

## Introduction

The abstracts published in this volume reflect the value we at the University of St. Thomas place on faculty/student collaboration.

Students who have recently done collaborative work with a faculty member present that work in these abstracts and at this poster session for purposes of dissemination and scrutiny by their peers, their professors, and the academic public.

The University of St. Thomas expresses its deep gratitude to the Bush Foundation, who funded this event through a three-year Program Grant. The grant seeks to increase the use of inquiry-based teaching methods, so that students experience the real work of the professions, working on real problems often taken from outside the university, in the ways they will be called upon to employ their disciplines after they leave the university.

A second theme of the Bush Program Grant is to increase faculty/student collaboration. We believe that one of the very best ways to teach is to have professors work with students collaboratively. Students see how work is really accomplished in their chosen professions, and professors have the chance to share their work as it is being created.

We hope this event and this volume gives visibility and credibility to the ideas represented in our Bush grant



Robert Werner, Ph.D.  
Program Director 2005-2008



Vanča Schrunk, Ph.D.  
Program Grant Coordinator

### **Bush Foundation Program Grant Committee:**

Heather Bouwman, Ph.D., English  
Jan Hansen, Ph.D., Education  
Lynn Hartshorne, Ph.D., Chemistry  
Jeff Jalkio, Ph.D., Engineering  
Ellen Kennedy, Ph.D., Marketing  
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David Rigoni, Ph.D., Education  
Robert Riley, Ph.D., Economics



May 2006

As president of the University of St. Thomas, I am both pleased and proud to welcome you to the seventh poster session devoted to faculty/student collaboration projects developed as part of our three-year grant from the Bush Foundation, *Focus on Inquiry: Faculty/Student Collaboration at the University of St. Thomas*.

I believe that one of the most effective ways for students to learn is through collaborative inquiry: students and faculty working together on research that can have real-world consequences. This is completely in keeping with our mission as a Catholic university grounded in the liberal arts tradition. We strive to provide a high degree of personal attention in a challenging campus environment that is engaged with the complexities of our urban community and the world beyond.

Collaborative inquiry gives our students the opportunity to experience first-hand how their professors approach research questions in a given discipline. It also gives our faculty a better opportunity to understand how our students think, and helps them develop new ways of looking at research problems. Collaborative inquiry enables our students and faculty to experience their disciplines in action, deepening students' academic experience while simultaneously increasing career competency.

I am very proud of what our students and faculty are doing and I hope the work represented here will illustrate the importance of collaborative inquiry at St. Thomas.

Sincerely,

A handwritten signature in cursive script that reads "Dennis Dease".

Reverend Dennis Dease  
President

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*Jeni Anderson*

## **THE PORTRAYAL OF MENTAL ILLNESSES IN CHILDREN'S LITERATURE**

Faculty Collaborator: Dr. Jean Giebenhain

Stigma against the mentally ill is an important issue in our society today- one survey found approximately 74 million adult Americans living with some form of mental illness (www.washingtonpost.com). There is a great deal of stigma against the mentally ill which affects every facet of their lives, including their ability to live, work, and develop and maintain relationships (Wahl, 1997). Because so many people in our society live with a mental illness, it is imperative that parents and educators try to combat the stigmatization of mental illness as early as possible. One of the ways mental illness is stigmatized is through mass media, which is readily available for both adults and children in many different forms such as movies, television shows, comics, cartoons, music, and books. By intervening early in a child's life and providing accurate and positive portrayals of people with mental illness in all forms of mass media, attitudes about mental illness will improve with future generations. For this project, I analyzed the portrayal of mental illness in children's fiction literature and developed survey tools to use with children in the future after they have read selected books. Results and implications of the research project are discussed in full.

*Molly Andreason*

## **SUBSURFACE IMAGING WITH SPECTRAL AND POLARIZATION FILTERING**

Faculty Collaborator: Dr. Adam Green

In this experiment, we use wavelength and polarization filters to enhance our ability to take pictures of targets inside turbid (highly scattering) media like human tissues or murky water. Light of longer wavelengths generally penetrates deeper into turbid media than does short-wavelength light. So, by subtracting two images at different wavelengths, we can eliminate much of the light that scatters from the surface and more clearly see objects that are deeply buried. Our polarization filters enhance these images by blocking out even more of the unwanted surface reflections.

Initial tests of the apparatus reveal that these techniques dramatically improve our ability to take images of aluminum blocks buried inside milky water. After we improve our image processing algorithm somewhat, we will attempt to image structures buried inside real tissues like chicken breasts. Our goal is to better understand how light scatters in the human body and how to improve upon existing medical diagnostic tools that are used to make noninvasive biopsies of tumors and other lesions.

*Trina M. Arola*

## **SOLID-STATE INTERMOLECULAR INTERACTIONS IN HALOGEN/CYANO-SUBSTITUTED PHENYLHYDRAZONES**

Faculty Collaborator: Dr. William H. Ojala

We are working toward preparing new crystalline materials by co-crystallizing molecules we have designated "bridge-flipped isomers." These are isomeric pairs of molecules related by the reversal of a bridge of atoms that links two major parts of the molecule. We are currently examining phenylhydrazones, in which the bridge-flipped isomerism is  $\text{Ar-NH-N=CH-Ar'}$  vs.  $\text{Ar-CH=N-NH-Ar'}$  (where Ar = aryl). Because mutual solid-state solubility is greatest for compounds that are isostructural (having the same molecular packing arrangement), we are determining the solid-state structures of phenylhydrazones by single-crystal X-ray diffraction to identify isostructural bridge-flipped isomeric pairs that would be likely candidates for eventual co-crystallization. Intermolecular interactions linking molecules into similar chains in the two solid isomers might encourage their isostructuralism, so we have prepared

phenylhydrazones substituted with halogen atoms and cyano groups to encourage intermolecular Lewis acid-Lewis base interactions. Previously we determined the crystal structure of 4-cyanobenzaldehyde-4-iodophenylhydrazone and compared it to that of 4-iodobenzaldehyde-4-cyanophenylhydrazone (a structure determined by a previous student researcher). Here we describe another halogen/cyano-substituted pair of bridge-flipped isomers we have recently examined, 2-bromobenzaldehyde-4-cyanophenylhydrazone and 4-cyanobenzaldehyde-2-bromophenylhydrazone. Unlike the iodo/cyano phenylhydrazones previously determined, these bromo/cyano phenylhydrazones assume identical molecular packing arrangements in the solid state, making them compounds of special interest for future co-crystallization experiments.

*Jordan Bagley and Tyler Bagley*

## **LOCATING LARGE SCALE NATURE RESERVES IN THE GREAT PLAINS**

Faculty Collaborator: Dr. Paul Lorah

The Great Plains Restoration Council (GPRC) is currently raising funds to purchase 1 million acres for a Buffalo Commons preserve and prairie restoration project. The Buffalo Commons goal is to infuse bison into their native landscape to promote eco-tourism into an area that has endured a long period of economic decline. Our research for the GPRC locates the most suitable land within the Great Plains for this preserve. To accomplish this, we will construct two GIS models using ArcGIS model builder. Both models are based on data provided by other GEOG 222 students. The first model is an environmental suitability model based on transportation data and vegetation type data, the second is an economic/demographic suitability model based on population data and economic variables, like economic growth and subsidies.

We then analyze the relationship between environmental quality and economic/demographic decline using regression analysis and residual mapping. Our results pinpoint potential sites for large scale reserves. These sites are relatively pristine and they suffer from: population loss, a reliance on federal subsidies, declining property values, and an aging population. Lastly, we will create a functional map design layout to properly display our results.

*Katherine Boran*

## **THE STRUGGLE AGAINST A GLOBAL TIDE: THE LATENT EFFECTS OF GLOBALIZATION ON THE MIDDLE CLASS**

Faculty Collaborator: Meg Wilkes Karraker, PhD.

The discourse on the effects of globalization upon the United States has focused primarily on either the corporate benefactors of a growing global economy, or on the exploited workers in foreign countries. But what has the effect been on middle class America? While the term 'middle class' has large connotations, it is the goal of this project to survey theoretical approaches to both globalization (World Systems Theory, and contemporary Anthony Giddens) as well as that concerned with social class (Marx), in order to illustrate the definitive impact globalization has placed upon middle class Americans. The most recognizable changes have occurred in the employment sector, and in turn changes in technology and inequality. Suggestions will also be offered in regards to the most beneficial analysis of globalization, using the 'sociological imagination' of C. Wright Mills. Both qualitative and quantitative data will be used from a variety of sources, including U.S. Census Data, popular media, and academic resources.

## **COMPARISON OF SWING VELOCITIES BETWEEN MALE AND FEMALE COLLEGIATE GOLFERS**

Faculty Collaborator: Dr. Bridget Duoos

In the game of golf today, driving distances are becoming extremely important due to the increased length of many courses. New technology in developing drivers and golf balls may assist a golfer in hitting the ball farther off the tee, but only within the capacity of their swing. No matter how high-tech the equipment, a golfer's driving distance is still inhibited by their swing limitations. In order to hit a ball with maximal distance, a golfer must be able to generate a maximum amount of club head speed by the time the club contacts the ball.

The purpose of this study was to compare the swing velocities of competitive Division III men and women golfers. Four male and five female subjects each hit three golf balls off a brush mat and their swings were video recorded. Data were analyzed using Kinematics Analysis Video (Schleihauf, 2005) and Minitab 14. There was no significant difference between male and female mean maximum swing velocities which were recorded at 33.26 m/s and 33.11 m/s, respectively. Correlations were done to determine the relationships between height, weight, and handicap vs. maximum velocity. Male subjects showed no significant relationship with any of the three criteria, but the female subjects displayed a significant relationship with all three (p-values: ht., 0.03; wt., 0.002; hcp., 0.044).

