



UNIVERSITY *of* ST. THOMAS

BUSH FOUNDATION PROGRAM GRANT:
COLLABORATIVE INQUIRY

Inquiry at UST:
A Poster Session with the Results of
Faculty/Student Collaboration
at the University of St. Thomas

Abstracts

Vol. 10
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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.



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September 2007

As president of the University of St. Thomas, I am both pleased and proud to welcome you to the tenth poster session devoted to faculty/student collaboration projects developed as part of our 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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Jon Athmann and Mary Hammer

IN PURSUIT OF RUTHENIUM COMPOUNDS

Faculty Collaborator: Dr. David Boyd

This project will attempt to improve the efficiency of solar cells by synthesizing a ruthenium complex with specifically designed properties. In subsequent work, the newly formulated ruthenium complex will be linked to a crystal of zinc oxide, a substance known to convert light into electricity in a photovoltaic cell. The ruthenium compound will absorb visible light, while the zinc oxide absorbs only higher energy ultraviolet light. It is proposed that the two linked substances will be able to capture a wider portion of the solar spectrum, which in turn will lead to production of more energy. The goal of this project is to build a molecule that will successfully link the two light absorbing compounds. The problem central to this project lies in constructing this linking molecule. The linking molecule has been designed, and can be obtained through several synthetic steps. This project will build upon the efforts of previous researchers and the current team at the University of St. Thomas to complete the project.

Barjeta Balidemaj

EFFECT OF SUBSTITUTION ON THE MOLECULAR CONFORMATION AND CRYSTAL STRUCTURES OF SOME CENTROSYMMETRIC BENZYLIDENEANILINES

Faculty Collaborator: Dr. William Ojala

We are conducting an X-ray crystallographic study of benzylideneaniline “bridge-flipped” isomers, benzylideneaniline isomers that differ only in the orientation of the bridge of atoms between the two major parts of the molecule ($R-CH=N-R'$ vs. $R-N=CH-R'$). The purpose of this study is to determine how frequently and under what conditions the individual isomers are isostructural, assuming the same molecular packing arrangement; isostructural isomers might be especially easy to co-crystallize as a method of forming new solid materials. Because centrosymmetric molecules tend to assume packing arrangements in which the molecular center coincides with a crystallographic inversion center, we have recently begun to examine the crystal structures of centrosymmetric bis-benzylideneanilines to determine whether or not this tendency leads to isostructural bridge-flipped isomers. In earlier work we determined the molecular and crystal structures of two isomeric dimethoxy-substituted bis-benzylideneanilines; for the purpose of comparison, here we describe the molecular and crystal structure of 2,2'-difluoro-N,N'-(p-phenylenedimethylene)-dianiline, prepared for the purpose of determining the effect on crystal and molecular structure of varying the substituent at the ortho position.

Cassie Bonefas

THE (UN)CONSTITUTIONALITY OF THE GOVERNMENT'S FAITH-BASED AND COMMUNITY INITIATIVES PROGRAM

Faculty Collaborator: Dr. Tom Mega

The Establishment Clause of the First Amendment states, “Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof.” How to interpret and apply this provision has long been debated, with controversy surrounding the constitutionality of key issues such as government involvement with parochial schools, prayer in public schools and the legal prohibition of the theory of Evolution.

President George W. Bush's Faith-Based and Community Initiatives program is a contemporary point of contention for American citizens. Established by executive order in January of 2001, the goal of the program was to

“enlist, equip, enable, empower, and expand the work of faith-based and other community organizations to the extent permitted by law” in order to “strengthen their capacity to better meet social needs in America’s communities.”

Is an executive order that purposely forms a relationship between the government and religious organizations constitutional in either its intent or application? Although the United States Supreme Court decided in a 5-4 decision that the Adolescent Family Life Act (AFLA) of 1981, an act that provided government funding to religious organizations in support of their social works, was not a violation of the Establishment Clause, I argue otherwise. Using the precedents set by the Supreme Court in both their 1947 *Everson v. Board of Education* and 1971 *Lemon v. Kurtzman* decision, I demonstrate the unconstitutionality of the president-issued and Congressionally approved legislation.

Lucas J. Brand

SUBSTANCE P IMMUNOMODULATION OF T CELL CYTOKINE PRODUCTION IN MICE

Faculty Collaborator: Dr. Jill M. Manske

Substance P (SP), an immunoregulatory neuropeptide, has been demonstrated to have immunomodulatory effects on several mediators in anti-tumor response. Previous studies in our lab have shown that pretreatment of mice with SP for at least five days decreased K1735 mouse melanoma tumor establishment, as well as slowed tumor growth. This requires the presence of two major classes of leukocytes, T cells and Natural Killer (NK) cells. A 2006 experiment demonstrated that this tumor resistance can be transferred between animals via adoptive transfer of T cells after exposure to SP. We hypothesize that pretreatment with SP primes the immune system in preparation to act against melanoma. As part of this process, the T cells would initiate communication with NK cells through production of cytokine signaling molecules. In this study, we examined T cell cytokine production when treated with SP *in vivo*, specifically Interleukin-2 (IL2), gamma-Interferon (IFN γ), and Tumor Necrosis Factor Alpha (TNF α). Intracellular staining of cytokines was accomplished by interrupting Golgi Body activity, causing a buildup of synthesized cytokine in the cell, and subsequently staining cytokines with fluorescent antibody via membrane permeabilization. Results show a significant spike in intracellular levels of IFN γ after five days of SP treatment, suggesting that IFN γ is a crucial intercellular mediator in this model.

Nathaniel C. Brandt

TRANSIENT ABSORPTION SPECTROSCOPY FOR PHOTOINDUCED ELECTRON TRANSFER PROCESSES

Faculty Collaborator: Dr. Joseph M. Brom

Photoinduced electron transfer reactions are important in many aspects of chemistry and can be studied in detail by transient absorption spectroscopy. An apparatus was constructed for transient absorption spectroscopy by modifying an existing apparatus used in the observation of transient fluorescence decays. The laser dye 1,3,5,7,8-pentamethylpyrromethene difluoroborate (pyrromethene 546 or PM 546) was chosen for analysis due to its suspected ability to undergo a variety of photoinduced electron transfers, namely its ability to function as both an excited state electron acceptor and an excited state electron donor. Transient absorption of the PM 546 radical cation were observed near 400 nm along with photobleaching near 460 nm using tetrachloro-para-benzoquinone as an accepting reagent for photoinduced electron transfer. Transient absorption of a related species, pyrromethene 567, was observed at 410 nm along with photobleaching near 470 nm.

Rebecca A. Clark

THE HANDMAID'S TALE: TRANSLATING MODERN LITERATURE TO MODERN OPERA

Faculty Collaborator: Dr. Shersten Johnson

This project attempts to make light of the many musical tools used by Danish composer Poul Ruders in his endeavor to bring Margaret Atwood's novel *The Handmaid's Tale* to life on the operatic stage. Through research involving such diverse musical topics as theory, history, and acoustics, this multimedia project strives to cross disciplinary boundaries by presenting a sampling of the many ways in which this modern composer used common musical tools to interpret Atwood's text. Portions of the project also delve into specific choices Ruders made regarding voice part distribution, and what these decisions contributed to the overall work.

Jordan T. Crow

POLYLACTIC ACID - POLY-L-SERINE BIODEGRADABLE COPOLYMERS WITH BIOCOMPATIBLE DELIVERY

Faculty Collaborator: Dr. J. Thomas Ippoliti

Polymers that break down into naturally occurring molecules in the body are of great interest for biomedical applications. We are interested in synthesizing a copolymer of polylactic acid (PLA) and polyserine, which breaks down into natural occurring byproducts, lactic acid and serine. While the properties of PLA are well known, the addition of polyserine provides a novel mechanism for functionalizing the biodegradable polymer. Serine has been successfully coupled with benzylchloroformate to protect the amine in good yields and the serine monomer has been lactonized.

Using benzyl alcohol and Tin(II) Octanoate at elevated temperatures, a copolymer was successfully synthesized. Additionally, serine has been successfully coupled with the trityl group to protect the amine in high yields and the protected serine has also been lactonized. Trityl protected serine however does not polymerize while using metal catalysts. New ways of polymerizing this monomer using carbenes are being investigated.

Scott DeMuth

THE MINNEHAHA FREE STATE: COLLECTIVE ACTION BETWEEN CROSS-CULTURAL GROUPS

Faculty Collaborator: Dr. Lisa K Waldner

The research involves a case study of the occupation in Minnehaha Regional Park, which has come to be known as the Minnehaha Free State. The Free State took place between August 10, 1998 and December 11, 1999, and was a protest attempting to stop the proposed reroute of Highway 55. It was one of the longest urban occupations within the United States, besides the take-over of Alcatraz by the Indians of All Tribes in 1969. It was also one of the first successful coalitions between Earth First! and Native American groups. The study focuses on the structure of the Free State and the interactions between the different groups (primarily neighborhood groups, the Mendota Mdewakanton Dakota Community, and Earth First!) comprising resistance to the highway reroute. In particular, the study looks at the perception of interactions by participating groups, what conflicts emerged throughout the Free State, and ultimately what made these coalitions successful. Data was collected through qualitative interviews with participants, supporters and observers involved in the Free State. Supplementary data was collected from published resources including news articles, interviews, and participant narratives.

