



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. 1
September 26, 2002**

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 2002

As president of the University of St. Thomas, I am both pleased and proud to introduce the first annual 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 heartily endorse this effort, and I hope this presentation of work accomplished to date will illustrate the importance of collaborative inquiry at St. Thomas.

Sincerely,

A handwritten signature in black ink that reads "Dennis Dease".

Reverend Dennis Dease
President

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**Guitar music performed by:
Shaun Koelsch**

Nathan Aamot

THE ASCENSION PROJECT

Faculty Collaborator: Dr. Paul Lorah

The University of St. Thomas is participating in a service-learning project for Ascension parish in north Minneapolis whereby the parish hopes to gain a greater understanding of the surrounding neighborhoods so it is able to serve the local community better. Our project examines various descriptive spatial attributes of Ascension parish and the surrounding area. Visual summaries of this information in the form of numerous maps were created and distributed to Ascension and University of St. Thomas participants in this service-learning project. The maps serve as a foundation for further research, surveys, interviews and Ascension outreach programs. Data was obtained from the Minneapolis-St. Paul Metropolitan council, the Lawrence Group, the U.S. Census Bureau, MetroGIS Regional Parcel Data Set, the Archdiocese of St. Paul and Ascension parish. Demographic composition, age composition, single parent household distribution, estimated property values, property development time and Catholic church distribution were all examined and mapped to help paint a picture of the geography of Ascension parish and the surrounding area. This research found Ascension's local community to be quite young, almost 100 percent African American and to have a large percentage of single parent households. Estimated property values are relatively low and the structures there are older compared to nearby communities such as Golden Valley or Robbinsdale.

Benjamin J. Anderson

SYNTHESIS AND CRYSTAL STRUCTURE OF DIAZIDOBIS(H-PENTAMETHYLCYCLOPENTADIENYL)TITANIUM(IV)

Faculty Collaborator: Dr. David C. Boyd

Reaction of $Cp^*_2TiCl_2$ with an azide source yields $Cp^*_2Ti(N_3)_2$. Various conditions were used to synthesize the product, and a few methods of recrystallization were attempted. The goal of the project was to find a high yield synthesis of the $Cp^*_2Ti(N_3)_2$, to find an appropriate method to grow crystals, and to obtain the solid state structure by means of single-crystal x-ray diffraction.

Jillian Berg

ATTRACTION AND SELECTION: COHABITATION

Faculty Collaborator: Meg Wilkes Karraker, Ph.D.

Work for a chapter in a family studies textbook, *Families With Futures* (McGraw, Hill, 2004) was completed in the summer of 2002 in collaboration with Dr. Meg Wilkes Karraker in the Sociology Department at the University of St. Thomas. Jillian Berg, the student collaborator, researched for sections in the first draft of the chapter titled “Attraction and Selection: Dating, Cohabitation, and Staying Single in a Coupled World.” Among other contributions to the chapter, her work focused on the section on Cohabitation. In that chapter, the history of cohabitation is explained along with the similarities and differences found between people that take part in cohabitation and those who choose to form the bond of marriage. Characteristics of people in a cohabitating relationship as well as the relationship dynamics and outcomes are also examined within the section. Statistics on stability of the relationship, age of the partners, and likelihood of divorce are incorporated into the chapter section.

The textbook work brought useful insight into the area of academic writings and a better understanding of how the creation of a textbook takes place. The collaboration between Ms. Berg and Dr. Karraker helped to engage both in an educational, effective working relationship between the student and teacher. It also encouraged Ms. Berg to consider a profession as a professor and academic writer.

Alysha Boie

MAYA LIN’S WINTER GARDEN AND THE RHETORIC WITHIN

Faculty Collaborator: Dr. Bernard J. Armada

Amidst the loud and busy roar of downtown Minneapolis lies an enchanted garden with a peaceful waterfall, rolling hills, and black olive trees that provide a tranquil refuge for work-weary business people in need of a change of scenery. Since its recent installation in April of 2002, Maya Lin’s Winter Garden has altered the urban landscape of 10th Street and 3rd Avenue. Maya Lin is the acclaimed designer of the Vietnam Veterans Memorial in Washington D.C. and the Civil Rights Memorial in Montgomery, Alabama. We are interested in studying the ways in which Lin’s latest work—the Winter Garden, located at the new American Express Client Services Center—functions as a form of visual communication. The Winter Garden is an architectural space like no other, changing the urban landscape of the downtown area in complex ways. We wish to explore the ways in which it both complements and opposes its surrounding urban, professional environment. It compliments through the beautification of the urban landscape and by providing a quiet space to the employees and the greater public. Simultaneously, it subtly critiques corporate values, urban sprawl, and perhaps even capitalism in general through its use of epideictic rhetoric.

The goal with this study is to gain a deeper understanding of human communication through the analysis of corporate art and architecture. The Winter Garden’s use of ambiguity, ethos achieved through corporate art, heterotopias, and epideictic rhetoric will be the focus of this study. The analysis of humanly constructed environments is a growing area of study within the discipline of communication; we wish to contribute to that dialogue and facilitate its development among scholars. Moreover, we hope our research will benefit numerous disciplines outside of the communication field. The methodology for achieving our goals will be to collect data from numerous sources, analyze the findings, and critique the rhetorical significance of the Winter Garden, and with corporate art and architecture in general.

Ann M. Brigino

CRYSTAL PACKING ARRANGEMENT AND MOLECULAR STRUCTURE OF “BRIDGE-FLIPPED” ISOMERIC PHENYLHYDRAZONE DERIVATIVES

Faculty Collaborator: William H. Ojala, Ph.D.

Reaction of a benzaldehyde derivative with a phenylhydrazine derivative produces a phenylhydrazone. We are currently synthesizing selected pairs of substituted phenylhydrazones that we have designated “bridge-flipped” isomers and are determining their crystal structures by means of X-ray crystallography. “Bridge-flipped” isomeric compounds differ only in the orientation of the carbon-nitrogen bridge joining two aryl rings. Our goal is to determine whether isomeric pairs of these compounds assume either identical or different molecular packing arrangements in the solid state, as well as to identify any chemical factors, such as hydrogen bonding, Lewis acid-base interactions, or steric interactions, that might either encourage or discourage crystallization into the same crystal structure. Previous research has shown that bridge-flipped isomers usually assume different crystal structures. One possible explanation for differences is that the “flipped” bridge connectivity leads to very different intermolecular contacts. We are investigating the possibility that placing certain substituents onto the phenylhydrazone molecule might result in close intermolecular contacts so favorable that they would be preserved in the packing arrangements of both bridge-flipped isomers, encouraging these compounds to assume the same packing arrangement. In the crystallographic literature, several close intermolecular Lewis acid-base contacts between halogen atoms and nitrile groups have been reported previously. With the idea that similar attractive contacts might encourage pairs of bridge-flipped isomers to crystallize in the same packing arrangement, we have now synthesized two bridge-flipped phenylhydrazones, each having cyano- and bromo- substituents at the para positions of the rings. The compounds are the 4-cyanophenylhydrazone of 4-bromobenzaldehyde (I) and the 4-bromophenylhydrazone of 4-cyanobenzaldehyde (II). We have found that neither crystal structure involves a close bromine-nitrile contact. In I there is a close contact between the nitrile group and the bridge N-H group that does not occur in II. The nitrile group of II shows evidence of crystallographic disorder.

Sarah Brown

DRINKING WATER PROTECTION IN PIPESTONE COUNTY

Faculty Collaborator: Dr. David Kelley

For safety purposes, federal guidelines stipulate that only diminutive amounts of nitrate can exist in drinking water. Nitrate is a dissolved chemical that is being leached into the soil through by-products of farming, such as fertilizer. The farmers are using the fertilizer to help the plants grow, however, not all of the fertilizer is reaching the plants. Some of the soils that are farmed are very porous and the fertilizer is seeping into the water tables and contaminating the drinking water. One way to help protect the water or lower the occurrence of leeching is to farm crops that are not as reliant on fertilizer to grow, or to stop farming on those soils all-together. If the farmers are educated on what is causing this, perhaps they will adopt land management techniques that will help the water to be safer not only for their families but for their community as a whole.

I am using different map layers of soil types and land management systems to see which areas are most likely contaminating the ground water and which ones are not. Farms growing annual crops such as corn and soybeans on soils that are very porous or located directly above or very close to the aquifer may need to consider alternative management to minimize or avoid contamination. Farms growing perennial forages such as alfalfa on impermeable or resistant soils may not need to alter their land management practices much. Other map layers I am using show the farmed areas, never farmed areas (homes, driveways), and areas that are naturally not farmed (streams, creeks). This will also help to distinguish how much each farmer will have to alter his or her present practices.