This study showed that gender had a small effect on golf swing velocity. The men showed a significantly higher velocity at ball impact than the women, which leads to better club head squaring at impact (Lephart, 2003). The square club head at impact would increase control and distance, therefore, possibly translating into lower handicaps.

*Nathaniel C. Brandt*

## **CONSTRUCTION OF AN APPARATUS FOR TRANSIENT ABSORPTION SPECTROSCOPY**

Faculty Collaborator: Dr. Joseph M. Brom

The light-induced interactions of molecules is a chemical process with many important applications. Of specific interest is the photoinduced transfer of electrons from an excited state molecule to a ground state "quencher". The quenching process is observable via transient absorption spectroscopy, in which the short lived ions created by the electron transfer quenching reaction are detected via their ability to absorb specific wavelengths of light. The objective of this experiment was centered on the construction of a reproducible apparatus and experimental method for the detection of transient absorption spectra which could then be used in subsequent studies of photoinduced electron transfer reactions. An apparatus was successfully constructed via modification of an apparatus used for fluorescence studies and was calibrated via detection of the transient absorption spectrum of a CrCO<sub>5</sub>-benzene complex which exhibits a lifetime on the microsecond timescale. At the current time, spectra are observable but lack sufficiently large intensities for full scale use. The next phase of this project will involve optimization of the spectra as well as the analysis of other, more complicated photoinduced reactions with the eventual goal of studying new systems not analyzed in chemical literature.

*Korey Connor*

## **MUSICAL MISSING-LINK -- CHROMATIC TO MODERN: GUITAR TRANSCRIPTION OF WELLESZ' SONATE FÜR VIOLONCELLO**

Faculty Collaborator: Dr. Christopher Kachian

In terms of classical instruments, the guitar is relatively adolescent – the overwhelming majority of its developments have come about in the last 120 years, and only within the last 80 years has it even been considered a legitimate concert instrument. As a result, the repertoire for classical guitar is limited at best. It is, however, an instrument that has an inconceivably vast potential – a potential that, unfortunately, can only be released by the hand of a true master composer, and in particular, the hand of a composer who is intimately familiar with the instrument and its myriad subtleties, secrets, and idiosyncrasies. What follows from this is that many composers are too intimidated by the instrument, and choose to ignore it altogether rather than write a sub-par work. Recognizing this, guitarists have taken it upon themselves to expand their repertoire by any means necessary, most often by making transcriptions of “guitaristic” pieces originally composed for other instruments.

The *Sonate für Violoncello* by Egon Wellesz (1885-1974) is a work that is of the utmost importance because it provides guitar repertoire with a much needed (and currently lacking) bridge between chromatic late-Romantic works and the shocking originality of the Avante-Garde composers of the 1960s (such as Takemitsu, Crumb, and Davidovsky). The *Sonate* was written in the period immediately preceding Schönberg's development of the 12-Tone method, and guitar repertoire does not currently have any solo-works in this immediately pre-Serial Second Viennese School style; thus, the connection provided by this work is vitally important. The linear progression of ideas in the 20th Century has roughly led the arts to whole new worlds of aesthetic possibilities – aesthetics that may not be comfortable, but which are absolutely necessary, because as Schönberg said, “Art comes not from can, but rather from must.”

*Amanda Demeules*

## **THE GENDER GAP IN EARNINGS: DOES URBAN LOCATION MATTER?**

Faculty Collaborator: Dr. Marsha Blumenthal

Dating back to ancient times one can find references and data pointing to women not earning as much as men. In fact Leviticus (27: 3-4) states that a woman is worth 30 shekels of silver and a man 50 shekels of silver. This paper aims to explore the modern gender gap in earnings in Mid-western states, specifically, examining the influence of metropolitan location. Individual data from the Current Population Survey will be used to construct an Oaxaca decomposition, controlling for age, educational attainment, race and marital status.

*Cortney Jo Dirks*

## **TITLE: GENDER EMBODIED: WOMEN IN HOCKEY**

Faculty Collaborator: Ellen Riordan

In his book, *Introduction to Documentary*, Bill Nichols writes, “...a documentary is a creative treatment of actuality, not a faithful transcription of it” (2001, 38). Even though audience members bring with them a set of assumptions that documentaries represent “truth” or “reality,” Nichols' quote reminds us that the documentary maker has the license to treat factual material in an imaginative way. Because of this license and audience assumptions, documentary makers are faced with a number of ethical issues regarding how to represent subjects. Ethical issues faced by documentary makers are manifold when working in the area of gender identity. Because a subject may not consciously

reflect on his or her gender, the filmmaker must convey these subtleties to an audience in a respectful and insightful way.

I tackled this challenge in my project: *Gender Embodied: Women in Hockey*. I wanted to portray the positive effects sport has on women without misrepresenting the truths revealed through my interaction with the athletes. This was a difficult but exciting challenge. While this project continued to develop my technical skill, learning to present my material truthfully and creatively proved to be a greater lesson.

*Beth Domeier*

## **PETROGRAPHIC CORRELATION OF VOLCANIC ASH IN THE LAKE MEAD AREA NEAR LAS VEGAS NEVADA**

Faculty Collaborator: Dr. Lisa Lamb

Our area of study is in the Lake Mead region east of Las Vegas, Nevada. My project is on the petrography (microscope analysis of rock thin sections) of volcanic ashes from this area that can help unravel a complex history of tectonic events. Faulting has rearranged the land, and to reconstruct what has happened, we need to have a feature to help put it back together. The feature that will help is the ashes. The first step is to figure out the stratigraphy of the area, then date the volcanic ash samples. Other members of our research group have provided chemical correlation of the ashes. Thin sections tell us the texture and phenocryst composition of a particular sample. I look at the grain size of the sample and the kinds of minerals that are found. They either confirm the geochemical correlation or they tell us there is no correlation. As of right now, there are five pairs of samples that are confirmed by microscope observations. In the future, the next step is to take my samples and analyze them on a Scanning Electron Microscope (SEM), which will then tell me the amount of different elements within certain minerals to find out the composition in that mineral, further supporting our correlation efforts.

*Melanie Drake*

## **DO HOCKEY PLAYERS NEED AEROBIC FITNESS? RELATION BETWEEN VO<sub>2</sub> MAX AND FATIGUE DURING HIGH-INTENSITY INTERMITTENT ICE SKATING**

Faculty Collaborator: Dr. Daniel G. Carey

The primary objective of this study was to assess the relationship between aerobic capacity, as measured by the VO<sub>2</sub> max test, and recovery from high intensity intermittent exercise. Eleven female collegiate hockey players agreed to participate. Subjects skated 5 one-lap intervals around the hockey rink at maximal intensity with a 30-second recovery period between skates. The VO<sub>2</sub> max test was performed on a motor-driven treadmill following a modified Bruce protocol. A fatigue index was calculated by measuring the total increase in skate time from trial one to trial five. This fatigue index was then correlated to VO<sub>2</sub> max. This correlation coefficient (-0.422) was not significant ( $p > .05$ ) and indicated that only 17.8% of the variance in VO<sub>2</sub> max could be explained by the fatigue index. It was concluded that ability to recover from high intensity intermittent exercise is not related to aerobic capacity. Coaches and trainers probably do not need to include aerobic training in their practices, since the high intensity interval training commonly seen in hockey training also improves aerobic capacity, as reflected in the high VO<sub>2</sub> max values of these subjects.

*Joseph W. Dubis*

## **EFFECTS OF PHOTOPERIOD ON THE CIRCADIAN MECHANISM IN CYANOBACTERIA.**

Faculty Collaborator: Jayna L. Ditty, Ph.D.

Cyanobacteria are unicellular, photosynthetic microorganisms that utilize a circadian clock to efficiently regulate their cellular activities. The mechanism of the circadian clock in the cyanobacterium *Synechococcus elongatus* PCC 7942 has been studied intensively. However, what has received little attention in this field thus far has been how the circadian clock communicates with the environment. In particular, very little is known about how the circadian clock in cyanobacteria responds to photoperiod, or the duration of light versus the duration of darkness within a 24-hour day. Photoperiods have been shown to have considerable impacts on circadian clocks in other model systems, therefore this project investigated the effect of varied photoperiods on the circadian rhythm of wild-type *S. elongatus*. Wild-type *S. elongatus* cultures were entrained to the photoperiods of 12 of light and 12 hours of dark (12L:12D), 18L:6D, and 6L:18D for seven days, and then allowed to free-run in constant light. Results showed that increasing the duration of light (18L:6D) within a photoperiod has little effect on the free-running period of wild-type cells. Conversely, decreasing the duration (6L:18D) of light within a photoperiod may shorten the period by up to an hour depending upon light intensity. In addition, wild-type *S. elongatus* was analyzed for its phenotypic response during the 18L:6D photoperiod. It appears as though they exhibit a biphasic rhythm as they entrain to the environmental photoperiod. This is a much different phenotype from cells entrained to a 12L:12D photoperiod. This preliminary data will be used as a baseline in further experiments to determine the relationship between photoperiod and individual circadian clock input genes such as *cikA* and *ldpA*.

*Breanna Duffey, Ashley Perron, and Kaleb Stromberg*

## **THE IMPACT OF ENVIRONMENTAL QUALITY ON PATTERNS OF PER CAPITA INCOME**

Faculty Collaborator: Dr. Paul Lorah

Previous studies indicate there is a positive correlation between the presence of wilderness and high income. These areas are typically defined by natural amenities such as mountains and forests. However, does this theory hold true for the preserved areas of the Great Plains region? Is a vast expanse of grasses, prairie dogs and bison enough of an amenity to attract visitors and money?