Karley Downing

THE NEGLECTED SOLDIER: THE UNITED STATES COLORED TROOPS AND CIVIL WAR AMERICAN SOCIETY

Faculty Collaborator: Dr. Joseph Fitzharris

During the American Civil war, great changes occurred in society. Relations between North and South changed dramatically. The Constitutional Union was threatened with destruction; and the document itself was changed significantly. The war was fought to save the union, but the status and future of the African-Americans in that Union was a major cause and issue. Blacks were freed in the South, and allowed entrance into the Union Army in 1863. However, racist ideas and actions plagued this politically charged atmosphere. This paradox brings up the question of how this environment affected the African Americans serving the Union in the United States Colored Troops (USCT), the branch of the army established for this race. Through an analysis of Minnesota soldiers and the U.S.C.T. regiments that they served in, the conditions both races experienced was discovered. By studying several regiments of white soldiers from the same state and U.S.C.T. regiments that were led by men transferred from these white Minnesotan regiments, outside factors that could have altered the conditions the men were serving under were minimized. The remaining differences in the treatment and lifestyles of the two regiments are reflective of society's values during this time period.

Northern Society was attempting to end slavery. However, Northerners were still hampered by their racist misconceptions of the African race. This contradiction resulted in the varying conditions the United States Colored Troops served in during the Civil War. The instances where the African American was treated in the same manner as a white soldier are illustrative of the efforts Northern society was making at changing the status of blacks. There were many times when the racism of the era reared its head and U.S.C.T. troops were neglected. Black and white soldiers suffered greatly during the Civil War. However, because society suppressed the treatment of African Americans in several vital instances, the overall experience of the United States Colored Troops was inferior to that of the white Union soldiers.

Joseph W. Dubis

AMINO ACID SUBSTITUTION IN OPSINS TUNE THE TEMPORAL CHARACTERISTICS OF THE L AND M CONES

Faculty Collaborators: Maureen Neitz and Jay Neitz, Department of Ophthalmology, Medical College of Wisconsin

A complete understanding of the mechanisms underlying color vision requires detailed information about the characteristics of the different types of cones. There is an interest in the possibility that the L and M cones may have distinguishing characteristics in addition to their different spectral sensitivities. Classically, dichromats have been studied to characterize the properties of the L vs. M cones with protanopes serving as the model for normal M cone responses and deuteranopes serving as the model for normal L cone responses. More recently, it has become apparent that even among pigments with similar spectral sensitivity curves, there can be large variability in amino acid sequence with little to no effect on spectral peak, but may nonetheless affect other molecular characteristics, such as the temporal properties of the photopigments. We studied the temporal characteristic of Critical Flicker Fusion Frequency (CFF). CFF is the frequency of a flickering object at which the gaps of a flicker are no longer perceivable by the eye thus resulting in the perception of a solid object. We examined CFF as a function of light intensity using L and M cone isolating stimuli in males whose L and M opsin sequences have been deduced through gene sequencing. We found wide variability in CFF with the differences seeming to correlate with non-spectral tuning amino acid differences. These results suggest that amino acid differences in the opsins tune the temporal properties of the cones.

Because the cumulative lifetime amount of all-trans retinal produced by a photoreceptor is directly proportional to the number of times the photopigment goes through the visual cycle, and hence to the amount of toxic A2E that is

produced, the temporal characteristics of the photopigments are likely to prove important in predicting risk factors for age related macular degeneration.

Travis Emmert

SYNTHESIS OF STRUCTURE DIRECTING COMPOUNDS FOR USE IN ZEOLITES

Faculty Collaborator: Dr. J.T. Ippoliti

A recent popular topic of research focuses on size exclusion chromatography, a methodology that separates molecules based on their size difference. Zeolites are vital to this type of separation because the pore sizes can be changed. Structure directing compounds are used as framework for the silica and aluminum to bind to and grow Zeolites. This research project focused on synthesizing new structure directing compounds for the preparation of new Zeolite materials.

Sean Ewen

EXPRESSION OF *mPER2* IN THE SUPRACHIASMATIC NUCLEUS: CUSTOM DATA MEASUREMENT AND ANALYSIS WITH LABVIEW SOFTWARE

Faculty Collaborators: Dr. Dwight Nelson and Dr. Adam Green

The suprachiasmatic nucleus (SCN) is a region of the mammalian brain that is responsible for maintaining an animal's circadian rhythm, the 24 hour cycle that regulates body functions. Located in the hypothalamus of the brain, the SCN uses gene expression such as the mouse *Period2* (*mPer2*) gene to maintain circadian rhythms. The activity of *mPer2* can be measured in tissues from mice that have been genetically altered to express the protein luciferase simultaneously with *mPer2* (LUC::*mper2*). Tissue bioluminescence is then an assay for the molecular expression of the *mPer2* gene.

A light measurement device called a photomultiplier tube (PMT) is sensitive enough to detect individual photons and can be used to detect tissue bioluminescence. This information is then transmitted to a computer card that counts the number of photons detected per minute. Finally, the number is sent to a computer program that selectively displays and saves the data. During the summer I developed a computer program and expanded the experimental set up to include two PMTs so that two tissue samples could be recorded simultaneously.

The computer program was created using LabVIEW, a programming platform that utilizes graphical programming. In graphical programming, icons signifying functions are pasted onto the "block diagram" and wired or connected to other icons with wires that determine the flow of data. Some of these functions can be manipulated and viewed on the "front panel" or user-interface screen while the program is running. The project succeeded in improving upon the old program by integrating new specifications such as simultaneous recordings from two PMTs and has been instrumental in creating the opportunity for additional research into the expression of *mPer2*.

Megan Frericks, Anna Meyer, Jennifer Woychik

ANALYSIS OF HIV/AIDS MORTALITY DATA IN MINNESOTA

Faculty Collaborators: Dr. Arkady Shemyakin and Dr. Palahela Dayananda

This project concerns the analysis of HIV/AIDS mortality data in Minnesota and is based on data collected by the Minnesota Department of Health. This data consists of information about people who have been diagnosed with HIV in Minnesota during the last 24 years. Using given dates of HIV diagnosis, AIDS diagnosis, and death, we computed the length of time between HIV and AIDS diagnosis, and AIDS diagnosis and death in days. These two time periods

comprise the variables we are working with. Our goal is to determine how a person's age and the type of treatment received affects the length of time of each period and how the two variables are related.

In order to find out how each variable correlates with age, we broke each variable into five age groups. Graphing the length of time of each stage, we determined that the data could follow an exponential model. We used Maximum Likelihood Estimation to find parameters to fit each variable. We then used three distributions, Exponential, Weibull and Gamma, to analyze the data. In order to determine how the two variables relate to one another, we used a joint exponential distribution. At the outset of our research, we hypothesized that the average number of days between each period would decrease as age increased.

Complications arising in our analysis were data truncation and censoring. Some subjects were diagnosed with HIV and AIDS simultaneously, resulting in a zero-day entry for the first variable and creating a possible source of error. For some of the data entries, an endpoint was not available because no date of AIDS diagnosis or death was indicated. We turned to survival analysis to correct this problem but have yet to determine whether the results yielded are, in fact, accurate.

Brianne Gaetze

CHARACTERIZATION OF MICROBIALITE LAMINAE OF THE BITTER RIDGE LIMESTONE OF THE BITTER SPRING QUADRANT, NEVADA

Faculty Collaborator: Dr. Thomas Hickson

The Bitter Spring Quadrangle (BSQ) Mapping Project in the UST Geology Department focuses on the eastern part of the Central Basin and Range (B&R) near Lake Mead, Nevada. My project focused on characterizing the microbialite laminae of the Bitter Ridge Limestone, a 13-14.5 million year old (Miocene) carbonate unit. I described the physical appearance and tested to see if there was any chemical variation across the laminae that caused them to appear the way they do. Microbialites are useful to study because they have an overall morphology, fabric, and mineral composition that indicate the environmental conditions in which it formed, as well as patterns of a specific community. The laminae texture is determined by characteristics of the algal mat. These mats must be lithified early on to strengthen the deposit and preserve it in the rock record. We can use this information to interpret ancient depositional systems and past climate. Past research at UST has included isotopic analyses of these same rock units. Oxygen and carbon isotope data have shown a sawtooth pattern, which suggest a varved or annual layering. Usually this means regular flooding and evaporation and/or changes in lake level. By analyzing the chemical and physical characteristics of these microbialites, we would be able to support our isotope data and further clarify our understanding of the ancient record of microbial communities and processes.