The MDA, MDH, the USDA, and Pipestone Extension Agents will use these maps and map products.

Erik Draxten

RESIDENTIAL DEVELOPMENT IN CHASKA, MN

Faculty Collaborator: Catherine Hansen

Over the last ten years the human population in Minnesota has grown rapidly, by nearly two million people. The majority of this growth surrounds areas of the Twin Cities. Prior to this increase population, land in areas surrounding Twin Cities was void of mass residential developments. The land consisted of farmland, wetlands, and forests with a few structures. But as population rapidly increased, land has been converted to residential use to meet the needs of the population increase. This study analyzes the past and present housing developments in the west metro City of Chaska, Minnesota, one of the rapidly growing suburban cities of the Twin Cities from 1990-2000. Are new residential housing developments in Chaska entering more natural areas, indicating sprawl? With the use of Geographic Information Systems (GIS) housing developments were mapped and analyzed to determine where housing is and where it is moving in the City of Chaska, Minnesota. After conducting research and producing maps, analysis concluded new housing developments are expanding and continue to enter natural areas around Chaska.

Colleen Duffy

MATHEMATICAL LOGIC

Faculty Collaborator: Dr. McLean

“The point of philosophy is to start with something so simple as not to seem worth stating, and to end with something so paradoxical that no one will believe it.” Bertrand Russell

Logic is the science of reasoning. It is a wide and varied field of study that is intimately connected with a variety of areas in mathematics and philosophy including, but not limited to, set theory, algebra, epistemology, foundations of mathematics, and symbolic logic. Some of these connections will be discussed in the manner of the above quote. First it is worthwhile to start with the ontology of numbers, which leads to one possible definition of numbers. Transfinite and infinitesimal numbers will then be considered along with some questions that arise from their existence. This will mainly include the Axiom of Choice (AC) and the Continuum Hypothesis (CH) in Zermelo-Fraenkel (ZF) set theory, and will continue with further topics from there. For instance, when talking about the AC and CH, it is helpful to also introduce Lebesgue measure, Gödel’s incompleteness theorem, Boolean algebra, and various paradoxes first. The purpose is to present some basic, important topics in mathematical logic from its beginnings until today.

Danielle Fagen

POLICE-IMMIGRANT RELATIONS: A SOMALI CASE STUDY

Faculty Collaborator: Dr. Shahid Alvi

This quantitative and exploratory study examines police-community relations from the perspective of Somali immigrants in Minneapolis, Minnesota. The research draws upon a purposive sample of 89 Somali and Ethiopian immigrants at a small, inner city, community center, located in the neighborhood of a public housing complex. Participants completed a self-administered questionnaire. The survey tapped respondent’s perceptions of relations between the Somali community and law enforcement, fear of police authority, and prejudice and victimization by police officers. Findings showed low levels of satisfaction with the Minneapolis Police Department and high levels of fear, victimization and perceived prejudice. This study hopes to initiate future research on police-immigrant relations in Minnesota.

David Gould

HISPANIC POPULATIONS IN RELATION TO ESL CENTERS IN THE TWIN CITIES AREA.

Faculty Collaborator: Dr. Robert Werner

The focus of this proposed research would evaluate the efficiency of English as a Second Language (ESL) services offered to battered Latina woman in the Twin Cities metro area. Using Geographic Information Systems (GIS), spatial relationships will be examined regarding Latina population locations with respect to ESL schools, Latina battered women's shelters, and bus routes.

Ultimately, this project will achieve two objectives. The first is to create an understanding of the relationship between characteristics of ESL centers and Latina shelters in a way that can readily suggest optimal ESL programs for shelter occupants, and secondly to present this to the Latina population through web page development and instruction so they develop a better understanding of their resources and ultimately reap the benefits that each provide.

Working with Dr. Robert Werner, Casa de Esperanza (a Latina battered women's agency) Vanderwall Consulting, and researchers from Bethel College, the objectives of presenting the relationships between Latina populations, ESL centers, Latina women's shelters and bus transportation will be achieved analyzing data in a GIS.

Meghan Hannon

EFFECTS OF CHANGING BASE LEVEL ON SEDIMENTATION IN LAS VEGAS WASH AND LAS VEGAS BAY

Faculty Collaborator: Tom Hickson

Understanding the effects of changing sea level (generally known as base level) on deltaic systems is important because (A) it would allow better prediction of changing sea level effects on coastal areas; (B) it will provide insight into how coastal margins and river systems respond to changing base level; and (C) it will give geologists a better understanding of the sedimentary rock record.

In this study, I investigated the hypothesis that a drop in base level will force a river delta to prograde at a faster rate than it would if there was no drop in base level. Assuming there is a gently-sloping, relatively flat incline in front of a delta, a base level drop would automatically lead to a change in shoreline position; this is not progradation. We define progradation as the lake-ward movement of the delta front due to normal erosional and depositional processes. If any of the factors within the system (such as sediment supply, water discharge, or base level) are changed, it will affect the rate of delta progradation.

Due to California's claims on the Colorado River water we had the opportunity to study a deltaic system where the only changing factor was base level, in this case the surface of Lake Mead. California's withdrawal has caused the lake level to drop about 197 to 230m (60 to 70ft). We received a time-sequential set of aerial photography from the area surrounding Las Vegas Bay and the downstream portions of Las Vegas Wash. By overlaying these photos we were able to follow and roughly map the position of the Las Vegas Wash shoreline and delta front. Plotting the magnitude of progradation against the magnitude of lake level drop has provided insight into how river and deltaic systems have responded to base-level drop.

Julia Hatler

THE 'RED DIAPER' PHENOMENON: SOCIALIZATION AND RELIGIOUS ACTIVISM

Faculty Collaborator: Dr. Ellen Kennedy

Since Peru gained its independence in 1821, the country has maintained third world status and has been stricken with extreme poverty, corruption within the government and a severe lack of infrastructure. Because of these conditions, shared grievances among Peruvians have led sociologists to investigate social movements within the country. Prior research in this area has focused largely on Leftist organizations, such as Shining Path, and their pursuit of social change through violence and terrorism.

In contrast to this violent movement, the Catholic Church has worked to promote peaceful social change. This study focuses on parishioners from St. Rita's parish in Cottage Grove, MN, who do not have an immediate shared grievance with the poverty-stricken of Peru but who still participate in high-risk social activism. The stories of these parishioners reveal similarities to McAdam's red diaper phenomenon¹ that took place during the Civil Rights movement. In the case of the St. Rita's volunteers who have traveled to Peru, they were all socialized early on into religious commitment, but even more than that, into religious activism. This finding suggests that the process of social activism has remained constant over a forty year period, has bridged the gap of global movements, and has continued to be driven by prior socialization.

1 McAdam, D. 1988. *Freedom Summer*. New York, New York: Oxford University Press.

Lauren Hruby

PHASE RESETTING IN NORMAL AND PERIOD2 MUTANT MICE SYNCHRONIZED TO ABNORMAL LIGHT CYCLES

Faculty Collaborator: Dr. Dwight Nelson

All animals have an internal mechanism that serves to synchronize daily (circadian) physiological rhythms with the environment through light cues. This mechanism is also able to maintain a near 24-hour rhythm in the absence of light through the molecular feedback loops within specialized cells of the brain. Our lab has been working to decipher the potential roles of a group of genes that control these feedback loops, the Period genes.

It has been suggested that mammals lacking Period2 genes have shortened periods of circadian rhythms and are unable to phase delay (a type of clock resetting). Our lab is currently testing whether this lack of clock resetting is caused by the gene mutations themselves or due to some non-specific influence of the gene on circadian resetting caused by the abnormally short circadian period. Our initial experiments examined phase resetting in mPer2 mutant mice.

Wild-type mice were contained in an environment with an artificial light:dark cycle of 25.5 hours. This caused the animals' activity to reset by ~1.5 hours every cycle to remain synchronized, similar to the resetting necessary for a mutant Period2 mouse to remain synchronized with a 24 hour cycle. Once synchronized the mice were placed in complete darkness. Groups of mice received a light pulse on the first or seventh day of darkness at a time known to cause large phase delays. After stimulation, all mice were left in darkness for 14 more cycles to see how the freerunning rhythm was influenced by the stimulation. Results from our experiment suggest that the lack of circadian resetting observed in Period2 mutant mice may, in fact, be due to the "abnormal" synchronization to the 24 h light cycles. This draws into question the results other labs suggesting that the Period2 mutation abolishes resetting of the circadian clock.