To answer this question, it is first necessary to establish where natural areas persist in the Great Plains. This is accomplished by creating a wilderness continuum model based on currently protected lands, water resources, unplowed land, and a human use index. We then analyzed the impact of environmental quality on income levels by using the wilderness continuum as an independent variable and county level per capita income in 2000 as the dependent variable. Residual mapping will be used to find the exceptions to this relationship.

*Laura M. Eaton*

## **GEOCHEMICAL CORRELATION OF VOLCANIC ASH IN THE LAKE MEAD AREA NEAR LAS VEGAS NEVADA**

Faculty Collaborator: Dr. Melissa Lamb

The western portion of the United States is experiencing tectonic extension, a pulling apart of the Earth's crust. Extension has caused complex geology to develop in this region. A more complete understanding of the current and

past movement of this plate is desirable in predicting future movement and preventing destruction due to tectonic activity. Our study area focuses on the Lake Mead area near Las Vegas, Nevada. Detailed observation and interpretation of the structure and stratigraphy of the rock layers in the region was done. This project focuses on chemically correlating layers of volcanic ash in the area deposited millions of years ago. Upon correlation of select ash layers, we have come closer to understanding the tectonic puzzle we are challenged with solving. Following chemical analysis and subsequent statistical correlation, chemically equivalent rock layers have been identified between different layers of strata. Chemical analysis of the ashes was done using a technique called X-ray fluorescence (XRF). An example of one such correlation of trace element concentrations between two ashes is shown below in Figure 1. These results are supported by research done on statistical correlation methods by William Miley, as well as petrographic analysis of the ashes by Beth Domier.

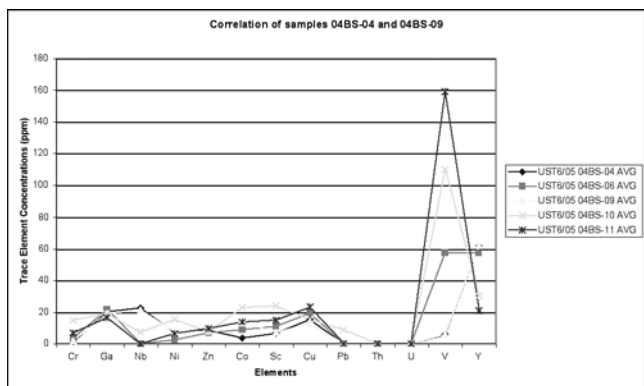


Figure 1. Trace element composition of volcanic ash layers arranged from most reliable elements on the left to least reliable elements on the right as determined by William Miley, for two correlated ash beds.

*Ann Eibensteiner*

## THE EFFECTS OF TWO WARM-UP TECHNIQUES ON THE VOLLEYBALL APPROACH JUMP AND BLOCK JUMP

Faculty Collaborator: Dr. Bridget A. Duoos

**Purpose:** The goal of this study was to determine the relationship between static stretching on two vertical jumps heights important in volleyball, the approach jump and the block jump. The relationship between a whole body warm-up and approach jump heights and block jump heights was also determined.

**Methods:** Twelve collegiate women volleyball players (age =  $19.53 \pm 1.45$  yrs, wt =  $65.92 \pm 8.23$  kg, ht =  $174.4 \pm 7.4$  cm) performed vertical jump tests using the Vertec Vertical Jump system over four nonconsecutive days. Data was collected in this order: static stretching (SS) and vertical approach jump height (VAJH), total body warm-up (TB) and VAJH, then SS and vertical block jump height (VBJH), and TB and VBJH. The static stretching warm-up protocol required the athlete to perform 13 different stretches, each held for 20 seconds. The total body warm-up protocol required the athlete to engage in a typical volleyball pre-game warm up (ball handling, serving, hitting, mini-game) lasting 20 minutes. Athletes' vertical approach jump height was measured by performing a standard three-step approach, while the vertical block jump height was measured by performing a standard counter-movement jump. Three vertical jumps were measured following each warm-up and the highest jump was recorded.

**Results:** Analysis of the data revealed that SS increased the athletes' VAJH an average of 1.3 cm and VBJH an average of 0.3cm. TB increased the athletes' VAJH an average of 4.6 cm and VBJH an average of 2.0cm. At  $\alpha = 0.05$ , only TB and VAJH proved significant.

**Conclusions:** The results suggest that it may be desirable for athletes to engage in activities which get the whole body warm prior to competition. The practical importance is relevant to athletes and coaches who are concerned with vertical jump performance during an athletic event.

*Robert Ertel*

## **TIME-OPTIMAL SKIING**

Faculty Collaborator: Michael Hennessey

Over January 2005, in Kinematics and Mechanism Design (ENGR 225) the problem of minimum-time skiing was proposed. Using a 4th-order state-space model derived from application of Newton's second law, students attempted to "ski" down the mountain from a start point to a finish point across the mountain in minimum time. An in class conjecture was made such that a constant body yaw rate for a skier traversing the hill yields the time-optimal result. Mathematically, the problem involves the calculus of variations and use of the 4th order state-space formulation. With funding from the University of St. Thomas Center for Applied Mathematics, summer 2005 yielded some exciting results as an entire framework for solving more important practical but yet difficult problems was developed. It should now be possible to solve related problems such as incorporating Coulombic friction, accommodating fairly arbitrary slope geometries, different end conditions, examining different optimization criteria, and so forth. There is even interest in the professional ski coaching community in these results.

Over this past spring my major accomplishment was to analytically determine the optimal control law for the case where Coulombic friction is present. While the control law is fairly simple, the derivation was very complicated. It required approximately 30 pages of symbolic calculations and was independently checked for correctness by Dr. Hennessey. To my surprise, the model structure had to change. Specifically, it was necessary to augment the plant model with an integrator yielding a higher-order model (now 5th order) and view the yaw acceleration (vs. yaw rate) as the true input to the system. Future work can focus on the end conditions using the variational calculus formalism (unlike the zero friction case where the initial states are easily determined) and subsequent numerical simulations within MATLAB™.

*Sean Ewen*

## **MATHEMATICAL MODELING OF POTASSIUM CHANNEL BEHAVIOR**

Faculty Collaborators: Dr. Dwight Nelson and Dr. Mikhail Shvartsman

Animal nervous systems can transmit information with incredibly high speed. Information signals must travel quickly through the axon, one of the most important parts of the neuron for long distance communication. The membrane of the axon conducts electrical signals and transmits information along its length through active differences in electrical charge between the outside and inside of the cell membrane. The drop in potential (voltage) is caused by ions entering and leaving the axon through specialized ion channels. One important type of neuronal potential is the action potential and is responsible for the re-amplification of signals as they travel along the axon. The potassium channel allows potassium ions to leave the axon and is responsible for the repolarization phase of the action potential peak to prepare the axon for a new action potential. If the potassium channel fails to open, the membrane potential remains too high and another action potential cannot be induced.

We were able to take a first order differential equation that applies to the change in concentration of open potassium channels over time and create a simplified form to solve for the time it takes potassium channels to become completely open at a specific voltage. The solution was used to find the concentration of open potassium channels at various voltages. Currently, we are working to define and model the frequency (number of action potentials per second) at which action potentials are conducted within an axon. If action potentials could be thought of as waves moving with velocity and wavelength, it appears that a maximum frequency will be reached when each action potential will be followed consecutively by another because action potentials cannot overlap. This maximum frequency is different for various axons and depends on variables such as velocity and size of the action potential.

*Megan Flavin*

## **ELECTROMYOGRAPHY OF ABDOMINAL MUSCLES IN TRADITIONAL EXERCISE VERSUS THE STABILITY BALL**

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this study was to determine whether abdominal exercises performed on the floor, or a stability ball, activate more muscle contraction in the external obliques and rectus abdominis muscles.

Five college age males (age=23.6 yr.  $\pm$  3.58; ht=181.61cm  $\pm$  6.46; wt=76.9 kg  $\pm$  5.09) who worked out on average five days per week volunteered to participate in this study. Maximum voluntary contraction (MVC) of the rectus abdominis and external obliques was measured twice for each subject on a weight machine using surface electromyography (SEMG). For the third session, a traditional sit-up and twisting crunch were performed on the floor and stability ball, in random pre-selected order. A metronome was set to forty beats per minute and subjects kept time, completing fifteen repetitions for each of the four sets. The middle five repetitions of each set were analyzed.

Strong correlations were found between exercises performed on the floor and the stability ball. However, to determine whether or not a significant difference existed between muscle activity in the two methods, a paired t-test was performed. P-values were found to be  $>.05$ , thus no significant difference resulted.

Activity performed on the stability ball and the floor did, in fact, elicit similar muscle activation. Despite this, abdominal exercise on the stability ball did not stimulate more muscle contraction than abdominal exercise on the floor.

*Christina Freiberg*

## **REBUILDING MOSCOW: THE EFFECTS OF SOCIALIST CITY PLANNING UNDER STALIN**

Faculty Collaborators: Dr. Robert Werner and Dr. James VonGeldern, Macalester College

How did urban planning change under Stalin? The Socialist banner declares the old state would wither away, and new state would take its place. Under the First Five Year Plan (1928-1932), Stalin took great strides to change Russia into a socialist country. Not only did he improve agricultural and industrial production, he envisioned Moscow as the seat of socialism. Relying on the principles of Marx, the Kremlin would remain the center, but the city would have to undergo changes. On July 10th, 1935, Stalin signed the "Master Plan for the Reconstruction of the City of Moscow." The presentation will cover the geographical history of Moscow and relating it to newly adopted socialist city planning, key components of the Plan such as transportation, architecture, and open spaces, and finally, the consequences of the Plan on Muscovites.