Anna Gajdel

PROFESSIONAL RELATIONSHIPS OF VICTORIAN WOMEN WRITERS: CHARLOTTE BRONTË AND ELIZABETH GASKELL

Faculty Collaborator: Dr. Alexis Easley

Charlotte Brontë understood that her writing had an impact on her friends. In November of 1849, she wrote, "I know how my writings have affected their wise and pure minds. The knowledge is present support and perhaps, may be future armour." Brontë's declaration suggests Victorian women writers' reliance upon each other as a means of support during a time when there was shame associated with being defined as a professional woman writer. Brontë and Gaskell were part of a small, early group of women who developed professional female friendships despite the challenges of working in a male-dominated society. Contemporary discourse on women's professional "sisterhood" created a new

environment where Gaskell and Brontë could form and sustain a professional working relationship, even though society questioned the validity and worth of their friendship.

Their private friendship began in 1850 after the publication of *Jane Eyre* and Brontë's ensuing celebrity, and their relationship was made public after Brontë's death and Gaskell's immortalization of Brontë in *The Life of Charlotte Brontë*. Brontë and Gaskell's five year exchange of letters from 1850 to 1855 provides a vivid illustration of how women formed and sustained literary communities during the Victorian era. Their professional relationship also demonstrates the networking methods used by professional women writers who were not welcome in male literary circles. Obstacles such as competition, self-promotion, and their desire for respectability complicated the conditions of their friendship thus exemplifying the benefits as well as challenges of professional relationships between women writers during this period. Together Gaskell and Brontë pioneered women's working relationships and served as a model for later female friendships by revealing complexities the next generation of professional women writers would encounter.

Lucy E. Ganseboom

SYNTHESIS AND TESTING OF A THIADIAZOLE FUNCTIONALIZED ANTIBACTERIAL OXAZOLIDINONE

Faculty Collaborators: Dr. J. Thomas Ippoliti and Dr. Jayna Ditty

The ongoing multi-drug resistance is beginning to be a worldwide concern in the field of medicine. In April 2000, the FDA approved a drug, market name Zyvox, belonging to a new class of antimicrobials composed of oxazolidinones. Recently, there have been reports of resistance to Zyvox, resulting in further exploration in new synthetic antibiotics. A six-step synthesis was developed to optimize an oxazolidinone functionality bound with a thiadiazole moiety and an R-group consisting of a p-methoxyphenyl group. Step 1 and 2 (oxazolidinone ring formation) were successfully completed as presented, with Step 3, 4, 5, & 6 yet to be completed.

Lanita Marie Gaworski

SYNTHESIS OF LATENT CHROMOPHORES FOR COUPLING WITH ALCOHOL OXIDASE AS A NOVEL VISUAL INDICATOR SYSTEM FOR ELISA ASSAYS

Faculty Collaborator: Dr. J. Thomas Ippoliti

Previous research in the Ippoliti group has lead to fluorescent indicators for an ELISA assay coupled with alcohol oxidase; however, fluorescent indicators present the limitation of the necessity of an ultraviolet light source. A colorimetric latent chromophore would be ideal because it would eliminate this need for an ultraviolet light source by giving a visual indication. Latent Chromophore-2 is one such indicator. Although progress has been made towards its synthesis, the addition of the borate ester has proved to be challenging. Continued research will be done to add the borate ester to indole to form Latent Chromophore-2 while also pursuing other colorimetric indicators.

David Green

THE PRESENTATION OF COMMUNITY POLICING IN INTRO CRIMINAL JUSTICE TEXTBOOKS: A CONTENT ANALYSIS

Faculty Collaborator: Dr. Peter Parilla

Introductory criminal justice text books serve as many criminal justice professionals first contact with criminal justice concepts. These texts play an essential role in establishing the foundation of knowledge that students build upon as they embark on their career path. For this reason this research focuses on these texts and examines their presentation of an increasingly relevant concept in criminal justice: community policing. By performing a content analysis of current textbooks and presenting this information, this poster shows from a broad perspective the way that current criminal justice students are being educated about this important concept.

Amy L. Gunty

IS YOUR THINKING ALL SCREWED UP?: MALADAPTIVE AND ADAPTIVE SCHEMAS AS PREDICTED BY FAMILY DYNAMICS

Faculty Collaborator: Dr. John R. Buri

Individuals' levels of healthy and unhealthy thinking patterns as a function of parenting variables were investigated. Results revealed that (a) negative parenting styles are positively related to the presence of unhealthy thinking patterns and inversely related to the presence of healthy thinking patterns and (b) positive parenting styles were inversely related to the presence of unhealthy thinking patterns and positively related to the presence of healthy thinking patterns.

Patrick Hawk

ALIGNMENT OF SURFACE-ANCHORED SUPRAMOLECULAR NUCLEIC ACIDS VIA A UNIFORM AC FIELD

Faculty Collaborator: Dr. Thomas Marsh

Nucleic acids are attractive materials for creating nanoscale devices by virtue of their inherent ability to self-assemble into complex supramolecular structures given the appropriate sequences and reaction conditions. The ability to chemically synthesize nucleic acids with any sequence enables them to be employed as a programmable scaffold components designed to self-assemble into a specific structure. One application of this property is the construction of molecular scaffolds or nanoscaffolds. These scaffolds are very useful for the positioning of other materials, such as gold nanoparticles, at regular intervals with a relatively high degree of precision. However, the positioning of the scaffolds themselves is quite random. Manipulation by a scanning probe microscopy tip or by dielectrophoretic focusing can position the scaffolds. Another way of positioning the scaffolds is to have a starting point for assembly directly on the surface. Our work deals with creating an apparatus that can test how scaffolds made of G-DNA (Tet1.5, (GGGGTTGGGG)) can be lined up in a predictable, reproducible way via dielectrophoretic focusing. Once the parameters for the focusing have been found, dielectric substrates that include starting points for the build-up of scaffolds could also be utilized.

Jonathan W. Hennek

COMBINATORIAL LOW-PRESSURE CHEMICAL VAPOR DEPOSITION OF HIGH- κ STRONTIUM-DOPED HAFNIUM DIOXIDES

Faculty Collaborator: Dr. David Boyd

Previously characterized liquid strontium precursor (1) was used along with $\text{Hf}(\text{OtBu})_4$ (2) to deposit thin oxide films with variable strontium / hafnium concentrations in a cold-wall, combinatorial low-pressure chemical vapor deposition (LPCVD) reactor. Simultaneous delivery and decomposition of both precursors on a single-crystal silicon substrate heated to 500 °C yielded mixed $\text{SrO} / \text{HfO}_2$ materials exhibiting a variety of crystalline phases. A desired cubic hafnia phase, which possesses a high dielectric constant, was found in regions of low Sr concentration (~15%). Regions of high Sr content showed evidence of SrHfO_3 and SrCO_3 . LPCVD reactor schematics and characterization techniques will be discussed.

Lue Her

XILINX BOARD PROJECT

Faculty Collaborator: Dr. Christopher S. Greene

A Field Programmable Gate Array (FPGA) is a device that can implement digital logic. FPGAs can be used to build microprocessors, digital signal processors, custom hardware logic – anything that can be built with AND, OR, and NOT gates can be implemented inside of an FPGA, given enough resources of that particular FPGA. My task was to build a small Printed Circuit Board (PCB) around the Xilinx Spartan 3, a low cost FPGA with 400,000 system gates and 8,064 logic cells. The board has FLASH ROM support for storing programs, SRAM support for running programs, and a power subsystem that takes in 5 Volts and outputs the core voltages for the FPGA of 1.2 Volts, 2.5 Volts, and 3.3 Volts. A bypass capacitor network was also designed to keep the core voltage supplies stable. A 50 MHz clock is provided, as well as a standard 8-pin DIP for a secondary clock. Eight LEDs are provided on the board, as well as pin holes for 49 user input/output pins. A programming reset button is provided, as well as jumpers for some programmability options. Lastly, a JTAG port that is compatible with the existing JTAG connector we have in the engineering labs is present. The board uses two signal layers and two power planes. The board is 3.7 by 2.4 inches. The advantages of this board compared to the current boards we have is that it has a smaller physical size, having a minimum number of onboard peripherals; it also has plenty of user input/output pins, and is flexible enough so that students can use it in many different types of applications.

Amanda Hixon

FLUORESCENCE QUENCHING OF PYRRMETHENE 546

Faculty Collaborator: Dr. Joseph M. Brom

Pyrrromethene 546 (PM 546) is a laser dye that possesses a very high fluorescence quantum yield. When a quencher is put into solution with the PM 546, the fluorescence intensity is reduced. These intensities are measured and compared at varying quencher concentrations in PM 546 solutions. Applying the Stern-Volmer equation to these intensities we can determine their Stern-Volmer constant or K_{sv} values. The larger the K_{sv} value the better the quencher.