Tonia Johnson

INVESTIGATION OF THE RELATIONSHIP BETWEEN CHANGES IN LAKE LEVEL IN LAKE MEAD (NV) AND THE SEDIMENTARY RECORD OF LAS VEGA BAY

Faculty Collaborator: Tom Hickson

In this study, I investigated the relationships between changes in lake level in Lake Mead, Nevada, and the sedimentary record of one arm of this lake, Las Vegas Bay. Variations in the sedimentary record of large, man-made lakes such as Lake Mead hold implications both for the lake itself and other similar environments. On a global level, research on sedimentation in these settings can help us understand the sedimentary effects of sea level change associated with glaciations and deglaciations, because the lake can be viewed as a medium-scale version of a continental margin. On a local level, such studies may help to address several key water quality issues associated with Lake Mead.

This research began by coring sediment from Las Vegas Bay, an arm of Lake Mead (Nevada), in June 2002, followed by core logging and analysis. Lithological correlation of these logs allowed me to identify three different sequence boundaries (erosional surfaces that separate cycles of deposition) in the sedimentary record, one dating to the construction and initial filling of Hoover Dam in 1935. The boundary correlating with Hoover Dam construction is identified as a conglomerate overlain by silty-clay. The other sequence boundaries may correlate with lake drawdowns in 1956 and 1964 and are more difficult to identify.

Kevin R. Knutson

IS THE MALL OF AMERICA A DISRUPTIVE INNOVATION?

Faculty Collaborator: Dave Brennan and Lorman Lundsten

The Mall of America is the United State's largest enclosed shopping mall. It has four anchor stores, 520 specialty stores, an amusement park, nightclub area, a fourteen-screen cinema, a wide variety of restaurants and numerous entertainment attractions. Because of its size and uniqueness to the Twin Cities' retail scene, the question arose as to whether the mall was a disruptive innovation.

Tenant data for all nine regional malls in the Twin Cities was collected from the Shopping Center Directory for the years 1986-2001. Tenant changes year-by-year, tenant five-year survival rates, and the uniqueness of tenants in each mall was measured. A total of more than 15,000 bits of data were analyzed.

Looking at five-year averages, it was found that at the end of a five-year period about 58% of tenants were still present five years later. The figure dipped to a low of 54% during the 1990-1994 period when the Mall of America opened and reached its high of 62% in the year 2000.

The Mall of America has the most unique stores within its walls. It has 196 compared to Maplewood with 37, Burnsville and Southdale with 34, Ridgedale with 31, Northtown with 27, Brookdale with 21, Rosedale with 16, and Eden Prairie with only 3.

Despite the Mall's huge size, uniqueness of stores, and many entertainment venues, the Mall of America has not been as disruptive as one would assume on local tenant mix, both in the short and long run.

Abraham Langseth

HOW MUCH LIGHT IS NEEDED TO SET A CIRCADIAN CLOCK?

Faculty Collaborator: Dr. Dwight Nelson

Light is the most important environmental influence on mammalian circadian rhythms. In all mammals, including humans, a specialized neural pathway (the retino-hypothalamic tract) carries light information from the eye to the suprachiasmatic nucleus (SCN), which contains the circadian pacemaker. Mammals then use this system to entrain or synchronize their circadian activity-rest cycle (and all other 24 h cycles) to the local environment. In this experiment we tested the ability of mice to entrain to light pulses of constant intensity but different durations.

Mice were housed in four environmental chambers with an illumination of approx. 35 lux, and within each chamber we established a different photoperiod (12 h, 1 h, 15 min, and 1.5 min light / 24h). After 24 days, the timing of the light period was shifted by five hours while keeping the total duration of light constant for each coffin. At the conclusion of the experiment we examined and quantified each activity record for each mouse to determine whether the LD cycle was enough to synchronize the mouse activity rhythm.

All the mice in the 12h light / 24 h appear to synchronize normally with the light cycle. The mice in the photoperiods of shorter light durations seem to synchronize differently, however, and some of them are not synchronized to the photoperiod at all. There is a possible correlation between the duration of light and the relationship between the time of light offset and the time of activity onset (phase angle of entrainment).

Peter T. Lloyd

COMPUTER VISION APPLICATIONS ASSOCIATED WITH EUCLIDIAN SIGNATURE CURVE STATISTICS

Faculty Collaborator: Dr. Chehrzad Shakiban

The field of computer vision is a dynamic and changing area that presents many opportunities to a wide variety of researchers. There are opportunities in the field of computer science to build machines and programs that are capable of carrying out computer vision related tasks. In addition, there are many opportunities in the field of mathematics, which focus on the analysis of numeric information behind computer vision applications. Although, much work in different areas of mathematics has been done to analyze computer vision problems, the technique of using a unique graph known as a “signature curve” has become the most popular. The type of signature curve that I focused on in my research is called a “Euclidean signature curve.” This type of signature curve is used to model the outline of any object and provide a way for a computer to identify that object.

However, a large amount of research has already been completed on Euclidean signature curves, therefore, my research focuses on a way to uniquely describe the signature curve to the computer using mathematics as a basis. One way to approach this is by analyzing signature curves using statistics. Statistical measurements such as standard deviation and variance provide unique numbers that can represent each curve. My goal was to find patterns in this statistical data in order to formulate a way for computers to more easily recognize signature curves for a given object. Thus far in my research, I have come across several interesting statistical patterns that have the potential of making computer vision applications more efficient. In addition, my research coupled with future computer vision breakthroughs could aid in the development of artificial intelligence or a similar future technology.

Jessica Loehr

CHARACTERIZATION OF OPTIMAL GROWTH CONDITIONS OF G-WIRES

Faculty Collaborator: Dr. Thomas C. Marsh

Guanine rich sequences of DNA have the ability to self assemble into different structures including wires. Four Guanines form hydrogen bonds to form a planar quartet structure which can then stack into long tubes given favorable thermodynamic conditions. These structures may be used in Nanotechnology. G-wires are stabilized by monovalent and divalent cations. Tet1.5 is a ten nucleotide sequence d(GGGGTTGGGG) that can self-assemble into G-wires. By optimizing growth conditions, long wires were produced. Na⁺ or K⁺ were used for stabilization. K⁺ wires were found to self assemble with heat treatments. Na⁺ wires produced structure of comparable length but were found to be less stable.

William M. Manzel

SYNTHESIS OF NOVEL SEGMENTED POLYURETHANES WITH PHOSPHATIDYLCHOLINE HEADGROUPS

Faculty Collaborator: Dr. J. Thomas Ippoliti

There are a number of unfortunate occurrences in life such as accidents, disease, or natural defects, which result in the need for replacement or enhancement in some part of the body. Adding something “foreign”, however, to your body introduces the possibility of rejection, or, at the very least, stimulates your natural defense mechanisms to decompose it. The best way to integrate something unnatural into your body would be to mimic the characteristics of a naturally occurring bodily substance such as the red blood cell. A red blood cell efficiently maintains a delicate balance between homeostasis and blood clotting. Fortunately, scientists have recently begun successfully producing chemicals that share similar properties to that of the red blood cell. Its hemocompatibility can be mainly attributed to its zwitterionic phosphatidylcholine headgroup, which allow little platelet adhesion.

The medical uses for biocompatible materials are extensive. Currently, coronary heart stents, contact lenses, and hip replacements are medical devices being improved with the aid of biomaterials. Over the years, polyurethane-based products such as the pacemaker have had medical success within the body. However, even these polymers can be improved with the addition of the phosphatidylcholine side chain. The incorporation of these zwitterionic monomers into polymers has proven to have greater hemocompatibility than the medical grade segmented polyurethanes. Since the polymers are to be used for different practices, it needs to be versatile to adapt to different conditions. We propose to change the properties of polymers by using a novel monomer containing the phosphatidylcholine headgroup.

Leo McNamara, Gaby Moon, Abraham Langseth, and Lauren Hruby

THE INFLUENCE OF THE CIRCADIAN CLOCK ON SPATIAL LEARNING – OR – DOES LATE NIGHT STUDYING REALLY HELP?

Faculty Collaborator: Dr. Dwight Nelson

Mice in enriched environments show increased neurogenesis and higher rates of spatial learning than mice in non-enriched environments. In addition, mice have a robust circadian rhythm of activity and rest that is synchronized by the light-dark cycle. The purpose of this experiment was to determine whether there is a difference between the spatial learning abilities of mice when trained during their activity phase versus their rest phase.

Twenty-four mice were entrained to a 24h light cycle over a period of several weeks. Once mice were entrained, we tested the spatial learning abilities of two groups twice per day over a period of one week. Group A was tested during their inactive phase. Group B was tested during their active phase. We used a Morris Water Maze to test their ability to remember the location of a submerged platform (beneath water level). The average distance to the platform and the total distance traveled during each test were used to determine spatial learning across trials. After the trials were finished, the mice were tested again to compare the memory recall of the two groups.