*Jacob K. Friefeld*

## **DE BOW'S REVIEW AND SOUTHERN NATIONALISM**

Faculty Collaborator: Dr. Joseph Fitzharris

The purpose of this project is to ascertain the role De Bow's Review played in the rise and evolution of southern Nationalism—the idea that the South is a unit larger than any one state, but different than the Union. Secondary sources were obtained in order to provide the researcher with knowledge of what other individuals have argued in regard to both the current subject, and the overarching theme of Southern Nationalism. Articles from De Bow's Review provided the majority of primary research during this study. The researcher found that De Bow's Review played two major roles in the rise and evolution of Southern Nationalism. The first of these roles is that of an advocate

of Southern Nationalism, encouraging Nationalism in conditional unionists and non-slave owners. The second role the Review played was that of an opponent of Southern Nationalism after the war in its appeals for a happy reunion and its willingness to “give a fair and honest trial” to emancipation.

*Adam J. Fritsch*

## **EFFECT OF FLEXIBILITY ON THE KINEMATICS AND SPRINT SPEED IN COLLEGIATE HOCKEY PLAYERS**

Faculty Collaborator: Dr. Bridget Duoos

**Purpose:** The purpose of this study was to determine if there is a relationship between hamstring flexibility and on-ice skating speed in Division III male hockey players. The hypothesis of this study was that hockey players with greater hamstring flexibility would have faster skating velocities and greater knee extension angles than players with less flexibility.

**Methods:** Eighteen Division III male hockey players (age =  $20.5 \pm 1.2$  yrs, wt. =  $85.59 \pm 10.09$  kg., ht. =  $181.71 \pm 6.9$  cm.) volunteered to participate in this study. Dominant leg hamstring flexibility was measured with subjects prone on their back. Subjects raised their straight leg as near to 90 degrees as possible and a goniometer was used to measure the angle. Subjects were videotaped performing an on-ice sprint from blue line to blue line (9.96m). Kinematics Analysis Video (Schleihauf, 2005) was used to digitize the trials and determine the maximum knee extension angle.

**Results:** Data were analyzed using the Pearson product-moment correlation coefficient on Minitab 14. The relationship between dominant leg hamstring flexibility and sprint velocities resulted in a negative weak correlation ( $r = -0.097$ ). A negative weak correlation ( $r = -0.189$ ) was also found in the relationship between hamstring flexibility and sprint velocities.

**Conclusion:** Flexibility is thought to be crucial to a player's skating speed and it was hypothesized that the results would show a significant correlation in the relationship between flexibility and sprint speed. The results of this study did not prove the hypothesis that hockey players with greater hamstring flexibility would have faster skating velocities and greater knee extension angles than players with less flexibility.

*Patricia Gamboni*

## **SURVEY OF ATRAZINE CONCENTRATIONS IN TYPE IV AND V WETLANDS IN TWO WESTERN MINNESOTA COUNTIES: CAN CONCENTRATIONS BE PREDICTED FROM ADJACENT AGRICULTURAL LAND USE?**

Faculty Collaborator: Dr. Kyle D. Zimmer

Atrazine is an herbicide commonly used in production of corn. Lab experiments have indicated atrazine levels as low as 0.1ppb may have negative influences on tadpole development. In June 2005, we measured atrazine concentrations in 71 shallow lakes distributed across Grant and eastern Polk counties in western Minnesota. We also used GIS to estimate the proportion of land used for agriculture within a 500m buffer around each site. Atrazine concentrations were significantly higher in Grant County (mean=0.956 ppb) compared to Polk County (mean=0.058 ppb). Additionally, 54% of the study sites in Grant County exceeded a 0.1 ppb threshold, compared to only 24% of the sites in Polk County. However, we detected no relationship between atrazine levels and percent of the 500m buffer used for agriculture ( $R^2 = 0.01$ ,  $P = 0.76$ ). Our preliminary results indicated widespread, detectable levels of atrazine in shallow lakes in Minnesota, but controlling variables are unknown.

*Susan K. Heinmiller*

## **WHEN 1 + 1 DOESN'T EQUAL 2: CASE STUDY OF A STRUGGLING 3RD GRADER'S DEVELOPMENT OF PLACE VALUE**

Faculty Collaborator: Dr. Lucy L. Payne

This case study took place at the University of St. Thomas's partnership school located in the Wayzata school district. The student did not have a basic understanding of place value skills. Further, student's construction of our number system was extremely limited and she approached problems in a rote manner. We worked on distancing the student from rote manner learning along with building a strong foundation through various place value activities that focused on conceptual and concrete understandings in connection with how numbers are represented in our base-10 number system. Weekly collaborations took place with the researcher, university faculty, school principal, and classroom teacher about the student's progress toward improving basic understanding of place value. The student completed evaluation assessment tests in order to adapt and modify various place value lessons to meet student's individual needs. The student's development of place value was consistently associated with concrete models in order for student to conceptually understand our number system. Lessons included the use of manipulatives and technology which provided the student with real-world connections and resulted in increased student motivation and interest. In addition, novelty and game-like activities were integrated into lessons. Student movement into abstract concepts and computations such as partial sums and expanded notation were achieved once student's development of place value strengthened. The student continues to work with implemented place value lessons in order to strengthen personal foundation, growth, and confidence with our base-10 number system.

*Lindsey Hines*

## **SIMULATION AND VISUALIZATION OF A SECOND ORDER DYNAMICAL SYSTEM**

Faculty Collaborator: Dr. Michael P. Hennessey

A dynamic mechanical system is a system that contains objects or parts that change position over time in response to the application of forces or torques. In engineering they are extremely prevalent and being able to understand them is very important in both design and analysis. Understanding these systems, however, can be problematic due to system complexity. By creating a visualization along with a mathematical model and numerical simulation for a situation, one can ensure reasonable results while providing an environment to experiment with and explore the system easily. This spring I created such a visualization with a combination of mathematical modeling and CAD software. The motion of an object over time was determined by a model in SimMechanics<sup>TM</sup>; the resulting raw position data was sent into SolidWorks<sup>TM</sup> to illustrate movement of a three dimensional representation of the object. The system chosen to be modeled was an RC hovercraft. The hovercraft model in MATLAB<sup>TM</sup> and SIMULINK<sup>TM</sup> was tested over last summer; the model in its new form using SimMechanics<sup>TM</sup> could be compared and accuracy could be assessed. The finished product was a computer generated video showing the hovercraft moving as if in real-time with numerical data from SimMechanics<sup>TM</sup> and MATLAB<sup>TM</sup> & SIMULINK<sup>TM</sup> in good agreement. Not only was it a fascinating project to complete, but it will also assure the feasibility of the topic in a future class setting. This research will serve as a foundation for an engineering class (Visualization and Simulation of Dynamic Systems) in the degree programs of Systems Engineering, Electrical Engineering, and Mechanical Engineering.

*Melissa Jones*

## **EXTRACTION OF GAS PHASE ANALYTES FROM AQUEOUS SOLUTION USING MICRODIALYSIS MEMBRANES**

Faculty Collaborator: Dr. Tony Borgerding

The goal of our study was to develop a probe for in vivo sampling of volatile analytes. The probes were developed as a “side-by-side” design with staggered fused silica capillary. The end was inserted into a hollow regenerated cellulose microdialysis membrane (200  $\mu\text{m}$  i.d.). Dialysis membranes were utilized because of their small dimensions, which allowed rapid permeation of analytes through the thin membrane walls. Typically dialysis membranes are used for extraction between two liquid phases; however, our study focused on gas phase extraction from aqueous solutions. The probes were tested for their effectiveness in extracting ethanol from aqueous solution using a flame ionization detector (FID). Ethanol was extracted from water in less than 10 seconds, as shown by in the FID signals. The probe had a similar response to toluene and ethyl benzene. The rapid extraction capabilities of these probes were combined with fast GC for monitoring of volatile organic compounds (VOCs), which includes monitoring the change in concentration.

*Matthew Jungwirth*

## **NON-LINEAR DYNAMICS: TORQUE AND POTENTIAL CURVES FROM A MAGNETIC DIPOLE-DIPOLE INTERACTION**

Faculty Collaborator: Dr. Marty Johnston

The field of non-linear dynamics involves the study of chaotic motion. A simple pendulum can move in a chaotic fashion if torques from non-linear magnetic fields are applied to it. The current experimental setup applies these magnetic fields as eddy currents to a disk attached to the pendulum. This research explores applying another magnetic field, applied directly to the pendulum in this case, with a double-magnet system that creates a dipole-dipole interaction. One magnet is placed at the end of the pendulum, rotating with the pendulum, while the second magnet is placed on the base of the apparatus directly under the pendulum pivot point. Theoretical modeling of this situation is done in MatLab, and then compared to previous results without the dipole-dipole interaction. Results show a clear difference between the two plots, which is strengthened by the potential of the system moving from a single to a double well plot.

*Rebecca S. Kilpatrick*

## **THE RELATIONSHIP BETWEEN VERTICAL JUMP HEIGHT AND ON-ICE SPRINT SPEED IN FEMALE COLLEGIATE HOCKEY PLAYERS.**

Faculty Collaborator: Dr. Bridget Duoos

Purpose: The goal of this study was to determine the relationship between vertical jump height and on-ice sprint speed in Division III female hockey players. The relationship between the maximum vertical jump knee angle and maximum on-ice knee angle was to also be established.

Methods: Twenty collegiate female hockey players (age: 19.6 yrs  $\pm$  1.5; ht: 1.65 m  $\pm$  0.05; and wt: 62.07 kg  $\pm$  5.92) performed three trials each of the Sargent vertical jump test and an 8.23 m on-ice sprint (Bracko, 2001; Bracko and George, 2001). Maximum knee angles were measured using Kinematic Analysis Video (Schleihauf, 2005) for both the vertical jump and on-ice sprint. The highest vertical jump and fastest sprint were used for analysis.

Results: The relationship between the vertical jump height and on-ice sprint speed revealed a weak correlation of  $r = 0.182$ . The maximum knee angles for vertical jump and on-ice sprint were stronger, but did not present a high correlation ( $r = 0.466$ ).