PM 546 in its excited state can act as either an electron donor or an electron acceptor. By using well know electron donating or electron accepting quenchers the relative K_{sv} values can be determined and compared. The K_{sv} values for the electron donating quenchers were extremely small when compared to the K_{sv} values for the electron accepting quenchers. This shows that although PM 546 can act as either an electron donor or an electron acceptor, it is more

apt to act as an electron donor.

Matthew Humbert

COMPARISON STUDIES OF GAS PHASE MICRODIALYSIS PROBES INTERFACED WITH BOTH PTR-MS AND GC-FID

Faculty Collaborator: Dr. Tony Borgerding

Gas phase microdialysis extraction can be used to measure volatile organic compounds in solution. This technique has many advantages in that the probes used are small (200micron diameter), have a fast response time (around 1sec), and can analyze both polar and non-polar compounds. We have interfaced the microdialysis probes with a proton transfer reaction mass spectrometer (PTR-MS) and have measured toluene at .01mM, which is 100 times lower than the detection limit using a flame ionization detector. Using the PTR-MS we have seen improvement in the detection limits of other VOCs. The PTR-MS has been used to monitor a reaction in which 10mM propanol is oxidized by dichromate. We have also interfaced the microdialysis probes with a GC-FID to monitor a reaction in which 200 mM ethanol in oxidized by dichromate. We studied the affect that solution temperature has on the probe's sensitivity. From 0°-60° ethanol's signal increased by a factor of 43, propanol's signal by a factor of 52, and toluene's signal by a factor of 4. We studied the affect that NaCl, protein, and acid in solution have on probe sensitivity. We found that NaCl and acid slightly increase the sensitivity for ethanol and propanol. Protein had little affect on the sensitivity for these analytes. The sensitivity of toluene decreased slightly with NaCl and Acid, and decreased by a factor of 17 with protein.

Allison Johnson

SYNTHESIS OF A LATENT FLUOROPHORE, A HIGHLY REACTIVE INDICATOR FOR USE IN AN ENZYME-LINKED IMMUNOSORBENT ASSAY

Faculty Collaborator: Dr. J. Thomas Ippoliti

As a diagnostic tool, Enzyme-Linked Immunosorbent Assays utilize the interaction between antigens and antibodies to detect the concentration of antigens in a sample. By using a highly fluorescent indicator molecule such as Latent Fluorophore, the application of an ELISA with the enzyme Alcohol Oxidase becomes highly advantageous due to the highly responsive and fluorescent nature of the molecule. This fluorescent indicator molecule, which was successfully synthesized, surpassed the previously synthesized Latent Fluorophore with a 7.2 times increase in fluorescent strength, making it a highly reactive molecule for use in diagnostic testing with the antigen, estradiol.

Amanda Kastelic, Kai Sill, and Christy Spampinato

SUBSTANCE P MODULATION OF ANTI-TUMOR RESPONSES: UPREGULATION OF ACTIVATION ANTIGENS ON NK AND T CELLS

Faculty Collaborator: Dr. Jill M. Manske

Substance P (SP) is a neuropeptide that has been shown to have immunoregulatory properties including effects on mediators involved in anti-tumor immunity. In previous studies we have shown that treatment of mice with SP provides protection against tumor growth. This protection requires both T cells and NK cells, and adoptive transfer of cells from SP-treated animals can transfer tumor protection. These studies suggest a model in which SP treatment prior to tumor challenge primes immune mediators to prevent or delay tumor establishment. In this study we

examined the ability of SP to upregulate activation antigens on NK cells and T cells. Mice were implanted with mini osmotic pumps that supplied a continuous supply of either SP or PBS over a 14 day period. During the 14 day period, mice were sacrificed at day 5, 9 and 14 and expression of activation antigens was analyzed. Cell analysis by means of specific antibody treatment (DX5, CD69, CD4, and CD25) was used to detect upregulation of activation antigens.

Antibody stained cells were acquired using flow cytometry and analyzed using FlowJo software. The effect of SP treatment on the expression of the IL-2 receptor (CD25) was used as a marker of early T cell activation. NK cells were analyzed for the expression of CD69 which is upregulated upon activation of these cells. NK cells from mice treated with SP showed signs of upregulation of CD69 when compared to controls. No SP effect was observed on IL-2 receptor (CD25) expression. These results suggest that SP treatment may upregulate activation antigens on NK cells. Taking into account previous studies, these data may help explain SP's protective effect against tumor challenge.

James Kavanaugh

RETARDANCE PROPERTIES OF THIN POLY-CARBONATE MATERIALS

Faculty Collaborator: Dr. Adam Green

The optical properties, specifically the retardance magnitude, of various thicknesses of poly-carbonate were explored using a Xenon light source and an Axometrics polarimeter. Retardance values were measured for multiple wavelengths and poly-carbonate orientations in order to determine the effectiveness for the poly-carbonate to be used as a cheap alternative for expensive zero order quarter- or half- wave plates. The results indicate a strong possibility that specific thicknesses of the poly carbonate have all of the characteristics of a zero order retarder. Furthermore, measuring techniques for the Axometrics polarimeter were developed to continue experiments on the study of the reflective polarization properties exhibited by the shells of scarab beetles and the wings of butterflies.

Emily M. Korman

CRYSTAL STRUCTURE OF A PYRIDYL-BENZYLIDENEANILINE

Faculty Collaborator: Dr. William H. Ojala

The purpose of this research project is to prepare and crystallize a pyridyl-halogen substituted benzylideneaniline in order to analyze its molecular packing arrangement in the solid state. This packing arrangement is then compared to the packing arrangements of two different halogen-substituted benzylideneanilines that are "bridge-flipped isomers" of each other. Bridge-flipped isomers are molecules related by a reversal of the bridge of atoms between two major portions of the molecule; in benzylideneanilines, this isomerism is $R-CH=N-R'$ vs. $R-N=CH-R'$. Our eventual goal is to co-crystallize bridge-flipped isomers to form solid solutions with new and useful properties. Co-crystallization of the two isomers is predicted to occur most readily if the two isomers are isostructural, assuming identical molecular packing arrangements in their respective crystals. By replacing a C-H group with a nitrogen atom in the ring, we hope to minimize conformational differences between the isomers that would cause them to assume different molecular packing arrangements in the solid state. In this case, we also wish to see whether halogen-halogen interactions occur in the pyridyl-benzylideneaniline, and we compare its intermolecular interactions here to those in a pair of brominated derivatives. In comparing the similarities in packing arrangement and halogen interactions, it is hoped that a better understanding will be gained of how these compounds might co-crystallize to form solid solutions.

Andrew Korte

ENVIRONMENTALLY-RELEVANT PHOTODEGRADATION OF TWO FLUOROQUINOLONE ANTIBIOTICS

Faculty Collaborator: Dr. Kristine H. Wammer

Two fluoroquinolone antibiotics, norfloxacin and ofloxacin, were examined to allow prediction of their photochemical fates in natural waters. Because the rate of degradation of these drugs was previously found to be largely dependent on pH, and due to the significant variation in values available from literature, pK_as were obtained by spectrophotometric titration for both molecules. These pK_as, along with observed photodegradation rates alongside a p-nitroanisole and pyridine actinometer, were used to calculate quantum yields for each of three species of each drug. Quantum yields were found to be much higher for the zwitterionic form (the dominant species in many environmental waters) of both norfloxacin and ofloxacin. Two norfloxacin photoproducts were proposed based upon mass spectrometry data, though confirmation by NMR is pending.

Marika K. Kuspa

CRYSTAL STRUCTURE OF A CENTROSYMMETRIC BENZYLIDENEANILINE: *N,N'*-BIS(3-CHLOROBENZYLIDENE)-*p*-PHENYLENEDIAMINE

Faculty Collaborator: Dr. William H. Ojala

This project is a single-crystal X-ray crystallographic study of the molecular packing arrangements assumed by pairs of organic compounds related by reversal of the orientation of a bridge of atoms connecting two major parts of the molecule; we refer to these pairs as *bridge-flipped isomers*. This kind of isomerism can be found among such families of organic compounds as the benzylideneanilines (R-CH=N-R' versus R-N=CH-R') and the phenylhydrazones (R-NH-N=CH-R' versus R-CH=N-NH-R'). The ultimate goal of this project is to co-crystallize these isomers in pursuit of novel solid materials under the assumption that bridge-flipped isomers may be co-crystallizable because of their similarity in molecular size and shape. Mutual solid-state solubility would be enhanced in those cases in which the isomers independently assume the same packing arrangement, forming *isostructural* crystals. Given the fact that centrosymmetric molecules tend to occupy crystallographic centers of inversion in their packing arrangements, we have begun examining pairs of centrosymmetric bridge-flipped isomers to determine whether or not this tendency can lead to isostructural isomers. As part of this effort, we have prepared the compound *N,N'*-bis(3-chlorobenzylidene)-*p*-phenylenediamine and determined its crystal structure. Here we describe the molecular structure and packing arrangement of this centrosymmetric molecule.