All the mice showed a decrease in distance traveled and average distance from the platform. Both groups demonstrated learning over the trials. Surprisingly, however, there did not appear to be a significant difference in the learning rates between the two groups. Following the training, there was no significant difference in recall. One potential difficulty with our data is that the training trials themselves may have disrupted the circadian systems of the mice and this will be an important consideration for future tests using the Morris Water Maze. Taken together, however, our data suggest that there may not be a significant influence of the time of day upon learning rates.

Marty Mertens and Geoff Rutledge

DEVELOPMENT OF FLOW CYTOMETRIC METHODS FOR IMMUNOLOGY RESEARCH AND IMPLEMENTATION INTO THE BIOLOGY CURRICULUM

Faculty Collaborator: Dr. Jill Manske

In spring semester of 2002, Dr. Jill Manske of the biology department of St. Thomas received a grant from the National Science Foundation for the purchase of a flow cytometer. The flow cytometer is a powerful scientific tool used to count and differentiate cell populations in a short period of time. This past summer, we worked extensively with the flow cytometer in collaboration with Dr. Manske and Tony Lewno, the head lab development coordinator for the biology department. We developed several applications of the flow cytometer for use in our immunology research, and these may be applied in the future in additional scientific disciplines. Our work this summer specifically focused on immunophenotyping of mouse lymphocytes and the DNA staining of YAC-1 cells, a lymphoma cell line. Immunophenotyping involves marking different cell types with specific fluorescent-labeled antibodies that can be individually distinguished by flow cytometry. CellQuest Pro software was used to analyze and interpret results. In addition, we examined the DNA from lysed YAC-1 cells by labeling the DNA with propidium iodide, a fluorescent dye recognized by the flow cytometer. Data were analyzed with the program ModFit. This fall we will continue to develop flow cytometry methods with the intention of integrating the technology into the biology educational curriculum.

Catherine A. Micek

STORMING SKIES ...OR NOT?

Faculty Collaborator: Dr. Paul Ohmann

(Special thanks to Dr. Doug Dokken and Sam Stechmann for their assistance)

Several factors are useful in predicting super-cell thunderstorms. By examining atmospheric data from Minnesota on July 31, 2002, a day when the conditions were favorable for storm development but none actually occurred, to data from Minnesota on August 3, 2002, a day when storms were forecast and did occur, we conclude that helicity, temperature behavior, dew point, and atmospheric cap are important factors in the formation of severe storms. We model storm development using a computer program called the Advanced Regional Prediction System (ARPS).

ARPS generates a numerical model of the storm from the raw data using atmospheric physics equations. From studying the simulations, we can then develop a generic idea of storm development and formation. The raw data highlights the most influential factors in storm development. The skewed-temperature/logarithmic pressure diagrams (Skew-T/Log-P diagrams) from both days indicate that the air was heavily saturated with water and the temperature was increasing rapidly near earth's surface. However, on August 3rd (when the storm did occur), the wind had a higher helicity, implying greater wind shear. In addition, on July 31st (when the storm didn't occur) the Skew-T/Log-P indicated an atmospheric cap. The cap—a dry, warm layer of air squeezed between unstable, humid air and colder air above—inhibited cloud and storm formation. Had the cap been broken on July 31st, some very severe weather would likely have ensued.

Chong Moua

SYNTHESIS OF 2-(TOLUENE-4-SULFONYLAMINO)-PROPIONIC ACID -1H-INDOL-3-YL ESTER

Faculty Collaborator: Dr. J. Thomas Ippoliti

3-Hydroxy indole ester derivatives are used as a colorimetric indicator for the detection of urinary tract infections. These indole ester derivatives are cleaved by the enzyme leukocyte esterase, which is triggered by the presence of bacterial infections in the urinary tract, to produce 3-hydroxy indole, which quickly oxidizes to form indigo, an intense blue dye. However, synthesis of these indole ester derivatives involves the usage of 3-hydroxy indole as the starting material. The drawback of using this compound is that it is highly unstable in the presence air due to the presence of oxygen. 3-hydroxy indole oxidizes very quickly to form indigo in the presence of oxygen. A 3-hydroxy indole amino ester, specifically 2-(Toluene-4-sulfonylamino)-propionic acid -1H-indol-3-yl ester, was synthesized from 3-hydroxy indole in six steps.

“HOW AM I DOING?” THE EFFECTS OF COMPETITIVE FEEDBACK ON MOTIVATION

Faculty Collaborator: Dr. John Tauer

Competition is pervasive in our society and has the potential to affect both performance and motivation (Deci & Ryan, 1985; Tauer & Harackiewicz, 1999). One component of competition that has received relatively little attention has been the different types of feedback that competition may provide. In most studies, participants have been provided feedback only after the activity is complete, thus removing the important element of continuous feedback. The present study set out to examine the effects of the frequency and valence of feedback on motivation.

Three hundred eighty participants in a youth basketball camp attempted ten free throws in a 2 (competitive context: competition vs. non-competition) x 2 (frequency of feedback: continuous vs. end-of-session) x 2 (valence of feedback: positive vs. negative) design. Frequency of feedback was manipulated by either having participants shoot at a basket with their opponent (continuous feedback) or at separate baskets (ending feedback). After shooting ten free throws, participants were asked to complete three dependent measures: positive affect ($\alpha=.90$), task enjoyment ($\alpha=.89$), and a behavioral intention item.

On both positive affect and behavioral intention, we found a significant main effect of feedback condition. Participants in continuous feedback conditions reported higher levels of both positive affect ($M= 4.41$) and the desire to do the drill again ($M= 4.20$) than participants in ending feedback conditions (M 's= 4.15 and 3.89, respectively). In addition, participants who outperformed the other participant reported higher levels of positive affect ($M= 3.85$) and task enjoyment ($M= 3.88$) than participants who were outperformed (M 's=2.96 & 2.94, respectively).

We believe these results demonstrate that both frequency and valence of feedback play a crucial role in determining motivation. In order to maximize motivation, we may want to structure activities so that competitors are provided with continuous feedback and better able to gauge their performance during the activity.

“I DON’T WANT TO FAIL”: AVOIDANCE GOALS, GENDER STEREOTYPES, AND MATH PERFORMANCE

Faculty Collaborator: Dr. John Tauer

Stereotypes are negative beliefs about specific groups of people. Stereotype threat occurs when individuals feel at risk of confirming a stereotype about their group and recent research suggests that stereotype threats can severely impair performance. Steele (1995) found that African-American’s academic performance decreased simply because their race was made salient to them. Similar research has found that women’s math performance decreased when the instructions for an exam reinforced gender stereotypes (Spencer, 1999). However, researchers have struggled to pinpoint the precise reasons that stereotype threats have such powerful effects. In motivation research, there is considerable evidence that the goals can affect individuals’ performance in an activity. We hypothesized that participants who adopt performance-avoidance goals (e.g., “I want to avoid failing”) would be particularly susceptible to stereotype threats.

Seventy-two participants were randomly assigned to one of two conditions: no-threat or stereotype threat. In the stereotype threat condition, participants were told that males typically perform better than females in math. Participants completed a questionnaire that assessed achievement goals (Elliot and Church, 1997) and then took a 15-question math exam.

Interestingly, in the no-threat condition, males ($M=4.85$) and females ($M=4.85$) performed similarly on the math test. However, in the stereotype threat condition, females ($M=3.88$) performed significantly worse than males ($M=6.40$). When we assessed goals, we found that females in the stereotype threat condition were much more likely to adopt a performance-avoidance goal ($M=24.71$) than females in the no-threat condition ($M=19.95$) or males in either condition ($M=19.96$).

The results from this study demonstrate the powerful impact that stereotype threats can have on individuals. Our research indicates that worry about failure helps explain why stereotype threats have such a negative impact on individuals. In future research, we hope to examine whether different goals may help prevent individuals from experiencing the negative effects of stereotype threat.

Tiffani Navratil

STRUCTURAL AND TECTONIC STUDY OF THE SHIN JINST AREA, SOUTHERN MONGOLIA

Faculty Collaborator: Dr. Melissa Lamb

This past summer, I traveled to Southern Mongolia to study and quantify the structural deformation of the Paleozoic rock units in the Gobi Desert. Detailed mapping has never been completed in most of the continent's interior; therefore, we have a poor understanding of how Asia geologically evolved. Studying a few strategic areas will enable us to infer much about the amalgamation and deformation of Central Asia.

The sedimentary rock layers that comprised my field area were initially horizontal units deposited between the Ordovician and Carboniferous periods. Currently, the beds steeply dip to the northeast, meaning that a significant amount of deformation occurred after the Carboniferous in order to shift the rock units from their original horizontal positions. I mapped the locations of the various rock units and their boundaries using topographic maps, GPS receivers, and surveying methods within a 6 square kilometer mapping area.