Conclusions: No relationship was found between vertical jump height and on-ice sprint speed. Poor vertical jump mechanics may have contributed to the low correlation between the maximum knee angles measured in the subjects. Female hockey players need to be taught the correct mechanics for the vertical jump test as well as how to explosively sprint on the ice.

*Andrew Korte*

## **PHOTODEGRADATION OF NORFLOXACIN UNDER ENVIRONMENTALLY-RELEVANT CONDITIONS**

Faculty Collaborator: Dr. Kristine Wammer

Contamination of lakes, streams, and rivers with antibiotics is an increasing concern, as it may lead to an increase in bacterial resistance to the drug. One mechanism of removal of antibiotics is a process known as photodegradation or photolysis. This project examined the photodegradation of norfloxacin, a member of the fluoroquinolone class of antibiotics. Environmentally-relevant pK<sub>a</sub>s were estimated for the drug by UV-visible spectrophotometry of norfloxacin solutions at several different pH values. Samples of a norfloxacin solution were photolyzed using borosilicate-filtered Hg-vapor lamps and analyzed by HPLC to determine concentrations at set time intervals. Rates for photodegradation in deionized water at a range of pH values were compared to those in 0.2 micron-filtered water obtained from Lake Josephine in St. Paul (which contains dissolved organic matter, or DOM) to determine what effect, if any, the organic matter present in the lake water had on the rate of degradation. While rates were found to vary significantly with pH changes, little difference was observed between the lake water and the DI water at a similar pH, indicating indirect photolysis was not a factor, and experiments performed in DI water may provide an adequate estimate of the degradation rate of fluoroquinolones in the environment.

*Ashley Kramer*

## **ANALYSIS OF VOLATILE COMPOUNDS OF DIAGNOSTIC INTEREST USING A MICRODIALYSIS PROBE EXTRACTION TECHNIQUE**

Faculty Collaborator: Dr. Anthony Borgerding

Microdialysis has become useful in sampling non-volatile compounds in biochemical systems such as different places in the human body. Our lab has had success using microdialysis sampling probes for volatile compound extraction from aqueous solutions into the gas phase. Experiments with breath analysis in the biomedical field currently use a breathing apparatus as a diagnostic tool, to measure volatile compounds in the body such as acetone, formaldehyde and dimethyl sulfide. Our research lab is currently testing our probes on these compounds for the long-term goal of using microdialysis as an in-vivo method. We have analyzed these compounds over a variety of concentrations. Acetone, for example, was measured over a concentration range of 0.001-0.5% acetone by weight.

*Marika K. Kuspa*

## **LEWIS ACID/LEWIS BASE INTERACTIONS IN HALOGEN/CYANO-BENZYLIDENEANILINES: A COMPARISON TO SOME METHYL ANALOGUES**

Faculty Collaborator: Dr. William H. Ojala

The object of this study has been to determine whether the two isomeric benzylideneanilines bearing a methyl group in one *para*-position and a nitrile group in the other assume identical molecular packing arrangements in the solid state (are isostructural with each other) and whether this solid-state similarity extends to any of the corresponding halogen/nitrile benzylideneanilines. A previous study showed that the isomeric *p*-cyano-*p'*-iodobenzylideneanilines pack similarly (but not identically) due to intermolecular Lewis acid-base interactions between the halogen atom and the nitrile group. These interactions are absent from the bromo/nitrile and chloro/nitrile analogues, which do not form isostructural crystals. We have found that *p*-cyano-*N*-(*p*-methylbenzylidene)aniline and its "bridge-flipped" isomer *p*-methyl-*N*-(*p*-cyanobenzylidene)aniline do not pack similarly to the halogenated compounds, but they do pack rather similarly (but not identically) to each other. The two crystal structures have similar unit cell volumes and have similar cell axial lengths and interaxial angles, but as in the case of the iodo/nitrile benzylideneanilines the packing arrangement differs at the three-dimensional level of molecular stacking. The presence of intermolecular Lewis acid-base interactions in the solid state does not guarantee isostructuralism for these isomers; at the same time, the similarity between the methyl/cyano benzylideneaniline crystal structures at least suggests that the absence of these interactions does not preclude it.

*Christine L'Abbe*

## **MICRODIALYSIS SAMPLING FOR THE ANALYSIS OF NITRIC OXIDE**

Faculty Collaborator: Dr. Tony Borgerding

The purpose of this research project is to design a noninvasive method of rapidly measuring nitric oxide in the brain. This method allows for the study of the nature of nitric oxide and its role in critical physiological functions and neurological diseases. Microdialysis probes are used in combination with a chemiluminescence detector to analyze nitric oxide samples at several dilute concentrations (100 nM to 100  $\mu$ M) in order to determine the limits and efficiency of the microdialysis measurement system. Modifications have also been made to the chemiluminescence detector so that it will be able to operate at lower flow rates ( $\sim$  1 mL/min) in order to analyze the small amounts of nitric oxide that would be found in the brain. The microdialysis probes have been previously shown to be capable of measuring minimal concentrations of analyte, and therefore, should be able to accurately measure nitric oxide at low concentrations. Once the extraction capabilities of the microdialysis probes are determined in relation to nitric oxide, the probes will be useful in understanding the nature of nitric oxide as a neurotransmitter. The microdialysis probes may also aid in *in vivo* examination of the nitric oxide release levels of nitric oxide-releasing polymers that are used to coat stents used in angioplasties.

*Michelle Lucius*

## **STABLE ISOTOPE ANALYSIS OF MICROBIALITE LAMINAE FROM THE BITTER RIDGE LIMESTONE, NEVADA**

Faculty Collaborator: Dr. Tom Hickson

The goal of my project was to evaluate microbialites of Miocene (23.7 to 5.3 million years ago) lacustrine limestones to determine the expected values of isotopes that occur within a given sample and see if there is a climatic signal

recorded within the laminae. Lacustrine limestones of two different microbialite facies from the Bitter Ridge Limestone (Lake Mead region, Nevada) were evaluated for oxygen and carbon isotopes. Lacustrine limestones were chosen to gain knowledge of sedimentary processes in the lakes created during the deformation that created the Basin and Range. The microbialite samples are characterized by finely laminated, alternating dark and light carbonate that formed by microbial processes. These laminae should be great recorders of climate because they sample lake chemistry. The samples were analyzed by mass spectrometry for O and C isotopes at the University of Minnesota Stable Isotope lab and showed 0.1 per\_mil standard deviations. The isotope results display a saw-tooth pattern specifically with the carbon isotopes that indicate seasonal changes in productivity. The oxygen values show evidence of opposite isotopic signals of carbon which support the changes in productivity based on seasonal changes in evaporation. These initial results will guide additional data collection at other localities in the Lake Mead region to further determine the environment of deposition of the lacustrine limestones and to constrain Basin and Range tectonics.

*Christian R. Lytle*

## **SIMULATION OF THE EFFECTS OF MULTIPLE-PLANE GRAVITATIONAL LENSING ON THE GALAXY-QUASAR ANGULAR CROSS-CORRELATION: DESIGNING A 3D RAYTRACE ALGORITHM**

Faculty Collaborator: Dr. Joshua Nollenberg

Angular cross-correlations between galaxies and high redshift ( $z > 2$ ) quasars have been linked to a gravitational lensing effect known as magnification bias, which affects visual sky density and apparent brightness of the lensed object. Measurements of these cross-correlations are useful for characterizing the matter-density evolution of the universe on large distance scales. Current theoretical models for galaxy-quasar cross-correlations predict magnitudes far below observationally measured magnitudes. We are attempting to resolve this magnitude discrepancy via a computational simulation of the effect of several gravitational lensing planes on photon bundles originating from multiple sources. Having previously translated current models of both linear and non-linear cross-correlation functions into numerical comparison models, we are now designing a three-dimensional raytrace simulation. We have completed the algorithm for a single-plane situation, and have compared results with theoretical connections. Furthermore, we have completed the mathematical foundation for a multiple plane situation and consider the necessary steps for integrating appropriate cosmological distances into our code.

*Matt Marcellus*

## **LEG STRENGTH AND PITCH VELOCITY IN EXPERIENCED YOUNG ADULT BASEBALL PITCHERS**

Faculty Collaborator: Dr. Bridget A. Duoss

The importance of the legs in the throwing motion is widely accepted, but little research has been done to validate their significance (Kibler, 1998).

Thus, the purpose of our research was to determine the importance of leg strength in overhead throwing velocity in experienced high school and college pitchers (age =  $17.6 \pm 1.4$  years; height =  $71.5 \pm 3.2$  inches; weight =  $175.5 \pm 25.2$  lbs.; pitching experience =  $5.2 \pm 1.6$  years). The hypothesis of our research was that stronger legs would enable a pitcher to generate a greater force, thus transfer more energy to their arm, consequently throwing the ball faster. Research was conducted using forty experienced high school and college baseball pitchers. The following five leg tests were administered in random order to subjects using a hand-held dynamometer: hamstrings ( $1.88 \pm .304$  Nwm/kg), quadriceps ( $3.07 \pm .66$  Nwm/kg), hip abduction ( $2.21 \pm .38$  Nwm/kg), hip medial rotation ( $1.32 \pm .224$

Nwm/kg), and hip lateral rotation ( $1.386 \pm .287$  Nwm/kg). Subjects forcefully contracted against the device and force outputs were recorded. A double leg lowering test ( $37.51 \pm 11.09$ ?) along with three hop tests (stance limb =  $0.849 \pm .08$  inches; non-stance =  $0.854 \pm .09$  inches; crossover =  $2.44 \pm .28$  inches) were also administered. Subject's pitching velocity while throwing from an outdoor pitching mound was measured using a radar gun. Correlation coefficients were calculated for leg strength and pitching velocity and a multiple regression equation was established.