Jennifer Labr

FINDING AND MAINTAINING SEPARABLE PREFERENCES

Faculty Collaborator: Dr. Jonathan Hodge, Grand Valley State University, Allendale, Michigan

In a democratic referendum, voters go to the polls in hopes of achieving their ideal outcome. However, referendum elections often do not result in the public's most ideal outcome and in fact, may result in the public's least ideal outcome. In a multiple question referendum election, a voter's preferences on one set of proposals may depend on the outcome of other proposals in the election. This may be because the proposals are related, for example if there were three proposals related to the environment, or because a voter does not want all proposals to pass for monetary reasons. The notion of separability is used to describe preferences that are free from this type of interdependence. The more separable a voter's preferences are, the more likely it is that the election results will please the voter. This summer, we created and used tools for understanding and testing the separability of a voter's preferences. When testing for

separability, a voter's preferences are arranged in a preference matrix. Each preference matrix is related to a set of subsets called a character. The term constructible is used to describe those characters that can be built from smaller characters through a technique known as a pre-separable extension. Using this method to build preference matrices allows one to control how much a voter's preferences will be separable. This summer, we characterized the constructibility of all admissible characters for referendums on four or fewer questions. The methods used give voters a way to combine their preferences on different proposals so as to achieve the maximum level of separability possible.

Molly Leonard and Fiona Lodge

GEMS CAMP

Faculty Collaborator: Dr. Lisa Rezac

GEMS Camp stands for Girls Experiencing Math in the Summer. It is a summer math camp for high school girls.

Some of the activities at the camp include:

- Two enrichment mini-courses introducing mathematics not commonly seen in the high school curriculum.
- Presentations on topics such as Cryptography, Financial Mathematics and Actuarial Science, and Mathematics and Art
- Panel discussion with female mathematicians working at research and teaching institutions and in industry
- Recreational time and field trips (e.g. the Science Museum of Minnesota)

Katherine McCaffrey

DENOISING VIA WAVELET TRANSFORMATIONS

Faculty Collaborator: Dr. Patrick J. Van Fleet

This research project explores the methods of using wavelet shrinkage in denoising data sets. To begin with, I learned the process of applying a wavelet transform to a vector and a matrix. Initially I worked with the Haar Wavelet Transform which averages values, which can be used in image compression and in edge detection. and worked with the explicit denoising algorithm with specific examples. Then, using the VisuShrink and SureShrink methods of denoising, I tested different threshold functions, searching for a more accurate method. In each of four cases used, I added random "noise" to the data sets, and used the original values to measure the error obtained by each threshold function. The VisuShrink method utilized a universal threshold value and an estimation of the noise level of a data set to accurately shrink the wavelet, while the SureShrink method removed the errors of VisuShrink and its reliance on the size of the data set. In using the SureShrink method, I tested a new threshold function, and applying the method, came up with the appropriate minimization function, with the hopes of minimizing the error in denoising. From this point, I will minimize this function, and, if it is successful, apply this method of shrinkage and denoising to an image of sedimentary deposits obtained by the Geology department for analyzing.

Kathleen McNulty

THE SUMMER OF THE OSTRACODS: THE USE OF OSTRACODS IN PALEOCLIMATOLOGY

Faculty Collaborator: Dr. Kevin Theissen

I am studying the fossils of microscopic shelled crustaceans called ostracods that are found in shallow lakes as part of a larger investigation to find out about past climates in Minnesota. I extracted fossilized ostracods from a three-meter long core taken from Lake Christina in the prairie pothole region of Minnesota. After some experimentation, I

used a hydrogen peroxide solution to break up clays and I separated samples into four size fractions using a wet-sieving technique. Through careful observation under a microscope, I found that there are 5 main species of ostracods present in the section of the core that I was studying: *Limmocythere itasca*, *Cyclopris ovum*, *Candona ohioensis*, *Candona decora*, and *Candona elliptica*. Changes in the abundance of these species provide information about corresponding changes in the chemistry of the lakes and clues to past conditions. I am in the process of completing detailed counts of these species and will continue my work during the school year.

Carl Mickman

PHASE RELATIONSHIP BETWEEN RHYTHMS OF MPER2::LUC AND LOCOMOTOR ACTIVITY FOLLOWING LONG AND SHORT DAY PHOTOPERIOD

Faculty Collaborator: Dr. Dwight Nelson

Behavioral and physiological changes to the rodent circadian system are modulated by photoperiod, however, the mechanism which by which these responses are elicited has not yet been definitively explained on the molecular, and more specifically, the genetic level. Several genes, including *Period2* (*Per2*), interact in a complex feedback loop causing them to oscillate on a ~24-hr cycle and contribute to an innate timekeeping system. On the organismal level, mice are thought to be entrained by a dual oscillator system which tracks to both light onset (Morning oscillator) and offset (Evening oscillator), although the location of this system is much disputed. Competing theories place the E/M oscillator system either within individual cells as a function of changes in clock gene expression, or as a result of differential activation of cell groups at various locations within the Suprachiasmatic Nucleus (SCN). Here, using a *Per2::Luc* reporter, we investigated these two postulates and examined the *in vitro* expression of this clock gene in mice entrained to both long (16:8) and short (8:16) photoperiods. Phase of *Per2* peak expression in the long photoperiod was significantly advanced in comparison with that of the short photoperiod and appeared to be tracked to light onset, correlating with the theoretical M oscillator, not the E oscillator as previous studies hypothesize. Also, phase of anterior and posterior sections of the SCN in each photoperiod were not different, indicating that location does not account for the E and M oscillators in *Per2* expression.

Benjamin Millmann

THE AMERICAN CROCODILE: A COMPREHENSIVE STUDY OF SALINITY'S EFFECTS ON OSMOREGULATION, POPULATION SIZE, AND MOVEMENT ON AN ENDANGERED MARINE REPTILE

Faculty Collaborator: Dr. Anthony Steyermark

The Tamarindo Estuary, located in the Guanacaste region of Costa Rica, is home to a diverse collection of plant and animal species. Unfortunately, it is also home to the sudden growth of nearby human development. One of the organisms most likely to be affected by this development is the American Crocodile, *Crocodylus acutus*. As increased human presence in the area leads to a corresponding drain on the area's water table, salinity levels in the estuary are expected to rise. This creates a significant amount of energetic expense for the crocodiles as more of their energy goes toward osmoregulation of internal fluids and less towards development and growth. It has already been shown that high salinity waters generally have a negative affect on crocodile size and swimming ability, but we hope to study the exact effects of fluctuating environments on crocodile osmoregulation, movement, population size, and fitness using techniques such as tagging and boat observations, temperature readings, and water composition tests. As a large keystone species of the area, and also an endangered species, this research could not only benefit the American Crocodile's survivorship by informing us of their environmental limitations, but it could also be beneficial in

educating local citizens about our impacts as humans on the environment by actively including them in the conservation of their surrounding wildlife.

Jim Moen and Kevin Hoffman

ISRAELI CLUSTER MUNITION STRIKES AND HEZBOLLAH ROCKET LAUNCHES IN SOUTHERN LEBANON

Faculty Collaborator: Dr. Virgil Wiebe

The aim of this project is to examine the relationship between where cluster munitions strikes are known to have occurred in Southern Lebanon and the points where Hezbollah rocket launches are known to have occurred during the Hezbollah conflict of 2006. Ultimately the relationship between launches and strikes proves to be quite interesting. Some areas where hundreds of launches occurred have fewer strike points than areas where between one and ten launches occurred. This calls into question the reasoning behind the use of cluster munitions in this particular case. Cluster munitions have been a controversial warfare weapon because of the high numbers of civilian casualties they cause as well as the high number of dormant munitions it leaves in civilian areas. Was Israel using cluster munitions as an act of defense or to terrorize civilians and ultimately subdue the Hezbollah rocket launches? Those are just two questions that we have been trying to answer in this ongoing project.

Jessica A. Monson, Neil T. Skupa and Amy E. Slama

FIRE EFFECTS ON THE SIZE AND AGGRESSIVENESS OF ANTS: THE ROLE OF CARBOHYDRATE RESOURCES

Faculty Collaborator: Dr. Adam D. Kay

Territorial aggression is common in ants, but the level and intensity of aggression differs substantially among species. Hypotheses aimed at explaining this variation have focused on either the distribution and abundance of food or on colony size. In this study, we are examining the relationship among the aggressiveness, size, and lipid content of ants across an environmental gradient associated with the availability of carbohydrates. Our study site is an oak savanna at the Cedar Creek Natural History Area (Anoka Co., MN). Over the past 4 decades, areas of this site have been burned at different frequencies, which has created variation in forest structure which in turn may affect the availability of carbohydrate resources for ants. Our study organism is the thatch ant, *Formica obscuripes*, which occurs across the entire fire frequency gradient. We found that the density of thatch ant colonies does not differ significantly among burn treatments. In addition, we found no difference among burn treatments in the average head width of individual ants, a key measure of ant structural investment. However, after controlling for head width, we found that ant dry mass was significantly higher in unburned areas than in burned areas, suggesting that ants differ in condition among sites. We are now seeking to determine whether this variation in ant condition is related to differences in lipid content and behavior, and whether it is associated with carbohydrate access in the field.