I also found, mapped, and measured right and left-lateral faults and folds within the rock units. The size of these faults ranged in size from a few centimeters to several kilometers. It is probable that a series of thrust faults also exist in the region, because parts of the stratigraphic section are missing in the mapping area. I measured the fault planes using a Brunton compass in order to describe the planes' three-dimensional orientations in space. These faults and folds are further evidence of deformation and will be spatially analyzed using stereonet software to determine the source of deformational stress and its changes through time. Since many of the faults crosscut each other, a relative dating of their ages can be established. Most or all of the deformation found in the area may be related to past collisions of continental material, which now lie in China, into the Asian interior.

Connell Nolan

NEIGHBORHOOD DEVELOPMENT, MARKETING STRATEGIES, AND SOCIAL CHANGE

Faculty Collaborator: Dr. Ellen Kennedy

This project investigates the role that nonprofit models for business development are having on creating positive economic and social changes throughout inner-city neighborhoods in Minneapolis and St. Paul. Throughout this project I have worked closely with the Neighborhood Development Center, Inc (NDC). NDC is a community based non-profit organization that works with emerging entrepreneurs in the inner cities of Minneapolis and St. Paul. NDC works to develop successful businesses that serve their communities, and help neighborhood groups develop stronger neighborhood economies. I spent time investigating not only NDC, but also ethnic business programs that are affiliated with NDC. Programs such as: the Mercado, a member owned cooperative of Latino owned businesses; the Suque, a similar concept to the Mercado, by Somali business owners; and Reba Free Investments, which provides small business financing interest free to Muslims, to whom paying interest is against their religious beliefs. Investigating NDC and additional programs through interviewing key personnel and employment at NDC, which included my own projects with these programs, I have been able to receive a macro view of the world of nonprofit organizations attempts to revitalize economically disadvantaged neighborhoods. The Center for Urban and Regional Affairs will use the results of my project to further work in urban development.

HOW DO I GET FROM HERE TO THERE? ACHIEVEMENT GOALS, MOTIVATION, AND HELP-SEEKING BEHAVIOR

Faculty Collaborator: Dr. John Tauer

How do achievement goals affect study habits? What goals should students adopt to maximize both performance and motivation? The answers to these questions may provide insight to educators regarding why a student may be struggling or experiencing success in the classroom.

The authors examined the effects of mastery (a desire to develop competence), performance-avoidance (a desire to avoid failure) and performance-approach (a desire to demonstrate competence) goal orientations on grades, motivation, and help-seeking behaviors of 408 students enrolled in Philosophy classes at the University of St. Thomas. At mid-semester students completed an Achievement Goal Questionnaire to assess their goals for the class. During the final week of class, students completed an Interest Wave Questionnaire that assessed their motivation in Philosophy. Final grades were obtained from the professors of the 337 consenting students.

Results indicated the goals students adopted significantly affected help-seeking behavior, grades and motivation. Specifically, students who adopted mastery goals were more interested in the class, more likely to seek help and received higher grades; performance-approach students received higher grades, were more likely to seek help, but interest remained constant; performance-avoidance goals had negative effects on both performance and motivation. In addition, interest in the material, obtaining help from the professor and the student's goal orientation were all independently correlated with students' grades.

These results indicate that students' goals can affect their motivation, performance, and help-seeking behaviors. In addition, students' interest in a class and their help-seeking behaviors were correlated with higher grades. These findings extend previous research conducted at larger universities in psychology classes. We recommend a multiple-goals approach where students adopt both mastery and performance-approach goals, and refrain from performance-avoidance goals. It is our hope that colleges can utilize these findings to help students adopt goals that will facilitate high levels of both performance and motivation.

Gregory Ogin

HIGH VOLTAGE POWER SUPPLY

Faculty Collaborator: Dr. Martin Johnston

The Electron-Atom Physics Group at the University of St. Thomas is working on an ambitious schedule of experiments to perform over the coming years. These experiments range from basic measurements of electron scattering cross-sections (which will be a proof of concept as well as useful data for the semiconductor industry) to cutting edge spin polarized electron scattering experiments which will push the frontiers of quantum theory.

Common to all of these experiments is the need for numerous precise high voltage power supplies. Unfortunately, due to the scale of the project, and the cost of suitable power supplies, we currently have no feasible way to supply the voltages that will be absolutely necessary in our experiments.

Over the past two summers, I have worked on the design and implementation of an inexpensive high voltage power supply that will suit our needs. The design makes use of new technology and results in a small modular power supply that will be cost effective in solving our high voltage supply problems, and will be invaluable to us and to other university labs around the country.

During the first summer, we created a basic design which would theoretically accomplish our goals. We selected parts and looked at logistic issues involved with fabrication. During the second summer we designed the digital interface, built a prototype, and began the long debugging process. This debugging process has led us through a plethora of subtle and devious electrical effects that we hadn't counted on.

Currently, our prototype is functional but noisy. The last problem we have to fix is a ringing which we believe is due to the characteristics of our feedback loops.

Catherine Osterberg

CONSTRUCTION OF A G-DNA FIELD EFFECT TRANSISTOR

Faculty Collaborator: Dr. Thomas Marsh

Recent studies have shown that double stranded DNA (Watson-Crick, a.k.a. B-DNA) is capable of functioning as a charge transporter. The capacity of B-DNA to conduct charge is due in large part to the presence of guanine residues (G) in the sequence. The goal of our research is to determine if another form of DNA, G-DNA, will also function as a charge transporter. G-DNA is a class of structures formed by G-rich sequences which have a distinctly different structural morphology compared to B-DNA. Computational models predict that G-DNA should function as a charge conductor but this has not been proven experimentally. Two G-DNA structures, 5'-GMP fibers and G-wires, are being studied for their charge transport properties by using them to construct a Field Effect Transistor (FET).

Abby Paavola, Tessa Pritts, Alissa Torgerson

PARENTAL INVESTMENT IN MONGOLIAN GERBILS, RESEARCH DESIGN

Faculty Collaborator: Susan Evarts

We are interested in parental investment in Mongolian gerbils. These gerbils inhabit the semi-arid, extensive steppe region of Inner Mongolia, China. They live in social groups composed of one founding pair and up to three litters. In general, parental investment is any investment by the parent that increases an individual offspring's chance for survival at the cost of the parent's ability to invest in other offspring. Because gerbils are mammals, parental investment involves lactation and gestation by the female, and care by both parents after birth. We questioned if female gerbils were able to invest in sons or daughters differently in order to enhance their own reproductive success. This could be accomplished in two ways: the mother could manipulate the sex ratio of the litter (have more sons or more daughters), or she could invest more resources (milk, protection, warmth) in one sex or the other. First, we needed to establish whether the female was capable of adjusting the sex ratio of her litter, and once the litters were born we planned to observe maternal behavior toward her offspring under varying environments. Our goal was to design an effective research protocol that would allow us to begin to answer these questions. First, we experimented with different habitats that would allow us to manipulate the female's environments. We did a thorough literature search and began writing a grant proposal for research funds. We also designed data sheets and began taking observations on maternal behavior and recorded litter sex ratios. We now have an efficient research design that will allow us to further our understanding of these questions.

Andrew Peltier

DEVELOPMENT OF A UNIVERSAL METHOD TO IDENTIFY DNA VIRUSES BY AFLPs

Faculty Collaborator: Dr. Gary Mabbott

A universal PCR-based method to detect and identify double-stranded DNA viruses using a single set of primers has been developed by creating amplified fragment length polymorphism (AFLP) fingerprints. Viral DNA was released from the protein coat and digested by two restriction enzymes, EcoR I and Hind III, which both leave sticky ends. The restriction fragments were then ligated to two sets of synthetic oligonucleotide adapters complementary to the sticky ends left by the two enzymes. This allowed amplification by PCR using the same adapters as primers. The resulting unique AFLP fingerprints were analyzed by gel electrophoresis and/or capillary electrophoresis. Amplified products were obtained for the 7 shortest fragments out of the 13 total produced from the digestion of purified bacteriophage λ by the EcoR I and Hind III restriction enzymes. A maximum of two amplified fragments were obtained using DNA extracted from whole enterobacteria phage T5 particles.