Weak correlations were found between isolated leg muscles and pitching velocity ranging from  $-0.241$  for leg lowering to  $0.195$  for the crossover hop. Knowing that muscles of the body never work in isolation, a multiple regression equation was established. The equation allowed the various variables to have a synergistic effect and revealed that  $33.7\%$  of pitching velocity could be explained by leg strength. Although isolated muscle groups were not significant predictors of pitching velocity, it appeared when they worked collectively pitching velocity could be explained. Leg strength is an important aspect to the overhand throw; however, further research must be conducted to provide statistical evidence of the overall importance of leg strength to pitching velocity. Research of this nature is of particular relevance to healthcare providers, athletes, and coaches by providing rationale to training for the overhand thrower.

*Cyndi Jo McCormick*

## **THEME COMPREHENSION**

Faculty Collaborator: Dr. Tonia Bock

In order for educators to effectively use moral stories as a tool when teaching children, the process by which a moral theme is comprehended must be understood. The purpose of our study was to examine whether inferences and evaluations made while reading stories facilitate comprehension of moral themes. Participants ( $N=17$ ) read two stories with intended moral themes, expressed their thoughts aloud as they were reading, answered questions about the theme at the end of each story, and completed a measure of moral reasoning development. Participants' thought expressions during the story were coded for explanatory inferences and ethical evaluations. In the first of two regressions, explanatory inferences, ethical evaluations, and moral reasoning scores each predicted participants' ability to identify the intended moral themes from a list of several possibilities. In contrast, none of the three independent variables predicted participants' ability to verbally describe the stories' moral themes in the second regression.

*William Miley*

## **REFINING XRF DATA ANALYSIS TECHNIQUES FOR VOLCANIC ASH GEOCHEMICAL CORRELATION**

Faculty Collaborator: Dr. Lisa Lamb

The Basin and Range (Western U.S.) is a geologically complex region of tectonic extension. Many questions exist regarding the magnitude, style, and timing, of Basin and Range deformational processes. Further understanding of such plate tectonic mechanisms has positive implications for a range of environmental, civic, and economic issues. Research aimed at deformation reconstruction can make significant contributions to our understanding of plate tectonics at various scales. One area of research involves x-ray fluorescence (XRF) analysis of stratigraphically bedded volcanic ash, so as to use geochemically correlated ash deposits as marker beds for deformation reconstruction. Over the past year Laura Eaton\* has been working on this type of project, but her research became impeded by correlation technique limitations due to insufficient understanding of typical trace element value ranges within a single ash bed. The goal of my project is to establish the correlative reliability of each trace element and to define the typical value ranges for the most reliable elements. Twenty ash samples from two distinct beds, the Lower and Upper Thumb, were taken from the Bitter Spring Quadrangle (Las Vegas, NV) and geochemically analyzed by XRF. The subsequent trace

element data was characterized statistically, resulting in plots of standard deviation, quartile, and Student paired t-test. The results identify the most reliable elements to be Rb, Ce, Cr, Ga, Nb, and Ni; and fairly reliable elements to be Zn, Co, Sc, and Zr. Understanding the limits of XRF ash data analysis will allow for accurate and confident stratigraphic correlations when combined with other research techniques such as radiogenic age dating and petrographic analyses, completed or currently underway by Angela Donatelle\* and Elizabeth Domeier\*.

\*denotes UST student research

*April Miller*

## **ST. JOHN CHRYSOSTOM ON VIRGINITY, MARRIAGE AND WOMEN**

Faculty Collaborator: Dr. Susan Myers

“When they (Adam and Eve) shed the princely raiment of virginity and laid aside their heavenly attire, they accepted the decay of death, ruin, pain, and a toilsome life. In their wake came marriage: marriage, a garment befitting mortals and slaves.” This statement, from St. John Chrysostom’s treatise *On Virginity*, gives a brief synopsis of his views concerning the supremacy of virginity and the difficulties that he believed defined marriage. It may appear that he is dishonoring and advising against marriage, but his arguments maintain that marriage is “honorable.” He upheld marriage for a few reasons, one being that heretics, such as the Gnostics, forbade marriage. Such harsh language against marriage is not entirely representative of all of his works. Although he claimed the supremacy of virginity the duration of his life, it is my belief that his views towards marriage improved in his later life after holding more pastoral positions and keeping a close, intimate friendship with the wealthy Constantinopolitan deaconess, Olympias.

For John, writing in the 4th century, the rigorous practice of asceticism for six years in his early twenties proved foundational for the majority of his subsequent thoughts. His writings also draw upon classical moral philosophy and traditional Greco-Roman social structures, which at times hold a somewhat dualistic view of humanity and reinforce hierarchical structure in the household. In addition to these influences, Scripture also supplied him with ample material to foster his arguments concerning the role of men over women, the supremacy of virginity and his claims about women. These ideas led him to abhor most earthly desires and practices including fornication, adultery, bodily adornments, luxuries and wealth. He strongly upheld virginity, chastity, poverty and simplicity – common views among many of his contemporaries. His writings were influential in his time and continue to be of interest today despite their formulation in response to his own experience and historical context.

*Reid Miller*

## **MARKET RESISTANCE TO OPEN SOURCE SOFTWARE**

Faculty Collaborators: Dr. Mari Heltne and Marius Tegomoh

*Wikipedia* defines the term ‘open source’ as “...general practices in production and development which promote access to the end product’s sources.” This means that information must always remain free. The term ‘open source’, although applicable to other areas, is most widely used to describe computer software. The code which makes up a piece of software is known as its ‘source code.’ Simply put, open source software is software which makes its source code freely available to anyone interested in looking. Programmers and companies can see the code, alter it as they see fit, and even sell their alterations to the code as long as the source and changes always remain open for others to do the same.

Despite the quality, maturity, and appealing aspects of many open source programs, the general public and many businesses meet these products with unwarranted resistance. A broad definition of my collaborative work with the QMCS department staff this year would be that I aimed to spread the word about open source software to small businesses, organizations, and others. When I started, I knew there would be resistance, but the level of resistance which I encountered was beyond what I had expected.

My research begins with a brief explanation of what open source software is. Next, I share the experiences of my grant work. Finally, in an effort to explain or describe the unexpected resistance which I met, I write about research which has been done in the field of open source software.

*Matthew J. Moen*

## **NOVEL SYNTHESIS OF (-)-"WINE LACTONE" IN RACEMIC AND ENANTIOMERICALLY PURE FORM**

Faculty Collaborator: Dr. J. T. Ippoliti

Two synthetic routes were developed in an attempt to synthesize (-)-"Wine lactone" in a more efficient and less costly manner. The first route proved to be successful in achieving this goal. Alkylation of the lithium enolate of 3-methyl-2-cyclohexen-1-one was found to be difficult to achieve using various alkylating groups; however, alkylation with ethyl bromoacetate proved successful, giving ethyl-2-(4-methyl-2-oxocyclohex-3-enyl)acetate in high yield: 'Wet' tetrahydrofuran was found to be responsible for enolate quenching in all previous alkylation attempts. Reduction with sodium borohydride in methanol gave ethyl-2-(2-hydroxy-4-methylcyclohex-3-enyl)acetate in adequate amounts. Following isolation, the product was refluxed in 10% sodium hydroxide and acidified using dilute aqueous hydrochloric acid. This gave 3,3a,4,5-tetrahydro-6-methylbenzofuran-2(7aH)-one in high yield. Methylation using lithium diisopropyl amide and iodomethane gave (-)-"Wine lactone" in high yield and relatively pure form. A second synthetic route, which uses starting materials and oxidative methods that are not currently published in the literature, is currently underway. Thus far, the steps of this synthesis have been giving pure products in relatively high yields.

*Gregorio Montejo*

## **MAXIMUS THE CONFESSOR AND VIRTUE EPISTEMOLOGY**

Faculty Collaborator: Dr. Paul Gavriluk

This collaborative inquiry was an interdisciplinary study of the theological anthropology of the seventh-century theologian Maximus the Confessor in light of recent developments in the philosophic discipline of virtue epistemology. Salient features of this newly emergent theory were highlighted and compared with Maximus' own conception of the virtues, thereby pointing out areas of both congruence and dissimilarity. The project analyzes how a Maximian understanding of virtue, amid the wider context of patristic ascetical theology, may inform the challenging and evolving field of contemporary virtue epistemology. Reversing the centuries-long focus of epistemic research into the criteria of true beliefs in such areas as rationality, justification and warrant, virtue epistemology devotes its attention to an evaluation of "good epistemic properties of persons rather than on properties of beliefs," it shifts attention from acts to agents, and thus broadens "the range of epistemological enquiry to include such neglected epistemic values as understanding and wisdom," and reintegrates affective and cognitive states within a broader epistemological framework (L. Zagzebski, "Virtue Epistemology," in *The Routledge Encyclopedia of Philosophy*, ed. E. Craig [London: Routledge, 1998], IX, 578). The work of Maximus and other early Christian writers is of more than merely antiquarian interest. On the contrary, ascetical epistemology is a rich, and as yet, largely unexplored source of noetic insights. Although these insights may be studied in a purely historical or sociological manner, this interdisciplinary inquiry attempted to bring patristic cognitive studies and the novel conceptualizations of epistemic virtue into creative dialogue with each other. This collaboration examined three specific areas of inquiry: (1) an analysis of epistemic properties in terms of virtuous activity; (2) the reintegration of the cognitive and affective faculties as active virtues; and (3) an examination of theosis, or progressive divinization, as the mechanism of this reintegration.