Katherine M. Motz

USING ALKYL AMMONIUM CATIONS TO FACILITATE G-DNA SELF-ASSEMBLY AND STABILIZATION OF G-WIRES FOR USE IN MOLECULAR SCAFFOLDING

Faculty Collaborator: Dr. Thomas C. Marsh

G-wires are linear G-DNA supramolecular polymers that self-assemble from guanine-rich nucleic acid oligomers.

The fundamental structural element of a G-wire is the G-quartet, a cyclic structure of four guanines held together by hydrogen bonds. Previous research has shown that monovalent cations, such as potassium (K^+), sodium (Na^+), and ammonium (NH_4^+) serve to stabilize G-DNA structures by coordinating between stacked G-quartets. This research explored the potential of using alkyl ammonium cations to stabilize G-wires. The molecular cations used in this study included ethanolammonium ($EtOHNH_3^+$), dimethylammonium (DMA), trimethylammonium (TMA), choline, lysine, and spermidine. Results from Polyacrylamide gel electrophoresis (PAGE) assays, UV thermal denaturation and TM-AFM showed that primary alkyl ammonium cations, such as $EtOHNH_3^+$, facilitate G-wire formation and stability. The ability of an alkyl ammonium cation to stabilize G-wires significantly decreased as the number of alkyl groups bound to the nitrogen. These results show promise for developing new ways of organizing alkyl ammonium passivated nanoparticles by targeting the coordination site of G-DNA.

Nicole Nathán

EFFECTS OF INCREASED PHYSICAL ACTIVITY ON MAJOR HEALTH FACTORS IN ADULT WOMEN

Faculty Collaborator: Dr. Bridget Duoos

This study was designed to determine the physical, psychological and behavioral health benefits that a community-based exercise program has on the adult female population. The effects of increasing one's daily activity through a community-based exercise program were tracked and measured over six weeks.

The following pre- and post- fitness assessments were done one week prior to the program commencement and repeated at the end on 13 adult females ages 46.53 (± 8.72 s.d.), 165.85 lbs (± 40.43 s.d.): blood pressure, cardiovascular health, hamstring/low back flexibility, and body composition. Psychological/behavioral health and stress vulnerability were determined through readiness for exercise and vulnerability to stress questionnaires. Subjects recorded all physical activity performed and were asked to participate in weekly group meetings that involved walking, low impact aerobics, nutrition and stress management seminars. Subjects exercised on their own and chose mode of activity to participate in. Pedometers were given to five interested subjects for recording activity levels.

No significant statistical data was found using a t-test. Mean weight loss for six of the 13 participants was 1.77 lbs (± 2.17 s.d.), mean pre-systolic b. p. was 127 bpm (± 9.79 s.d.) and mean post-systolic b. p. was 119 bpm (± 11.65 s.d.). Mean change in stress vulnerability scores was a negative six points (± 4.93 s.d.) indicating a reduction in perceived stress. Hip to waist ratio risk dropped one category for one subject. Risk factors for waist circumference risk dropped for two subjects. Seventy-seven percent of the subjects gained upper body strength and 85% of subjects increased abdominal strength.

Nicholas Newstrom

WHEN THE GOING GETS TOUGH: ADOPTIVE MOMS NAVIGATE DIFFICULT ADOLESCENT YEARS

Faculty Collaborator: Dr. Jean Giebenhain

Although research indicates that adopted teens have no more serious difficulties during adolescence than other teens, those who do experience problems have another layer of potential complicating issues that their non-adopted peers do not face. Adoptive parents may have difficulties navigating the teen years, and find they have few supports. In this study, mothers whose adopted teens are experiencing significant difficulties, identified their teen's struggles, particular parenting challenges, family stresses, as well as their support systems and resources.

Sara Padley

LEARNING HOW TO WIN AND HOW TO LOSE: THE ROLE OF PARENTING IN YOUNG ATHLETES' GOALS, SPORTSPERSONSHIP AND MOTIVATION

Faculty Collaborator: Dr. John M. Tauer

According to the National Council of Youth Sports, more than 41 million boys and girls participate in organized sports. With such a large number of young athletes, it is important to understand the role that parents play in children's athletic experiences. While some children may play because they want to, others may play to please their parents. This study examined the relationship between parenting style, children's achievement goals, and children's levels of sportspersonship and intrinsic motivation. Three types of parenting styles were studied: permissive parenting, marked by low levels of control; authoritarian parenting, marked by high levels of control and low levels of warmth; and authoritative parenting, marked by high levels of control as well as high levels of warmth. Two types of goal orientations were studied: task orientation, in which individuals work towards personal improvement, and ego orientation, in which individuals are more concerned with appearing competent.

The 391 participants in this study (ages 8-17) completed two questionnaires over the course of the weeklong basketball camp they were attending. The questionnaires took approximately 10 minutes to complete and contained questions assessing parenting styles of participants' mothers and fathers, participants' goals, levels of sportspersonship, and intrinsic motivation.

Results indicated that children with authoritative parents were more likely to be task oriented, while children with authoritarian or permissive parents were more likely to be ego oriented. Furthermore, results indicated authoritative parenting predicted higher levels of sportspersonship and intrinsic motivation, and these effects were partially mediated by task goal orientation.

The results of this study make it clear that parenting plays a significant part in children's athletic experiences. It is important for parents to understand how they can help their children adopt goals that place importance on personal improvement, thereby promoting high levels of both sportspersonship and motivation.

Rachel Piotraschke

EXTENSIONAL FAULTING IN THE BITTER SPRING QUADRANGLE

Faculty Collaborator: Dr. Melissa Lamb

The geological province known as the Basin and Range is a wide rift zone comprising much of the western United States. Our area, the Bitter Spring Quadrangle (BSQ), is located near the northern arm of Lake Mead, Nevada, and is part of the Central Basin and Range. Specifically, it lies within the northeast-striking, left-lateral, strike-slip Lake Mead Fault System. Tectonic extension is typically associated with the formation of normal faults; however, the role that strike-slip faults play in an extensional regime is not well understood. Rock outcrops in our area, as in much of the Central Basin and Range, are well-exposed, making it an excellent place to study the region's extensional tectonics. Our research included field mapping of part of the BSQ, followed by quantitative and qualitative analysis of the faults we found in the area. Through the use of mapping, cross-sections, and stereonet analysis, our findings were compared to current models of extensional faulting involving the relationships between strike-slip, normal, oblique, and detachment faults. At this point, we have found at least three models that may explain some of our areas of faulting. Our study contributes to other current research regarding the roles of different types of faults in Basin and Range extension, leading to better understanding of the ongoing extension in this tectonically active region and increasing the possibility of predicting hazards.

Bethany Rhein

THE AFFECT OF DIFFERING PHOTOPERIODS ON THE OUTPUT GENES, *PSBA1* AND *PURF* OF THE CYANOBACTERIUM *SYNECHOCOCCUS ELONGATUS*

Faculty Collaborator: Dr. Jayna L. Ditty

Cyanobacteria are single-celled prokaryotes that exist and thrive in most habitats on earth and use a circadian clock to efficiently regulate their cellular activity. The oscillator genes *kaiA*, *kaiB*, and *kaiC* are responsible for the circadian mechanism and therefore regulate output gene activity. Genes such as *psbA1* (important for photosynthesis) and *purF* (important for purine biosynthesis) are examples of two output genes that are expressed in the cyanobacterium *Synechococcus elongatus* PCC 7942 due to the circadian clock.

Photoperiods have been shown to have considerable impacts on circadian clocks in other model systems; however, the effect of photoperiod on the cyanobacterium *Synechococcus elongatus* is not well understood. To determine the effects of photoperiod on cellular activities, *S. elongatus* reporter strains AMC408 (*purF::luxAB*) and AMC669 (*psbA1::luxAB*) were exposed to 12L:12D (12-hours of light and 12 hours of dark), 6L:18D & 18L:6D photoperiods. Preliminary results suggest that the AMC408 strain showed little difference in circadian oscillation in response to the different photoperiods, while AMC669 demonstrated a phase advance when exposed to either an 18L:6D or 6L:18D photoperiod compared to 12L:12D. These preliminary results suggest that the different photoperiods differentially affect the circadian expression of the different *S. elongatus* output genes *purF* and *psbA1* genes.

