

# UNDERGRADUATE SYMPOSIUM ABSTRACTS ADDENDUM

*Celebrating research, creative endeavor and service-learning*



THE UNIVERSITY  
*of*  
**WISCONSIN**  
MADISON

## Undergraduate Symposium 2009

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*Celebrating Research, Creative Endeavor and Service-Learning*

**University of Wisconsin–Madison  
Great Hall, Memorial Union  
April 16, 2009**

9:45 a.m.	<i>Welcome to Student Participants</i> Aaron Brower, Vice Provost for Teaching and Learning
Noon	<i>Celebrating Undergraduate Education at a Research University</i> Carolyn “Biddy” Martin, Chancellor  Undergraduate Research Awards Ceremony Carrie Kruse, Director of College Library

### **Oral Presentations, Poster Sessions, and Performances**

Check the registration table outside Great Hall on the 4th floor  
for specific times and locations.

10:00–11:30 a.m.	Session I: Oral Presentations
12:15–1:30 p.m.	Session II: Oral Presentations
2:00–3:30 p.m.	Session III: Oral Presentations
10:00 a.m.–4:00 p.m.	Posters and displays will be on view in Great Hall, Class of '24 Room and Tripp Commons.

Refreshments will be available throughout the day in Great Hall.

## Alphabetical List of Presenters

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Abubakar, Saminu	Jackson, Tarica	Pace, Andrew
Baalbaki, Maha	Jara-Almonte, Jonathan	Patnode, Ann
Banker, Greg	Jones, Tiffany	Pesis, Martin
Bartholomew, Anne	Jordan, Ashley	Pflum, Zach
Beardsley, Adam	Kahn, Adam	Poli, Elizabeth
Bechle, Adam	Kaplan, Dan	Pozza, Jacqueline
Bednar, Karen	Karl, Kevin	Premer, Courtney
Bhaheetharan, Jeyanthi	Khalil, Maria	Rana, Sehrish
Bird, Tom	Kleist, Thomas	Rau, Caitlin
Bonavia, Jennifer	Knezic, Anna	Rohde, Kalynn
Borchert, Megan	Knoepfler, Christopher	Rolen, Larry
Bothfeld, William	Kohl, Kevin	Rutkoski, Jessica
Bramson, Ali	Kovanda, Michael	Saini, Gaura
Brennan, Megan	Kuehn, Carly	Saphner, Elizabeth
Brevik, Megan	Kuranz, Abby	Schlais, Benjamin
Budzien, Jonathan	Kusiak, Jeffrey	Schomberg, Samantha
Burns, Charles	Lanser, Alex	Seider, Sam
Butte, Caitlin	Larson, Erik	Sims, Terrance
Butterbaugh, Nicole	Lazarus, Brenda	Smoot, Joel
Cayemberg, Crystal	Lecoanet, Daniel	Stecker, Collin
Cervantes, Lucina	Lee, Brian	Suhs, Kaleigh
Chang, Haeyoon	Lee, Eric	Swander, Aaron
Chen, Sixun	Lehman, James	Swinsky, Kyle
DeLucia, Rosa	Li, Annabel	Terhaar, Nathan
Demery, Leanne	Lin, Lin	Thal, Adam
Dibble, Eve	Linstroth, Lee	Thompson, Stephanie
Elmergreen, Jonathan	Lorenz, Katie	Toussaint, Elizabeth
Feng, Mingen	Lubin, David	Vierstra, Jeff
Flood, Abigail	Madden, Mallory	Walton, Mary
Fossum, Croix	Man, Sheryl	Wetzel, Liz
Frey, John	Maus, Adam	Whitemarsh, Regina
Furey-King, Conor	Minhtuyen, Mai	Wier, Sarah
Garry, Raechel	Molinariolo, Steven	Wiersma, Anneka
George, Madeleine	Montgomery, Kayla	Wilke, Jerry
Gilbert, Steven	Moreland, Anna	Wisniewski, Megan
Hall, Charlie	Nelson, Michael	Wood, Michael
Hartman, Charlie	Nemmetz, Michael	Worth, Rachel
Harvey, Christopher	Nguyen, Carolyn	Ziehr, David
Hawk, Daniel	Nilsestuen, Jennifer	
He, Shuhan	Oberman, Jacob	
Houston, Jacqueline	Oliveira, Artur	