*Lola Odinaeva*

## **CURRENT STATE OF SPOT MARKETS AND THE FEASIBILITY OF ESTABLISHING FUTURES MARKETS FOR GRAINS IN RUSSIA**

Faculty Collaborator: Dr. Thadavillil Jithendranathan

Futures markets for grains will help farmers and consumers to reduce the uncertainty associated with prices and despite being the fourth largest wheat producer in the world currently there are no such futures markets in existence in Russia. It is necessary to have active and transparent spot markets to support futures markets. In this study we use the daily price data for 2004 and 2005 from various grain producing and consuming regions in Russia and estimate price correlations and arbitrage opportunities between the regions and with international grain markets. Data for this study was obtained from the online trading platform of the Russian Grain Alliance. Preliminary results indicate that there is considerable variation in the grain prices from various regions. One of the factors that contribute to this regional variation in prices is the transportation cost. Grain prices in the Black Sea region, which is the largest producer of grains in Russia, are closer to international prices. On the other hand, Moscow region, which is a large consumption center, has higher grain prices than other regions as well as international prices. Russian government has twice intervened in the grain markets to support prices. Our study indicates that the intervention during the first half of 2004 pushed the prices of grain well above the international prices, but fell back after the intervention was over. In the year 2005, the Russian grain prices generally stayed below the international prices. When we include transportation costs in our study we find that there are substantial arbitrage opportunities between Moscow region and Siberian region. In this study we conclude that of all the regions in Russia, the Black Sea region is the most suitable for establishing grain futures markets. The availability of sea ports, large grain production and active spot market are the factors that favor futures markets in this region.

*Mallory Pikus*

## **OSTRACOD GEOCHEMISTRY AS AN INDICATOR OF PAST CLIMATE IN SOUTHERN PATAGONIA**

Faculty Collaborator: Dr. Kevin Theissen

Laguna Amarga is a small, shallow (2 m max depth) lake, located just outside of the Torres del Paine National Park in Chilean Patagonia (51° 00' S, 72° 00' W). This lake is a closed basin lake shut off by ridges and glacial moraines. Since Laguna Amarga is not connected to an outside water source, it is very responsive to changes in the regional moisture balance and we suspect that its sediment and fossil record accurately reflects past conditions in the region where few past climate records have been collected and published. During January, 2005, two nearly identical one meter-long sediment cores from Laguna Amarga were collected for reconstructing the climate trends of this area. Using the sediment from these cores, the calcareous fossils of ostracods, have been recovered for geochemical analysis. Isotopic values of  $^{18}\text{O}$ ,  $^{16}\text{O}$ ,  $^{13}\text{C}$ , and  $^{12}\text{C}$  from their shells will be used to explore the last several hundred years of climate and environmental history in this region. In conjunction with sedimentary and mineralogical research that revealed evidence of cyclic dry and wet periods, this geochemical research will add information on the past water chemistry and water balance of this area.

*Benjamin L. Sanders*

## **SOLID-STATE STRUCTURES OF SOME ORTHO-SUBSTITUTED BENZYLIDENEANILINES**

Faculty Collaborator: Dr. William H. Ojala

We describe isomeric benzylideneanilines as “bridge-flipped” isomers if they differ only in the orientation of the linkage connecting the two aryl groups (Ar-CH=N-Ar’ vs. Ar-N=CH-Ar’). The existence of crystalline benzylideneanilines in which disorder exchanges the –CH= and =N- moieties has led us to consider whether bridge-flipped benzylideneanilines could be co-crystallized to produce new solid-state materials. Because co-crystallization requires similarity in molecular conformation, we previously determined the X-ray crystal structure of a benzylideneaniline bearing an *ortho*-hydroxyl group to compare the conformation and packing arrangement of this molecule to those of its bridge-flipped isomer. Intramolecular H-bonding produces two different conformations for these isomers, but both are nearly planar. Here we compare the crystal structures of two benzylideneanilines in which the hydroxyl group has been replaced in turn by a fluoro and a bromo substituent. These benzylideneanilines are nonplanar, assume different packing arrangements, and engage in different intermolecular interactions in the crystal.

*Luke Schroeder*

## **EFFECTS OF FISH COMMUNITIES ON AMPHIBIAN AND REPTILE ABUNDANCE IN SHALLOW LAKES**

Faculty Collaborator: Dr. Kyle Zimmer

We examined the effects of variable fish communities on reptiles and amphibians by estimating abundance of tadpoles, salamanders, painted turtles, and fish in 73 shallow lakes in Polk and Grant counties in Minnesota. Fish communities in Minnesota shallow lakes are highly variable. Past research has shown that fish influence the abundance of amphibians and reptiles; however, influences across the types of fish communities are currently unknown. Based on fish species sampled, we classified fish communities in each lake as fishless (F), planktivores only (P), planktivores+benthivores (PB), and planktivores+benthivores+piscivores (PBP). We then tested for related trends in abundance of amphibians and reptiles in both Polk and Grant counties. Results showed that abundance of tadpoles and salamanders in Grant County were significantly higher in F and P lakes compared to PB and PBP lakes, but no difference was found for painted turtles. In contrast, no differences were detected in Polk County. We hypothesize that these differences are due to 4X higher abundance of benthivores in Grant County lakes, suggesting a density-dependent effect of benthivores on amphibians. Additionally, our results show that influences of fish on amphibians may not be restricted to piscivores.

*John Schwerkoske*

## **SYNTHESIS OF A NOVEL POLYACETYLENE FOR USE AS A STABLE LEUKOCYTE ESTERASE DETECTOR AND THERMOCHROMIC POLYMER**

Faculty Collaborator: Dr. J. Thomas Ippoliti

This research aims to take advantage of a new polymerization technique recently developed to create a more stable assay for the enzyme Leukocyte Esterase while at the same time screening these new polymers for their thermochromic properties. A chain of syntheses will be performed to create a series of monomers both with and without a substrate specific to the enzyme Leukocyte Esterase attached. The monomers will then be polymerized to form a polyacetylene (PA) of high molecular weight. These polymers are expected to self assemble under catalytic conditions easier than

previous polymerizations using polydiacetylenes (PDAs), resulting in a series of polymers with unique thermochromic properties in addition to their abilities to serve as a Leukocyte Esterase enzyme detector for fast and accurate diagnosis of urinary tract infections

*Zach Simmons*

## **CONSTANCY AMID CHAOS: INVARIANT MEASURES IN NON-LINEAR DYNAMICS**

Faculty Collaborator: Dr. Marty Johnston

Our chaotic pendulum system has been modified with the addition of a magnetic dipole interaction. We know this interaction qualitatively affects the behavior of the system but it would also be nice to understand the differences quantitatively as well.

Although chaos is not predictable and regular, it is not totally random or stochastic either; it has structure in phase space. Thankfully, there are measurements that we can perform on this structure that can tell us how chaotic the system is. One of the main measurement tools we have are Lyapunov exponents. Lyapunov exponents are a measure of how fast the trajectories in phase space diverge, i.e. how sensitive and chaotic the system is.

However, in order to measure Lyapunov exponents of an experimental system we must reconstruct its phase space. This is accomplished through a process known as time-delay reconstruction and is dependant upon parameters that must be extracted from the data.

This work focuses on determining those parameters in multiple ways to assure our confidence in them and using them to reconstruct the phase space. From this we will be able to measure the Lyapunov exponents of the system, hopefully with enough precision to detect and better understand the influence of the magnetic dipole.

*Jill M. Spude*

## **HALOGENATED ISOMERIC BENZYLIDENEANILINES: SIMILARITIES AND DIFFERENCES IN SOLID-STATE MOLECULAR PACKING ARRANGEMENTS**

Faculty Advisor: Dr. William H. Ojala

We are conducting a solid-state study of pairs of benzylideneanilines we have designated “bridge-flipped isomers,” isomers that differ only in the orientation of the chain or bridge of atoms connecting the two aryl groups ( $\text{Ar-CH=N-Ar'}$  vs.  $\text{Ar-N=CH-Ar'}$ ). Our long-term goal is to prepare new solid materials having properties that can be controlled or modified by co-crystallizing various proportions of these compounds. Mutual solid-state solubility is most extensive for components that have the same molecular packing arrangement in their respective crystals, so we are preparing benzylideneaniline bridge-flipped isomeric pairs and determining their crystal structures to identify isostructural pairs that would be especially suitable for co-crystallization. We recently discovered our first isostructural pair: 2-trifluoromethyl-N-(2-methylbenzylidene)aniline and 2-methyl-N-(2-trifluoromethylbenzylidene)aniline. Here we compare these earlier examples to another pair, 4-chlorobenzylidene-2-cyanoaniline (a structure we have recently determined) and 2-cyanobenzylidene-4-chloroaniline (a structure determined by a previous student researcher). These two compounds, unlike the isostructural pair noted previously, assume unique packing arrangements. Here we also describe the structure of another halogenated benzylideneaniline, 2-cyanobenzylidene-3-iodoaniline; we have examined this structure and the two non-isostructural compounds noted previously for evidence of Lewis acid-Lewis base contacts between halogen and nitrile groups, an interaction that might link molecules into similar chains in different isomers and encourage isostructuralism in halogen/nitrile-substituted benzylideneanilines.

*Katherine M. Stanton*

## **EFFECTIVE BUSINESS TO CONSUMER WEB SITES**

Faculty Collaborator: Joseph A. Komar

The objective of this project was to research how to develop and then develop a nearly fully functional Electronic Commerce (e-commerce) web site. The development included installing and configuring the software for the server, designing the flow of the web pages, developing all the web pages, writing the server software to accept and store customer orders, and simple reporting from the database. The research that went into this project was immense and included research on such topics as databases, scripting languages, servers, available software, and Electronic commerce. There are three different methods for the creation of an e-commerce site and they are: creating all of your own programs and pages from scratch, proprietary software, and open source software. I chose to focus on the available Open Source software to aid me in the process. I used XAMPP and Zen-Cart. XAMPP is an Apache distribution containing MySQL, PHP, Perl, Mercury Mail Transport System, FileZilla FTP server, and other tools. Zen-Cart, which uses the XAMPP download, is an e-commerce shopping cart system that contains the basics of a functional e-commerce site allowing for complete business transactions to be completed.