Andrew Rischall

INCREASING SENSITIVITY OF GAS PHASE MICRODIALYSIS PROBES USING A CARBON NANOTUBE COATED COLUMN

Faculty Collaborator: Dr. Tony Borgerding

Gas phase microdialysis extraction (GPME) probes are used for collecting volatile analytes from a water sample. The small GPME probes are advantageous since it allows gas phase diffusion of both polar and non-polar analytes. A major disadvantage of the probes is their lack of sensitivity. The GPME probes have been interfaced with a cryofocussing gas chromatogram using a short (33 cm) carbon nanotube (CNT) coated column. Cooling the front of the CNT column (3 cm) allowed adsorption of the analytes to the tubes. Then by heating the CNT column, the analytes desorb off the CNT coated column. Cryofocusing allows for 100 times greater sensitivity. Dilutions of 0.001 mM ethanol solutions have been detected using a flame ionization detector (FID). In addition, separations of 1-propanol, methanol, and toluene using the CNT column have been achieved.

Katherine Robertson

LOCALIZATION OF CALCIUM AND CHITIN IN SPITTLEBUG SPECIES

Faculty Collaborator: Dr. Thomas Marsh

Calcium is an important mineral nutrient with a wide variety of functions in living things that range from structural roles in teeth, bones and shells to serving as a cellular signal messenger. It has been found that calcium content in several species of spittlebugs has revealed high levels of calcium content for a terrestrial arthropod. The goal of this project is to identify the location of calcium and chitin in spittlebugs, which would allow insight into the evolutionary adaptations of terrestrial arthropods. In this experiment, microscopy will be used to identify areas on the spittlebugs that contain calcium and chitin, and chitin assays will be used to quantify the relative amounts of chitin per bug. Also, inductively coupled plasma mass spectrometry (ICP-MS) will be performed.

Cabin Ross

MAPPING THE NORTHEAST CORNER OF THE BITTER SPRING QUADRANGLE: LAKE MEAD, NEVADA

Faculty Collaborator: Dr. Lisa Lamb

The Bitter Spring Quadrangle (BSQ) is an ongoing mapping project of the UST Geology Department that focuses on the eastern part of the Central Basin and Range (B&R) in Lake Mead, Nevada. This area of the B&R has been severely deformed by the most recent and largest amount of extension, or pulling apart of the earth's crust. The BSQ mapping project and other research projects are attempts to understand the nature of extension in this central location. My project focuses on the northeastern corner of the BSQ, where this summer's teams spent two weeks mapping the Paleozoic ridges and breccia hills. This summer's mapping was added to the existing BSQ mapping and is being used in the analysis of faulting and deformation of this area. By mapping a geologically deformed area, it is possible to understand the behavior of faults and how they have changed the layout of the rock units. One hypothesis introduces the idea that the three large faults defining the Longwell Ridges may be secondary responses to stress of two larger faults in the Lake Mead area. The accommodation that these secondary faults provide may explain the presence of ridges in a low topography landscape. The deformed landscape can be pieced back together and used to understand the history of timing and significance of factors involved in the extension of the central B&R. Knowing this history will serve for predictions of future geologic events in this area and areas undergoing the same kind of stress.

Emily Sauter

PUBLIC SPEAKING IN MINNESOTA: A STUDY ON THE APPLICATION OF RHETORICAL THEORY

Faculty Collaborator: Dr. Kevin Sauter

In the field of Communication Studies one of the core elements of the discipline is the critical analysis of public speaking. When scholars conduct research on the success of public messages they usually look to large-scale political speeches. Most public speakers, however, will not address a large audience on pressing matters of public policy, but rather they're going to make smaller presentations prompted by issues of importance to them and their community. These smaller speeches are not less relevant because of their size and significance but are in some ways even more central to understanding the nature and impact of public speaking in Minnesota and the nation. By understanding how these everyday speeches succeed or not we can help the community at large improve their communication skills and help our discipline understand the intertwining of theory and practice.

In order to meet the goals of the project I chose four speeches based on the event that called for public address, instead of choosing speeches based on gender, age or location: a funeral, a Rotary meeting, a city council meeting and an informational community meeting. Each of these speeches, though vastly different in content, had some element of persuasion as its goal. After selecting my speeches I then witnessed and recorded the speech and gathered ancillary information. This stage also included interviews with the speakers and members of the audience. Finally I analyzed the speeches using the rhetorical theories of Lloyd Bitzer (*The Rhetorical Situation*) and Eugene White (*The Context of Human Discourse*).

I found that by applying these different rhetorical theories and concepts to the speeches I was able to develop a deeper understanding of everyday public speaking. Though results and conclusions differed among the speeches I found that rhetorical theory is a vital tool in understanding any communication act in any situation.

Jenna Schroeder

ANALYSIS OF ENROFLOXACIN DEGRADATION & PHOTOPRODUCT ANTIBACTERIAL ACTIVITY

Faculty Collaborator: Dr. Kristine H. Wammer

Enrofloxacin is a fluoroquinolone antibacterial used for agricultural applications. Along with other fluoroquinolones, enrofloxacin has been found in natural waters at low concentrations. This drug is subject to photodegradation when exposed to natural sunlight. While attenuation by sunlight usually mitigates the environmental impacts of antibacterial compounds, problems may arise if the photoproducts themselves introduce additional antibacterial activity. The antibacterial activity of enrofloxacin was compared to that of its photoproducts to determine whether the products presented any additional antibacterial activity against *Escherichia coli* DH5a. Enrofloxacin's photoproducts greatly inhibited bacterial growth, necessitating isolation of each product in order to examine the potential environmental impacts. A minor photoproduct was isolated and identified as ciprofloxacin, a different antibacterial fluoroquinolone; formation of ciprofloxacin had also been observed in previous research. Analysis of ciprofloxacin's antibacterial activity cannot solely account for the overall inhibition of bacterial growth due to the photoproducts. Through continued isolation, the remaining photoproducts will be identified in order to account for the additional antibacterial activity observed.

Louis Sigtermans

TRICLOSAN RESISTANCE IN ENVIRONMENTAL BACTERIA

Faculty Collaborator: Dr. Kristine Wammer

Triclosan is a widely used antibacterial and antifungal agent that is included in many consumer and personal health-care products, such as toothpastes, deodorants, and shampoos, but also in household items including plastics and fabrics. Due to its wide usage in a variety of products, there is growing concern that resistant strains of bacteria could develop, possibly with the potential for cross-resistance or co-resistance to other antimicrobials. One area of potential concern is in natural waters, where triclosan has been widely detected at sublethal concentrations, which could increase resistance among environmental bacteria. In preparation for long term studies of effects of sublethal triclosan concentrations on environmental bacteria, experiments were performed to assess current resistance levels in a natural water sample. Before the antimicrobial effects of triclosan could be studied, it was necessary to improve the detection limit of the biocide using high performance liquid chromatography and solid phase extraction. Upon achieving an acceptable detection limit, bacteria were collected from the Mississippi River and exposed to a range of triclosan concentrations. We plan to isolate the bacteria growing at elevated concentrations for further study.

Amy Sobolewski

DO BACTERIAL PHOSPHATASE GENES PLAY A ROLE IN THE CIRCADIAN MECHANISM IN *SYNECHOCOCCUS ELONGATUS* PCC 7942

Faculty Collaborator: Dr. Jayna L. Ditty

Synechococcus elongatus is a single-celled member of the cyanobacteria family, whose members can be found in almost every environment on Earth. These organisms are significant producers of some of the most basic organic compounds and oxygen in freshwater environments. The cellular activity of *S. elongatus* functions on a light-dependent circadian clock that functions on a 24-hr cycle. This clock is made up of three proteins: KaiA, KaiB, and KaiC. It has been previously determined that the level of phosphorylation of the KaiC protein is critical for the overall function of the

circadian clock in *S. elongatus*. The goal of this project was to determine what role phosphatases play in the regulation of KaiC activity in the *S. elongatus* system.

Three potential phosphatase genes were found in the *S. elongatus* genome using sequence comparisons to known phosphatase genes in other cyanobacteria, including gene 428, gene 938, and gene 1501. In this project, the 1501 gene of *S. elongatus* was mutated to determine if its encoded protein was important for the circadian mechanism in *S. elongatus*. Circadian activity was measured by monitoring the promoter activity of a *kaiB::luxAB* reporter fusion. After analyzing the bioluminescence patterns of both wild-type and the 1501 mutant *S. elongatus* strains, no differences in circadian oscillation was detected, indicating the 1501 gene is not important for circadian function in this organism. Genetic verification of the 1501 mutation still remains to be determined.