## PROLOTHERAPY AS AN ALTERNATIVE TREATMENT FOR KNEE OSTEOARTHRITIS

Rosa DeLucia, David Rabago (Mentor), Family Medicine

Knee osteoarthritis is a common, progressive condition that has severe impact on both the patient and society. Effective treatment options are limited; the Agency for Healthcare Research and Quality has called for new therapies for knee osteoarthritis. Prolotherapy is an injection-based alternative treatment used for chronic musculoskeletal pain. This study's objective was to test the hypothesis that prolotherapy improves pain, stiffness, function and overall quality of life in adults with knee osteoarthritis. Thirty-six adults with at least three months of knee pain and radiological evidence of knee osteoarthritis were recruited into this prospective case series and given treatment over a 26-week period. Follow-up data shows improved pain, stiffness and function scores which suggest prolotherapy may be an effective treatment for patients with knee osteoarthritis.

## DIGITAL PHOTOGRAPHY AND IMAGE ANALYSIS TO MEASURE VEGETATIVE COVER IN THE BIOCORE PRAIRIE

Caitlin Butte, Janet Batzli (Mentor), Biology Core Curriculum

Estimating ground coverage is a very useful procedure for characterizing vegetation and assessing its growth and development over time. Visual estimation methods are most widely used, but show high variation due to human subjectivity. We developed an alternative method for estimating ground cover using short range digital photography and image analysis to estimate coverage for 0.5m<sup>2</sup> plots in the Biocore Prairie and in artificial plots with known two dimensional areas. We found this technique was highly precise with 1% or lower variation and was reliable above a threshold of 5% bareground. Conversely, visual estimations yielded estimations with variation of 5–15% that was consistent over a wide range of cover (15–80%). Image analysis may be implemented when more precise and reliable coverage approximations are needed.

## ANTI-IMPERIALISM IN INDIA: VIOLENCE VS. PASSIVE RESISTANCE

Michael Kovanda, Jimmy Klausen (Mentor), Political Science

The question of the role of violence in the expulsion of the British occupation of India in the early 20th century was a topic of fierce debate amongst anti-imperialist intellectuals. Among those participating in the debate were M. K. Gandhi and Aurobindo Ghose. This research deals with the difference of opinion that these two thinkers held as to the means of liberating the Indian people from British domination. I went about investigating this topic by attempting to locate

all previously published scholarly articles that pertained to Gandhi or Ghose as well as violence, non-violence, and anti-imperialism in India. This research will hopefully contribute to a better understanding of the role of violence pertaining to the self-determination of a nation.

### **PRE-BUSINESS STUDENT DEVELOPMENT SEMINAR: PROJECTED CLASS FOR FALL 2009**

Jonathan Budzien, Michael Nelson, Megan Wisniewski, Shannon Elliott  
(Mentor), Accenture Leadership Center

Our objective is to construct a course that educates students of opportunities both within the School of Business and post-graduation. Through our experiences and the surveying of our peers we have found that there is a deficiency in pre-business advising. Through surveys, focus groups, and research analysis of other prestigious business schools we will develop a course structured upon the needs of pre-business students. It is our mission to not only develop and present our syllabus and course plan to the deans of the business school, but also to have it become a course. We hope that upon completion of this course, students will feel comfortable not only choosing a major but having a better grasp of their post-college plans.

### **STRIVING FOR CULTURAL COMPETENCE WITH HEALTH LITERACY**

Megan Brennan, Ana Schaper (Mentor), Nursing

Health literacy is the degree to which patients understand information exchanged in patient-provider interactions for decision-making related to their health. Low-level health literacy has been identified as a barrier to acquiring adequate health care, especially in minority and culturally diverse populations. The purpose of this evidence-based project was to evaluate culturally appropriate care at a worksite clinic and to provide recommendations to improve care of diverse populations, specifically for Hispanic/Latino groups. Data collection included personal interviews and informal surveys. The worksite clinic had implemented many culturally appropriate practices, and identified the AskMe3 Health Literacy program as a strategy for striving for cultural competence. Outcomes of the training program will be presented with implications for extending the health literacy program to other outpatient clinics.