*Jeremy J. Stubblefield*

## **INFLUENCE OF PHOTOPERIOD ON MAMMALIAN CIRCADIAN FUNCTION: CAN MY MOUSE TELL SUMMER FROM WINTER?**

Faculty Collaborator: Dwight E. Nelson Ph.D.

In mammals daily rhythms in behavior and physiology are driven by endogenous circadian oscillators. Light cycles entrain these oscillators to synchronize them with daily environmental changes. In turn these oscillators drive internal physiology and behavior to match environmental periodicities. Seasonal changes in behavior and physiology are also thought to involve the circadian system through the influence of daylength or photoperiod. We are examining photoperiod-induced changes in the circadian system in C57BL/6 mice – commonly regarded as insensitive to photoperiod. Mice were entrained to longday (16L:8D) or shortday (8L:16D) photoperiods and then maintained in darkness (DD). Light pulses were delivered on circadian cycle 7 of DD to induce phase shifts of the rhythm. Freerunning rhythm periods were also measured. Mice entrained to longdays had significantly smaller shifts (-82 +/- 11min) than mice entrained to shortdays (-167 +/- 11min; ANOVA; Tukey, F=19.15, P<0.0001). To test whether the full duration of light was needed, we also tested mice following “skeleton” light cycles (1 h light at onset/offset times for the complete photoperiods) matching shortday (SDSkel) and longday (LDSkel). Following skeleton photoperiods responses were not significantly different from those measured for complete photoperiods (-169 +/- 17min, SDSkel; -88 +/- 16 min, LDSkel; ANOVA; Tukey, P>0.94). We obtained similar results for circadian period. Surprisingly there is a large influence of photoperiod on circadian functions in C57BL/6 mice. We also found similar results of photoperiod in mice that have a mutation of a circadian gene, mPer2, suggesting this mutation does not alter photoperiod responsiveness. In fact, preliminary results suggest that longday photoperiods may also better maintain rhythmicity in mPer2 mutant mice. Our data suggest that photoperiod is a critical environmental signal for C57BL/6 mice. Manipulation of this environmental signal will be a useful tool for better understanding mammalian circadian entrainment. (Support: UST CIG to JJS; NIH MH60122 to DEN).

*Matthew Turner*

## **THE SELF-ASSEMBLY OF NUCLEIC ACID MOLECULAR SCAFFOLD ON A POLYMER TEMPLATE**

Faculty Collaborator: Dr. T.C. Marsh

The current strategy for creating nucleic acid molecular scaffolds is based on a specific interaction known as Watson and Crick base pairing (resulting in a structure commonly known as B-DNA) to control the positioning of individual scaffold components. The specificity of these interactions enables multiple B-DNA components to spontaneously form a highly ordered scaffold structure. This project uses G-DNA to create novel molecular scaffolding that employs a different self-assembly strategy. Unlike complimentary, double helical B-DNA, G-DNA utilizes guanine self-recognition to create quadruple helical structures that possess greater stability and rigidity compared to B-DNA. Previous work has shown that gold nanoparticles can be attached in a regular manner along this structure, opening the possibility of nano-scale wires. Our project aims to more accurately control the alignment of G-wire molecular scaffolds by coupling an oligonucleotide to a polymer backbone that will serve as a nucleation point for G-wire molecular scaffolds.

The work described here involved the synthesis of a rigid polymer with the oligonucleotide NH<sub>2</sub>-GGGGTTGGGG coupled as a side group at various points. Rigid polymer-oligonucleotide material served as a template for the self-assembly of G-wires. Specifically, poly-5-norbornene-2-carboxylic acid was polymerized through a ring opening metathesis polymerization (ROMP) reaction using Grubb's 2nd Generation Catalyst. The resulting polymer was cast into thin films and the amine-modified oligonucleotide was attached to the polymer through an EDC coupling reaction. Following this addition to the polymer, a self-assembly reaction was set up to create G-wire arrays.

*Theresa Tweet*

## **AN INTRODUCTION TO PALEOGRAPHY: A HISTORICAL STUDY OF THE WRITTEN DOCUMENT**

Faculty Collaborator: Dr. Susan Myers

This study has involved examination of ancient letter-writing practices and the transmission of written texts. The study expanded to include a variety of concerns related to writing and preserving manuscripts.

In particular, I investigated the inks, quills, and various writing implements used in producing texts, as well as the preparation of the writing surfaces themselves (papyrus, vellum, parchment), and storage practices. Ancient texts were produced individually, copied by skilled scribes writing by hand. As a result, no two manuscripts are alike. This led me to note the causes of errors and differences between the manuscripts, as well as the scripts used in the writing process. In addition, I examined the transition from writing on scrolls to the production of an ancient "book" (codex). Originally, written works were done on papyrus, then later parchment, and were preserved on long scrolls that were rolled up for storage. Eventually, these were replaced in the 1st century A.D. by the caudex (codex), wood tablets that were bound together into a type of "wooden" notebook. In time, sheets of papyrus, parchment, and vellum replaced the thin, inner pieces of wood or wax inlay as the filler for the writing surface.

Finally, a contemporary comparison was made to ancient practices. The St. John's Bible is being produced by hand at a scriptorium in Wales, without benefit of a printing press. I compared the preparation of the writing surfaces, use of inks, dyes, and implements for the St. John's Bible with the methods used in antiquity. I found that, while some of the practices currently being used are the same as those of the ancient scribes, others were closer to medieval procedures. Still other methods involved the use of varying modern practices to create this unique, artistic Biblical treasure.

*Adam Urness and Scott Reckinger*

## **POLARIZED LIGHT IMAGING THROUGH TURBID MEDIA**

Faculty Collaborator: Dr. Adam Green

We are using Polarization-Difference Imaging (PDI) to detect objects that are buried in murky (turbid) environments. This technique has several biomedical applications, and it is useful for robotics, underwater exploration, environmental sensing, and understanding how certain animals can navigate and communicate using polarized light.

We have completed the primary stages of this project. We constructed a PDI apparatus and tested it on a system that simulates a tumor imbedded in tissue. Our “tumor” was a block of aluminum with two square patches comprising orthogonal scratches that produced polarized light with perpendicular orientations. The block was submerged in milky water so that the scratches were largely invisible to the unaided eye. Previous experiments involved a liquid crystal retarder, which limited the viewing radius. Using an updated optical system, two images were acquired that accepted orthogonal polarization states. After some image processing, which included a transform subtraction and normalization, high-contrast images were produced. The oppositely polarized patches, which are nearly invisible through the milky water, were clearly visible in the processed images.

The next step of the project involved testing the process using different wavelengths of light. Filters were added to the optical system, which reduced the viewing radius once again. The processed images showed images at wavelengths in the near-infrared, which is beyond the scope of the human eye. Light sources and linear polarizers that work with longer wavelengths are necessary to further this step of the project.

*Michelle Verant*

## **FACTORS INFLUENCING COMMUNITY-LEVEL EXCRETION RATES OF NITROGEN AND PHOSPHORUS BY FISH IN A SHALLOW LAKE**

Faculty Collaborator: Dr. Kyle Zimmer

Fish excretion is an important source of nutrients in aquatic ecosystems. The amount of nitrogen (N) and phosphorus (P) excreted by a fish community is a function of many factors, including fish diet, growth rate, and species composition of the fish community. However, the relative influence of these factors on community-level excretion rates is unknown. We used bioenergetics modeling to estimate excretion rates of seven fish species in a shallow Minnesota lake for four months in both 2004 and 2005. Community-level P and N excretion rates and N:P ratios were then compared to fish densities, fish community composition, and fish diet composition to determine which factors are most responsible for driving nutrient excretion in fish. Regression analysis showed that fish density had a significant, positive relationship with P and N excretion rates and a significant negative relationship with N:P ratios. Residuals of these regressions were then regressed on PCA-derived scores for composition of fish diets and the fish community. N and P excretion rates showed significant relationships with diet composition, with higher excretion rates occurring in fish feeding on macroinvertebrates and fish compared to those feeding on zooplankton. In contrast, no relationship was detected between species composition of the fish community and N, P, or N:P of excretion, and N:P was also unrelated to diet composition. Our results indicate that fish density and prey selectivity are the most important drivers of community-level nutrient excretion by fish.

## **NITRIC OXIDE RELEASING SIBS POLYMER**

Faculty collaborator: Dr. J. Thomas Ippoliti

Thermoplastic elastomers are becoming increasingly important in the biomedical field. Because of their ability to adhere to surfaces, resist degradation under oxidative conditions, and be processed using traditional techniques, they are popular candidates for biomedical devices. Of particular interest in this study is the thermoplastic elastomer poly(styrene-*b*-isobutylene-*b*-styrene) (SIBS). SIBS is used to coat devices such as stents which are widely used in the angioplasty industry. A modified SIBS polymer is currently being synthesized using common polymerization techniques such as free radical polymerization and living carbocation polymerization. The modified polymer will be capable of releasing Nitric oxide (NO) as well as certain antibiotics typically found in stent coatings. NO has recently been shown to reduce restenosis (renarrowing of the arteries) after stent implantation. Once the synthesis is complete, reaction kinetics can be controlled in order to slowly release NO from the block co-polymer. The polymer will be a novel material that can be used to decrease restenosis after stent implantation. To date, various monomers have been synthesized and a styrene/<sup>4</sup>-benzylchlorostyrene has been synthesized that is currently being coupled with a protected diamine to yield an N-diazeniumdiolate derivative.



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