sent to English-speaking volunteers to read and provide commentary on the flow and style of the English translation. I am currently using volunteers' comments to develop my translation further. My goal is to reach a compromise between natural English composition and crisp language to recreate Alain Gagnol's French style in English.

Jarrett Zeman
Faculty Mentor: Gwyn Madden, Anthropology

Resurrection Machines: An analysis of burial sites in ancient Egypt's Valley of the Kings as physical and spiritual processes of rebirth

In Ancient Egyptian tombs, processes associated with sympathetic magic acted as a direct catalyst for resurrection. Sympathetic magic, defined as an action, object or depiction whose effect resembles its cause, is reflected in royal tombs constructed during Egypt's New Kingdom (1550-1069 BCE) in the Valley of the Kings. However, sympathetic magic has rarely been applied to Ancient Egyptian topics in an explicit fashion. As a result, the tombs of Amenhotep III (KV22), Seti I (KV17) and Ramesses IX (KV6) are analyzed as case studies of this phenomenon. Change and continuity evident in each tomb's architectural structure, decoration, and physical burial are linked to change and continuity in Egyptian religious beliefs during the New Kingdom. Further, the case studies show how the Egyptians designed their burial practices to gain control over their immortality. Such case studies allow for narrowly focused research in a discipline that often emphasizes a broad overview of the Valley.