### **INVESTIGATION OF WATER QUALITY THROUGH A STUDY OF BIOCHEMICAL OXYGEN DEMAND IN WILLOW CREEK**

Karen Bednar, Janet Batzli (Mentor), Biology Core Curriculum

Biochemical oxygen demand (BOD) is a procedure to measure oxygen consumption in a body of water, allowing predictions about water quality. In a 2007 seasonal survey of Willow Creek on the UW–Madison campus, BOD averaged 3.31 mg/L, indicating moderately high oxygen consumption and poor water quality. In 2008 we augmented this study with measures of carbonaceous BOD (CBOD), nitrates, sterilized BOD (SBOD), and a heavy metals scan to help characterize how oxygen is being consumed. This study confirmed that nitrifying bacteria do not contribute significantly to oxygen depletion. However, we were surprised to find relatively high nitrate and SBOD levels upstream compared to downstream sampling sites. A heavy metals screening indicated levels within a healthy range and showed no presence of toxic, oxygen-depleting concentrations.

### **SURFACE TENSION OF ORGANIC SURFACTANTS ON SULFURIC ACID**

Collin Stecker, Gilbert Nathanson (Mentor), Chemistry

Ozone depletion is a major environmental problem. Destructive chlorine atoms can be regenerated through reactions with sulfuric acid. Tiny droplets of this acid exist in the atmosphere. Studies show there are various organic compounds that are able to reach the stratosphere where the ozone layer exists. This project explores the interfacial chemistry of these organic surfactant molecules on sulfuric acid. This gives us insight into the composition of the gas/liquid surface and whether these organic molecules have the potential to block HCl from transporting inside the droplet to react and release chlorine. Other systems were explored as well, including binary salt solutions of ethylene glycol.

### **YOUR MAJOR DECISION**

Katie Lorenz, Shannon Elliott (Mentor), Business

The School of Business has a reputation of prestige and a great education. It offers 10 business majors and a certificate program. Students come to the UW–Madison to major in business. However, undergraduates are not properly informed about the opportunities available to them. As students in the School of Business, my group and I recognized this problem and decided to create a class that educates undergraduate students about the majors available in the Grainger School of Business as well as the requirements and expectations for getting into the School. Graduate students would run our class, “The Major Decision” and lecture about their future degree as well as have guest speakers assist in the process.

## **ERROR-DRIVEN LEARNING IN ADULTS AND INFANTS**

Conor Furey-King, Alexa Romberg (Mentor), Psychology

Adults can anticipate probable continuations of sentences they listen to. Studies show these predictions are made from using linguistic and real-world “context clues.” Correct predictions reinforce the relationship between “context clues” and predictions, while wrong predictions do the opposite and weaken this relationship. This sort of learning is utilized in many theories in psychology, but hasn’t been researched in regard to language acquisition and processing. This lab’s goals are to see which mental processes affect behavior in linguistic and nonlinguistic situations; also whether the behavioral change is proportional to how wrong the subject’s prediction was; and whether these effects are similar in infants and adults. Good results will have the potential to help find parallels between language disorders and other cognitive impairments.

## **CLONING OF SALMONELLA GENE YQHC**

Megan Brevik, Amin Fadl (Mentor), Animal Sciences

Salmonella is a food-borne pathogen that causes enteric illness in humans as a result of the consumption of contaminated food usually from a poultry source. Salmonella can cause disease in a human host because of special proteins known as virulence factors. Research has shown that Salmonella’s virulence factors may potentially be connected to the regulator gene yqHC. Therefore, deletion of yqHC will significantly affect the overall expression of Salmonella virulence gene leading to *in vivo* attenuation of the organism. Such attenuated strain could be used as a vaccine candidate for immunization of animals against Salmonella infections.

## **NATURAL VARIATION: EFFECTS OF SOLAR AND GEOMAGNETIC VARIATION ON THE UPPER ATMOSPHERE**

Tiffany Jones, Susan Nossal (Mentor), Physics

Understanding natural variation is important to the understanding of global climate change. A major component of the upper atmosphere is hydrogen, a by-product of lower atmospheric species, such as methane and water vapor, which are two greenhouse gases. The purpose of this study is to explore natural variation in the upper atmosphere. Changes in charged particles from the sun alter the earth’s magnetic field. We are studying the impact on atmospheric hydrogen of geomagnetic disturbances caused by changes in charged particles from the sun. We intend to distinguish human impact versus natural impact on climate. Data measuring disturbances in the earth’s magnetic field, due to solar particles, are reviewed to identify dates of high disturbance. We then review hydrogen-emission observations taken by the Wisconsin H-Alpha Mapper

Fabry-Perot spectrometer to identify dates of observation coinciding with high geomagnetic activity. Results will be presented along with sample spectra of hydrogen-emission observations.