Bryan Piras

SELF-ASSEMBLY AND STREPTAVIDIN DECORATION OF BIOTINYLATED G-WIRES

Faculty Collaborator: Dr. Thomas Marsh

Tet1.5 is a 10-mer oligonucleotide with the sequence GGGGTTGGGG. When mixed with the proper buffer solution and when in the presence of Ia and IIa metal cations, Tet1.5 has the ability to form self-assembling G-wires (2). It is possible to modify Tet1.5 and attach the vitamin biotin. Biotin forms extremely strong bonds with streptavidin, a tetrameric protein. Streptavidin-gold complexes bind with biotin attached to Tet1.5, making possible easy detection of the DNA, and also the ability to pass a current over the DNA. The prospect of conducting a current across DNA is a goal of many researchers in the realm of nanoscience. The streptavidin-gold can also be silverized giving it a greater ability to conduct a current (3). With the ability to conduct, Tet1.5 could be used as a semi-conductor. We were successful in decorating the modified Tet1.5 with streptavidin-fluorescein as a precursor to decoration with streptavidin-gold.

Elizabeth Plocher

SYNTHESIS OF AN OXAZOLIDINONE

Faculty Collaborator: Dr. J. Thomas Ippoliti

A completely new oxazolidinone is being synthesized through a series of seven synthetic steps. Progress has been made through the third step. The first step created the three ring aromatic system, thainthrene, that will be the substituent on the oxazolidinone base. The synthesis of the base, through the rest of the series, will be carried out to the final product.

Rebeka Poier

STRUCTURAL GEOLOGY AND REGIONAL TECTONICS OF PALEOZOIC STRATA, SHIN JINST, SOUTHERN MONGOLIA.

Faculty Collaborator: Dr. Melissa Lamb

Rocks of southern Mongolia record a key part of the tectonic growth, amalgamation, and deformation of central Asia. Understanding the deformation of these rocks is crucial to unraveling the geologic history of central Asia and will contribute to our understanding of continental growth and intracontinental deformation. Few structural studies, however, have been conducted in this region. I completed a geologic map and collected and analyzed structural data from one area within southern Mongolia, near the town of Shin Jinst. I mapped the boundaries between the rock layers and the locations of many of the faults and folds using a GPS (Global Positioning System) receiver.

The rock layers were deposited horizontally in the Ordovician to Carboniferous (354-490 Ma) and include limestone, shale, sandstone, conglomerate, and volcanic flow deposits. Currently the rock layers are steeply dipping to the northeast to slightly overturned to the southwest, which implies a deformational event. In addition to the tilt of the rocks, I collected data on the type, orientation, and location of faults and folds. I discovered that left-lateral strike-slip faults are the most prevalent fault type in the area, total movement along the faults range from a few centimeters to three kilometers. The spatial orientations of most of these faults run east-northeast, and are dipping vertically. There is also a smaller population of right-lateral strike-slip faults that are dipping vertically and oriented south southeast. Thrust faults are also present, indicated by numerous folds and repeated section. These faults are typically cut by left-lateral faults, which suggest that the left-lateral faults formed in a younger deformational event. Currently, I am continuing to analyze the spatial orientations of the folds and faults to better understand how they are related to the historical deformation of Central Asia.

Jodie L. Reiser

CRYSTAL AND MOLECULAR STRUCTURE OF 6-ACETYLBI METHYLENE-D-GLUCOFURANOSE

Faculty Collaborator: William H. Ojala, Ph.D.

We are investigating the structures of monosaccharides and their derivatives by means of X-ray crystallography. We have been especially interested in the product formed when a monosaccharide reacts with a nitrogenous organic base such as an amine or arylhydrazine. Unfortunately, sugars and their derivatives often occur as syrups rather than as crystals. In our attempts to synthesize crystalline sugars and sugar derivatives, we have combined many different monosaccharides with a variety of compounds, including thiosemicarbazide, various dihydrazides, simple hydrazine derivatives, the cyclic amines piperidine and morpholine, and a series of sulfa drugs. Although our recent efforts using amines have not produced crystals, we have been able to obtain a crystalline derivative of D-glucose by its reaction with paraformaldehyde in acetic acid solution. This type of sugar derivative, a bismethylene-protected monosaccharide, is of interest because it has been studied to a lesser extent than the more common isopropylidene-protected analogues. We report here the molecular and crystal structure of this 6-acetylbismethylene derivative of D-glucose as determined by single-crystal X-ray diffraction. Although D-glucose occurs predominantly in the pyranose (six-membered ring) form in solution, this sugar is in its furanose (five-membered ring) form in the solid bismethylene derivative. A second five-membered ring is formed by the bridging of O-1 and O-2 by one methylene, while a six-membered ring is formed by the bridging of O-3 and O-5 by the other. This latter five-membered ring shows evidence of crystallographic disorder, possibly due to the presence of two different envelope conformations of this ring in the same crystal. The six-membered ring is found to assume a chair conformation in the solid state. In future work, we intend to prepare related monosaccharide derivatives to determine whether or not the absence of hydrogen bonding (as is true of this structure) can either encourage or discourage their crystallinity.

Emily R. Rolfes

SYNTHESIS OF A NEW PHOTOCHROMIC POLYMER

Faculty Collaborator: Dr. J. Thomas Ippoliti

A polymerizable monomer was synthesized using a convergent synthesis. A spiroindolinobenzopyran photochromic compound with a carboxylic acid functional group was synthesized in two steps. In addition, a polymerizable cyclic olefin with an alcohol functional group was synthesized in two steps. The two compounds were then coupled to the polymerizable olefin by creating an ester linkage using DCC and DMAP to give a polymerizable photochrome monomer. The monomer was polymerized with a ruthenium-based catalyst by the process of ring-opening metathesis polymerization (ROMP). Characterization of the new photochromic polymer was done using ¹H-NMR and UV-Vis spectroscopy. A UV-Vis spectrometer was used to experimentally determine fade time and wavelength of maximum absorption of the colored form. The photochromic monomer had a lambda max of 590 while the photochromic polymer had a lambda max of 584. The fade times differed dramatically. The monomer had a fade time of 8 seconds and the polymer had a time of 16 seconds. A new photochromic polymer was successfully synthesized and characterized.

Alyssa A. Samek

“A RHETORICAL ANALYSIS OF HILLARY RODHAM CLINTON’S SUCCESSFUL 2000 UNITED STATES SENATE CAMPAIGN”

Faculty Collaborator: Dr. Debra L. Petersen

Our work-in-progress project is a rhetorical analysis of various aspects of Hillary Rodham Clinton’s successful 2000 United States Senate campaign. It includes an analysis of her televised ads, press appearances, speeches and televised debates. Our research methodology includes a content analysis of Rodham Clinton’s speeches throughout her New York campaign and a critical analysis of various aspects of her televised campaign ads.

Our research questions include: How did Rodham Clinton attempt to parlay her experiences as First Lady into electoral success? How and how much did Rodham Clinton include her family, including President Bill Clinton in her campaign materials and appearances? How did she respond to “carpetbagger” charges?

Our finds thus far indicate that: Candidate Rodham Clinton highlighted the issues she had worked on throughout her years in public service, including her eight years as First Lady, however she did not specifically refer to her First Lady experience; Rodham Clinton made significantly more references to herself in traditionally female roles as a daughter and a mother than to her role as wife to President Bill Clinton; Hillary Rodham Clinton drew upon stereotypes of women’s communication style when she labeled her visits to every New York county as a “Listening Tour.”

Brian J. Schmitz

A CHARGE MODEL FOR BORON CHEMISTRY

Faculty Collaborator: Dr. Joseph M. Brom

We present a new charge model. The charge model is designed to be able to obtain accurate partial electronic charges utilizing computational chemistry calculations with a mix of Hartree-Fock and density functional theory (DFT) character. The model maps partial atomic charges obtained by Löwdin population analysis into improved charges that reproduce accurate charge-dependent observables for molecules containing boron. The hybrid Hartree-Fock density functional theory we use here is based on modified Perdew-Wang (mPW) gradient-corrected exchange functional and the PW91 gradient-corrected correlation functional. The parameterization can be used with any arbitrary fraction of Hartree-Fock exchange in conjunction with the 6-31G* basis set. Geometry optimizations were computed for 45 separate molecules that contain atomic boron. Dipole moments computed from the model atomic point charges have a root-mean-square (RMS) error of 0.13 Debye compared to experiment. This is an improvement on the simple Mulliken population analysis model, which yields an RMS error of 0.88, and on the traditional Löwdin population analysis, resulting in an RMS error of 0.55 compared to experiment.

Greta Schwichtenberg

A RAPID PCR MACHINE USING A CLOSED SYSTEM OF MINERAL OIL

Faculty Collaborator: Dr. Gary Mabbott

The polymerase chain reaction is very widely used in studying DNA. One of the downfalls of this process is that it takes about three hours to complete the necessary number of cycles on a conventional thermocycler. This poster describes a machine that, by using a closed system of mineral oil in tubing and syringe plunger movement, can perform the adequate number of cycles in half the amount of time needed by the conventional thermocycler. Work is continuing to provide reproducible DNA amplification results.