Sarah Soucie

COMMON ROOTS: ANOREXIA NERVOSA AND MEDIEVAL ASCETICISM

Faculty Collaborator: Dr. Katarina Schuth

Anorexia nervosa is widely believed to be caused by socio-cultural conditions emphasizing an unhealthily thin body image for women. However, scholarly research in the recent past suggests that anorexia nervosa may have roots in the form of asceticism as far back as medieval times. If this is the case, how could two totally different socio-cultural environments produce the same disease? What are other factors in the development of this disease? In the case of both anorexia and asceticism, self-starvation is a technique used to gain control over one's self. So when does asceticism become anorexia? What other relationships can be discovered?

Ultimately, my goal with this research is to deepen our understanding of this tragic and widespread disorder. I will examine the similarities and differences between anorexia nervosa as manifested in the modern socio-cultural context and in the medieval practice of religious asceticism. More specifically, I will compare the causes, manifestations, and treatment of these two forms of self-starvation. In contrasting the similar and different qualities of anorexia and asceticism, I will determine what kind of relationship, if any, exists between them.

Hopefully, newfound information will be able to help counselors and therapists to treat and cure anorexia nervosa and related disorders earlier and more effectively. Since many of the psychological elements present in persons afflicted with anorexia nervosa are similar in other addictive and self-destructive behaviors, research could improve treatment in those areas as well. My research will include investigation into the psychology of anorexia nervosa, as well as historical study of medieval ascetics, particularly women, whose extreme fasting resulted in serious physical problems.

James Stokman

SYNTHESIS AND TESTING OF TWO NOVEL ANTIMICROBIALS UTILIZING AN AROMATIC OXAZALIDINONE RING STRUCTURE

Faculty Collaborator: Dr. J. Thomas Ippoliti

As bacteria resistance to current antibiotics continues to increase, new antibiotics must be continually researched and synthesized. Zyvox™ belongs to a new class of antibiotics utilizing an oxazolidinone ring which targets Gram positive bacteria by blocking the ribosomal 50s subunit, effectively preventing translation of DNA to RNA. In 2004 the Ippoliti lab synthesized a similar compound, which also proved successful in combating Gram positive bacteria. This poster proposes a synthetic scheme for synthesis of two novel antimicrobial compounds, similar to Zyvox™, but utilizing varying substituents off of the oxazolidinone ring. The first novel antimicrobial, proposed in a six step synthesis utilizes a thiadiazole aromatic ring substituent with known Gram negative antimicrobial properties. Synthesis has proceeded efficiently through step two. The second novel antimicrobial, proposed in a nine-step

synthesis utilizes an aminoisothiazole aromatic ring substitute, also believed to have antimicrobial properties. Synthesis has proceeded efficiently through step three. This poster, along with some background knowledge, looks at the overall scope of the project including: the synthetic techniques employed thus far and future work for completion and testing of antimicrobial potencies.

Katherine Theisen and Madelyn Mayry

TESTING THE ALL-ELSE-EQUAL ASSUMPTION FOR THE MAINTENANCE OF SEX FROM THE PERSPECTIVE OF ECOLOGICAL STOICHIOMETRY: DO ASEXUAL SNAILS REQUIRE MORE OF A LIMITING NUTRIENT THAN SEXUAL SNAILS?

Faculty Collaborator: Dr. Adam Kay

Theory suggests that sex should be rare or even non-existent because asexual individuals produce only female offspring, while sexual females produce both male and female offspring. Since only females can contribute to the rate of population growth, this difference between sexual and asexual reproduction means that asexuals will experience a two-fold advantage over a competing sexual population. The predominance of sex thus indicates that it must confer major advantages. One such advantage could be due to the increase in ploidy level that almost always accompanies a transition from sexual to asexual reproduction. Polyploid organisms have more DNA and RNA than diploids, and nucleic acids are rich in phosphorus, which is often a limiting nutrient in natural populations. If higher nucleic acid content in asexuals is linked to higher bodily-phosphorus concentration, then asexuals could be more limited by phosphorus availability than sexuals. In this case, sexuals might have an advantage over asexuals in nutrient-poor environments. We addressed this question by a) assessing bodily phosphorus (P) concentration in sexual (diploid) vs. asexual (triploid) *Potamopyrgus antipodarum*, a freshwater snail native to New Zealand, and b) comparing reproductive output in *P. antipodarum* genotypes of varying P content under conditions of high vs. low dietary P availability. As predicted, asexual snails had significantly higher bodily P concentration than sexuals. In addition, we found that genotypes with relatively high P content responded more positively to high dietary P availability than did genotypes with lower P content. Taken together, these results suggest that the higher ploidy of asexual *P. antipodarum* could be costly in nutrient-poor conditions, and could help to explain the maintenance and distribution of sex in this species.

Ryan Thompson

METHOD FOR DETERMINING THE QUALITY OF CLASSICAL GUITAR TIMBRE FOR A SINGLE PLUCK

Faculty Collaborator: Dr. Christopher S. Greene

A method for determining the musical quality of a single pluck on a classical guitar is described. A number of samples of guitar plucks were taken varying the strings, guitars, players, and tone quality (extremely “warm” to extremely “bright”). The quality of timbre is found to be dependant upon the ratio of the sum of amplitudes of the third to fifteenth harmonics to the fundamental for strings one through five. The sixth string requires a different ratio because of the natural characteristics of the string itself. The programs MATLAB and LabVIEW 8.2 were used for data collection and analysis This method is transposed into an algorithm that is implemented in a LabVIEW stand alone executable, and can be used to provide continuous feedback on the character of timbre to students playing the classical guitar.

Vy Tran

GRAPHICAL MODELS OF RANDOM KNOT GENERATION

Faculty Collaborator: Dr. Eric Rawdon

Random knots are used to model the behavior of DNA and other polymers in physical systems. There are several techniques used to generate random knots, and these methods are not fully understood. Problems such as the distribution of the knots generated and the number of steps required to randomize the edges have not been solved. I looked at three methods used to generate random knots, the crankshaft method, the hedgehog method, and the improved hedgehog method. These methods were visually modeled using Python to help understand the mechanics of how the knots are generated.

Matthew Turner

***IN SITU* SELF-ASSEMBLY OF G-DNA MOLECULAR SCAFFOLDS NUCLEATED BY A POLYMERIC TEMPLATE**

Faculty Collaborator: Dr. T. C. Marsh

Research on the structure and function of guanine rich nucleic acids has shown that multiple guanine repeats in a sequence enable these biopolymers to adopt a quadruple helical structure generally known as G-DNA. In previous work, the DNA oligomer GGGGTTGGGG (Tet1.5) was used to create a self-assembling linear supramolecular G-DNA termed a G-wire. This molecular scaffold is able to direct the positioning of gold nanoparticles on a mica substrate. However, the linear scaffolds were previously deposited from bulk solvent and were randomly dispersed on the mica substrate. To achieve better localization and dictate initial orientation of G-wire self-assembly, *in-situ* self-assembly using a polymeric template was performed. Specifically, the polymer poly-5-norbornene-2-carboxylic acid (D.P. 4000) with the oligonucleotide NH₂-GGGGTTGGGG coupled at a ratio of 1 oligonucleotide to 10 carboxylic acid groups was synthesized to serve as a rigid polymeric template for the self-assembly of G-wires. Atomic Force Microscopy was used to characterize copolymer-templated self-assembly of G-wires on a mica substrate.

Nicole Willette

THE EMERGENCE OF WOMEN IN PUBLIC SPACE: THE CAMPAIGN AGAINST THE CONTAGIOUS DISEASES ACTS

Faculty Collaborator: Dr. Alexis Easley

In 1866, the British Parliament created legislation called the Contagious Diseases Act to protect men from venereal disease by regulating prostitution and limiting women's civil rights. In response to the perceived threat of lost liberty, middle-class Victorian women entered the debate and voiced their concerns about gender discrimination inherent in the act. Although they lacked the right to vote, they successfully employed other political strategies to bring about political reform and defend women's rights.

In this paper I examine the strategies employed by Josephine Butler, Harriet Martineau and their followers in their fight to annul the Contagious Diseases Acts of 1866 and 1869. Because the laws were passed in an effort to reduce the spread of venereal disease, the act was framed as a medical issue and was first debated in medical journals by physicians and legislators. I explicate arguments published in the *British Medical Journal* by doctors and politicians, which were used to defend the acts and encourage their extension. As discussing the acts solely as a medical issue proved limiting for feminists, I approach the laws through a feminist lens and emphasize how feminists redefined the debate over the Contagious Diseases as a human rights issue. I then evaluate Martineau and Butler's writing to show how they broadened the audience for the debate and redefined the foundational point at issue by shifting the

arguments from medical to moral to constitutional. This reveals why the strategies Martineau and Butler employed – such as writing letters and pamphlets, instigating demonstrations and recruiting male allies – were ultimately successful. Finally I apply Butler and Martineau’s political efforts to the struggle for women’s suffrage. By examining the legacy of their tactics, I show that their emergence into shared space created a new female identity and paved the way for the next radical feminist battle.

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