Isaac Schwoch

OSCILLATOR PERFORMANCE ANALYSIS

Faculty Collaborator: Dr. Jeff Jalkio

Jitter is a major problem in circuits that supply an oscillating voltage, such as clock circuits inside microprocessors. Jitter exceeding the limitations of a given system can cause the entire system to fail, a major problem in expensive computing and guidance systems. This poster will describe the results of a study done on oscillators in the University of St. Thomas engineering department in summer of 2002 to determine the amount of jitter in various oscillator circuits. Temperature and component dependence of a number of the circuits were tested also. This information can be used by designers of digital or analog circuits depending on an AC voltage/clock signal for operation by comparing the performance and limitations of oscillator circuits as provided here.

Annie Szczepanski

EDUCATIONAL SOFTWARE REVIEWS

Faculty Collaborator: Dr. Joseph Fitzharris

Over the past six months I have worked with Dr. Fitzharris on reviewing educational CD-ROM software that has focused on twentieth century history.

Dr. Fitzharris has been the contact between the company that publishes the reviews and myself. He has arranged the two reviews I have completed. The first was entitled "Liberation and Change: The Late 20th Century (1945 to Present)". The second review, which I recently finished, was entitled "World Wars and the Quest for Order: The Early 20th Century (1900-1955)".

In order to write a thorough review I viewed the content on each CD-ROM and experimented with all the features the software advertised. With each analysis the concerns were accuracy of the material, the way in which it was presented, and the usefulness of the product for instructors. Dr. Fitzharris also critiqued and fine-tuned each of my completed reviews for accuracy before sending them to History Computer Review. Both of the reviews are forthcoming in History Computer Review.

Andrew Senn

THE DEVELOPMENT OF A HEAT TRANSFER EXPERIMENTAL APPARATUS FOR RESEARCH AND CLASSROOM LEARNING

Faculty Collaborator: John Abraham

The following research project revolves around the discipline of mechanical engineering, and more specifically the topic of convective heat transfer and jet impingement cooling. I have increased my own understanding through experimentation and research, and developed a method of experimentation that can be used for future research and classroom understanding. This was done by creating an experimental apparatus that can be set up easily and an experimental procedure with excellent repeatability. Conclusions were made by observing the behavior of a jet of air as it passed over an electrically heated plate of steel. The data that was taken verified the principles of convective heat transfer. The conditions of the air jet and the heated plate were altered to determine the effects on the transfer of heat from a fluid (air) to a solid surface. This experimentation allowed me to draw concise conclusions about the variables involved in all aspects of basic heat transfer. This experience gave me a greater understanding of a topic that I am interested in and gave me experience in a laboratory and research setting.

Timothy Slama

PHOTOPHYSICAL PROPERTIES OF NILE BLUE A PERCHLORATE

Faculty Collaborator: Dr. Joseph M. Brom

In recent years, the study of sol-gels has become of great interest because of their chemical and biological relevance. For example, doped sol-gels can be used as chemical sensors to detect small amounts of toxic metals and various pollutants. Also, sol-gels can be doped with enzymes and antibodies that present a vast number of experimental opportunities. A number of organic dyes have been doped into sol-gels and the resulting organic/inorganic hybrid materials have been studied. I have investigated the spectroscopy of Nile Blue A Perchlorate (NBA) in two sol-gel matrices. NBA is an organic dye belonging to the oxazine class of dyes. Of particular interest was to create a procedure for producing the sol-gels in a short amount of time by varying the reactants and stirring time. Previous research had focused on tetramethyl orthosilicate (TMOS) and tetraethyl orthosilicate (TEOS) as sol-gel reactants, and I have studied both materials as hosts for NBA. Also, gel samples varying in the time of stirring and in the concentration of NBA in the gel have been studied. After the sol-gels were produced, I investigated their photophysical properties using absorption and emission spectroscopy.

Vinita M. Solomon

CRYSTAL AND MOLECULAR STRUCTURES OF POTENTIALLY PHOTOCHROMIC BENZYLIDENEANILINES

Faculty Collaborator: William H. Ojala, Ph.D.

Photochromism is the color transformation of a chemical species caused by the absorption of electromagnetic radiation. One mechanism that has been proposed for photochromism involves formation of intermolecular charge transfer complexes (ICTC). It has been suggested that in certain photochromic compounds, some of the molecules change to a different tautomeric form upon irradiation, and photochromism occurs when the two different tautomers share electron density in an ICTC. Certain benzylideneanilines, Schiff bases formed by the condensation reaction of a benzaldehyde derivative with an aniline derivative, exhibit photochromism, possibly by ICTC formation. These compounds are also well known for their conformational variability in the solid state. We are using X-ray crystallography to determine the solid-state structures of selected pairs of benzylideneanilines that we have designated "bridge-flipped isomers," benzylideneanilines that differ only in the orientation of the HC=N link between the two aryl rings. Evidently the orientation of this link has a strong influence on the molecular packing arrangement. N-Salicylidene-4-bromoaniline (1) is a photochromic species. 4-Bromobenzylidene-2-hydroxyaniline (2) is the bridge-flipped isomer of 1, and it is not photochromic. The difference in photochromic behavior in the solid state may be due to the difference between 1 and 2 in molecular packing arrangement. In 1, an intramolecular hydrogen bond linking the hydroxyl group and the bridge nitrogen atom creates a favorable six-membered hydrogen bonded ring system, so intermolecular hydrogen bonding is less important in 1 than in 2, where the intramolecular hydrogen bond creates a less favorable five-membered hydrogen bonded ring system. Like 2, 3-bromobenzylidene-2-hydroxyaniline (3) has a five-membered hydrogen bonded ring and is not photochromic. In contrast, N-salicylidene-3-bromoaniline (4) has a six-membered hydrogen bonded ring system and is photochromic. Unlike 1 and most other benzylideneanilines that have been reported previously, 2-4 are almost planar in their crystalline form.

Dawn Sommers

UNDERSTANDING FEMINIST PHILOSOPHIES OF THE RENAISSANCE PERIOD: A RECURSIVE READING OF BOTH MALE AND FEMALE PLAYWRIGHTS.

Faculty Collaborator: William Banfield

The Renaissance period was no real Renaissance for women. Faced with a profound level of psychological oppression and inferior status in society, they were constantly forced to conform to the Renaissance ideal of being “chaste, silent and obedient.” Likewise, in some of his works Shakespeare portrayed women in a similar subservient manner. Yet, at the same time, by utilizing the practice of gender bending, Shakespeare allowed his fictional women to rise above these oppressive conditions and experience liberation in a way that was condemned in the real world.

However, I argue that even though Shakespeare may have succeeded in liberating his fictional women, he did so at the cost of women’s alleged predetermined inferiority, which required them to clothe themselves in the masculine world. This is especially important considering that there were several female playwrights of the Renaissance period that did allow their female characters to embrace a level of empowerment without the pre-requisite of being disguised as males. Contrary to the popular belief that women were generally excluded from the public stage and prohibited from taking part in all theatrical activity, it has recently been discovered in the last decade that there were many prominent women playwrights such as Elizabeth the 1st, Mary Sidney, and Elizabeth Cary, although their plays were never produced on stage

Moreover, the literature of female playwrights was significantly more sympathetic to its female characters than Shakespearean plays and others of the time written by men. And it is in precisely this notion that Shakespeare’s limitations really become evident; he was progressive for his time, yet he was still conveying sexist notions and keeping women as the perceived inferior sex. Ultimately, this leaves one to ask whether Shakespeare’s gender-bending device worked to successfully challenge patriarchal domination or was it rather simply serving its ends?

P.A. Stabler, J.J. Waataja

DOES INTENSE PHYSICAL ACTIVITY INFLUENCE THE LIGHT SENSITIVITY OF THE MAMMALIAN CIRCADIAN PACEMAKER?

Faculty Collaborator: D.E. Nelson

In mammals, the circadian pacemaker, located in the suprachiasmatic nucleus at the base of the hypothalamus, is the control center for all 24-hour rhythms that occur in the body everyday. The most important of these is the daily sleep-wake cycle. The mammalian pacemaker uses light to synchronize itself with local environmental time. Knowing this, scientists have suggested that other non-photic stimuli may also play a role in this synchronization. Non-photic cues such as exercise, food availability and social interaction all may play such a role. Furthermore, some of these non-photic cues may also influence the sensitivity of the resetting mechanism to photic stimulation. We performed an experiment that focuses upon the potential role of intense daily exercise in altering the sensitivity of the circadian resetting mechanism to light. In this experiment male C57BL/6J mice (Jackson Laboratory, Maine) were housed in clear plastic cages with or without running wheels. All animals were entrained to a 12:12 LD cycle for 7 days and then placed in constant darkness. On the 7th day of darkness mice were subjected to a light pulse at CT 16 for 60 min. The intensity of the light pulse was varied in order to generate a complete "dose-response curve" for the light stimulus. Our results clearly demonstrate that there is no significant difference between the light sensitivity of the circadian resetting mechanism for mice with free access to running wheels compared with mice that did not have wheel access. These results suggest that intense activity associated with running wheels does not significantly influence the photic sensitivity of the mouse circadian entrainment mechanism.

Patricia Tran

GAP JUNCTIONAL COMMUNICATION DURING ZEBRAFISH DEVELOPMENT

Faculty Collaborator: Alison Krufka

Our lab is interested in the role of on gap junctional communication in zebrafish development. Gap junction channels directly link the cytoplasm of two adjacent cells. Small molecules (less than a 1000 Daltons) can pass through these channels. There is evidence that gap junctional communication transmits signals among cells during embryonic development. Gap junction channels are comprised of connexin proteins. Our main objective for the summer was to initiate a study of connexin expression in developing zebrafish using in situ hybridization. Successful in situ hybridization requires the mastery of many different techniques including, zebrafish mating for the production of embryos, embryo processing and fixation, production of labeled RNA probes, and the in situ procedure itself. We have successfully established a colony of zebrafish fit to mate and have processed those embryos for the in situ procedure. In addition, we have produced RNA probes for detection of connexin43 and no tail, a developmentally important transcription factor expressed in the notochord. For production of these probes we mastered the following techniques: transformation of competent E. coli with plasmids containing connexin and no tails genes, plasmid mini-preps, linearization of plasmids by restriction enzyme digestion, and production of RNA probes by in vitro transcription. We are currently using these probes to analyze the temporal and spatial expression pattern of connexins. Additionally, we are producing probes to detect the formation of the vascular and muscular systems as well as other connexins.

Justin Tweet

GEOCHRONOLOGIC AND TECTONIC STUDY OF THE SHIN JINST AREA, SOUTHERN MONGOLIA

Faculty Collaborator: Dr. Lisa Lamb

Mongolia, which has received little geological study, has the potential to shed much light on the evolution of the Asian continent and, by extension, on how continents in general grow and are affected by tectonic forces. During the summer of 2002, a group of St. Thomas undergraduate students, including me, traveled to the Shin Jinst area of south-central Mongolia under the leadership of Dr. Lamb to gather field information to provide answers to the question of how the Asian continent evolved and of adding to the body of knowledge on Mongolian geology. My project was a geochronologic study undertaken to date igneous bodies associated with Paleozoic (570-248 million years ago) sedimentary formations, and thus provide dates to constrain the age of deformational events which affected formations under study by the other members of the expedition.

To produce this data, I first collected appropriate samples of igneous rock, mostly granites, because they, among igneous rocks, are the most likely to have zircon crystals, a mineral useful for uranium-lead radioisotope dating. Uranium-lead radioisotope dating uses ratios of uranium and lead isotopes and knowledge of the decay rate of the uranium isotope being used to provide age data. Once back in the States, I began a series of physical and chemical procedures to isolate zircons. I have so far subjected samples to a jaw crusher and an electro-pulse disaggregator to break down rocks to their individual crystals. Various mechanical and chemical separations will follow. The final step will be to analyze the zircons' isotope ratios through mass-spectrometry. With the data from this, I can provide information to the timing of tectonic events in Mongolia.

Jeremy P. Wenisch

BUILDING AN AGGREGATE LOSS MODEL FOR LIABILITY DATA

Faculty Collaborators: Dr. Heekyung Youn, Dr. Arkady Shemyakin

For both practical and legal purposes, insurers must be able to estimate future losses resulting from liability claims in order to ensure the necessary funds will be there when claims arise, in a process called loss reserving. Actuaries working at this task in the field today use methods that draw from mathematics, experience and judgment. They analyze existing trends in changing loss amounts in order to predict future losses. This project sought to review their methods and unearth any reasons that they may be improved using statistical techniques.

The major focus of the project, then, was to look at the problem of loss reserving from a primarily statistical standpoint. The basis of this exploration was the belief that aggregate claim amounts have compound distributions, composed of a number of individual claims. Since the number of claims and each individual claim are both random variables, they must each be analyzed in order to get a clearer picture of the aggregate claim amount. This project attempts to describe how each is distributed.

Holly Wilcox and the UST Mini-Baja Team

TOMCAT BAJA TEAM

Faculty Collaborator: Roy Jenson

The Society of Automotive Engineers sponsors Collegiate Design Competitions each year. One of the collegiate design competitions is the Mini Baja. Last year the University of St. Thomas made their rookie appearance in the Midwest Competition that was held in Milwaukee, Wisconsin, on May 31-June 2, 2002, with the Tomcat Baja Team. There were 129 teams that participated in the Midwest competition. The University of St. Thomas competed as team number 032. We finished in 60th place out of 129th and were the winner of the Polaris Perseverance award.

The Tomcat Baja team worked very hard in collaboration with our faculty advisor this past school year to promote support for this project to the engineering community at St. Thomas and within the Twin Cities. The team worked hard to recruit and retain members and finance the project. The object of this competition was to design, build, test, and race a vehicle that follows the rules of the competition. This project is a great new asset to the undergraduate program at St. Thomas. It gives students active involvement in working on a challenging real-world design project. More information about the race and Tomcat Baja can be found on our web-site: <http://webcampus.stthomas.edu/engineering/minibaja/default.html>.

Dan Willenbring

SYNTHESIS OF HOLE-TRANSPORTING AGENTS

Faculty Collaborator: Dr. J. Thomas Ippoliti

Organic light emitting diodes, or OLEDs provide an alternative to the current display technologies. The applications for OLEDs, include conventional lighting, computer screens, televisions, cellular phone displays, stereo displays, even wristwatches. OLED displays are relatively inexpensive to manufacture, use less power than liquid crystal displays or LCDs, are lighter and thinner than LCDs, have a viewing angle of 180°, and do not suffer from poor refresh rates like LCDs. However, the technology is far from mature. Currently, the materials used to manufacture OLED displays limit their efficiency and size.

One of the materials used to construct an OLED is a hole-transporting agent. Hole-transporting agents are materials that easily form radical cations. This is usually achieved with conjugated systems containing nitrogens that are easily oxidized. The goal of my research is to synthesize and test the efficiency of two molecules that fit the above criteria. For my research, the general route has been to synthesize, if necessary, a highly active aromatic system, brominate it para to the nitrogen, and create a tris amine.

New methodology has been developed and used to efficiently brominate julolidine, which was then used in an ammonia equivalent amination reaction, to produce a tris amine. Due to the rapid rate of decomposition of this molecule, work has been started on a second, similar molecule that doesn't suffer from the stability problems julolidine does.

Jonas Williamson, Molly Pein

SPIN-POLARIZING A TETRAHEDRAL MAGNETO-OPTICAL TRAP

Faculty Collaborator: Paul Feng

The standard magneto-optical trap exploits momentum transfer between light and atoms modulated by the Doppler effect and a non-homogenous magnetic field. As part of an ongoing project, we are spin-polarizing a magneto-optical trap—that is, aligning the angular momenta of trapped atoms—via optical pumping. During the summer of 2002 we implemented a fluorescence detection scheme that will enable us to measure the number of atoms in the trap. To improve trap performance and monitoring, the previously implemented magnetic shim coils and video imaging systems were refined. In addition, we have spin-polarized the trapped atoms by reconfiguring the geometry of the laser beams. A new “probe” laser was added to the setup this summer as well. By using a liquid crystal retarder in conjunction with the probe laser, along with various optical components, we will be able to determine how well the trap has been spin-polarized. Current work includes using LabView to create computer programs that will collect and analyze data.

Scott W. Wood

ESTIMATING LOCATION OF A RADIATION SOURCE

Faculty Collaborator: Dr. Arkady Shemyakin

A point in three-dimensional space emits radiation onto a plane in a uniform and circular distribution. By determining the center of this circular distribution, the location of the radiation emitting point can be deduced. The project examines four point estimators (arithmetic means, convex hull, Ermakov’s arc polygon, and the minimum spanning circle) that can be used to estimate the center of the distribution and thus, can be used to locate the original radiation emitting point. The purpose of this project is to create a Java simulation to model this radiation problem, including algorithms to calculate the four point estimators. In doing so, random samples can be created easily, and the four point estimators can be calculated to determine possible candidates for the true center. By running multiple trials and calculating their four estimators, statistics can be used to determine that Ermakov’s arc polygon and the minimum spanning circle are more reliable estimators than arithmetic means and convex hulls for small sample sizes. This project lays the groundwork for expanding the project into another dimension—analyzing the behavior for a uniform and spherical distribution.

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