## **THE WORLD OF WARCRAFT LEARNING AND COGNITION LAB**

Mai Minhtuyen, Elizabeth King (Mentor), Curriculum and Instruction

The World of Warcraft Learning and Cognition Lab is an after school program for boys who are disaffiliated and at risk in the traditional school setting. The objective of this study is to suggest correlations between how massive multi-player online role-playing video games (MMO), such as World of Warcraft, may align with learning and cognition. In MMO games, players control a character (avatar) within the game world where they complete quests, explore landscapes, battle mythical creatures and interact with other players. As research assistants, we participant in ethnography research which includes taking field notes and interviewing the boys about their interests in school and hobbies. Ultimately, we look for innovative ways to teach today’s children about subjects and skills such as informal science, digital and print literacy, computational literacy, collective problem solving, distributed apprenticeship, and pop cosmopolitanism.

## **THE DEVELOPMENT OF STREOSELECTIVE METHODS FOR CONJUGATED ADDITIONS TO ENYNES**

Lin Lin, Weiping Tang (Mentor), Pharmacy

The synthesis of nitrogen heterocycles is of great significance in pharmaceutical industry. Recent investigations in the Tang Group have shown the efficiency and variability of intramolecular hydroamination of the conjugated enyne system – the 1,4-addition of amine to enyne. In the effort to extend the utility of this reaction type, we studied the impacts of the nitrogen substituent and the catalyst in enyne bromoamination—the addition of nitrogen and bromine across enyne. The methodologies in this research are to substitute the amine hydrogen with various electron-withdrawing groups and to run the enyne bromoamination reaction in different catalytic environments.

## **ROLE OF MICRO FINES ON THE ALKALI-SILICA REACTION DEVELOPMENT**

Lucina Cervantes, Jose Munoz (Mentor),  
Civil and Environmental Engineering

Concrete is used through out the world’s buildings, streets, and bridges and also thought of as very reliable. However, concrete has failed and has caused prob-

lems to several structures across the United States. The primary purpose of this study is to determine the problems the concrete pavements of several airports are causing and to develop a solution. The concrete is composed of constant reactions and the Alkali Silica reaction is the main focus of this study. It is hypothesized that this reaction is causing the damage to the airport pavements and is a cost factor to the airports. To test this hypothesis, several experimental trials involving the different components of the reaction will be done and then further analyzed.

### **USE OF NANOPOROUS THIN FILM COATINGS TO PREVENT CONCRETE CORROSION**

Elizabeth Saphner, Jose Munoz (Mentor),  
Civil and Environmental Engineering

This study examines the most effective metal particle coating to prevent rebar corrosion in reinforced concrete by testing different coating solutions. Reinforced concrete is an essential construction material, but the steel rebar that reinforces it is susceptible to corrosion. The primary objective of this study is to evaluate the potential of nanoporous films of 0.5  $\mu\text{m}$  thickness to mitigate rebar's corrosion. To test rebar coatings, the electrical current intensity of coated rebar samples is measured as a function of the potential in a cell containing a solution that mimics concrete. The reactivity of the differently coated samples will be compared to find the coating that makes the rebar least susceptible to corrosion. Once found, this rebar coating could lead to reduced construction costs and longer lasting roadways.

### **ESTABLISHING MUSCLE STEM CELLS DERIVED FROM HUMAN EMBRYONIC STEM CELLS**

Liz Wetzel, Masatoshi Suzuki (Mentor), Waisman Center

Amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease, is a progressive neurodegenerative disease characterized by immobility in voluntary muscle control and eventually death. As a possible application of ex vivo cell therapy in ALS, we recently used human mesenchymal stem cells, which are categorized as adult stem cells, to deliver a neuroprotective growth factor directly into the skeletal muscles of ALS model rats. While a significant delay of disease progression and an increasing overall lifespan were observed in the transplanted animals, the grafted cells could not be integrated well into the muscles. In the present study we will establish skeletal muscle stem cells derived from human embryonic stem cells and determine whether these cells can be integrated into rat skeletal muscles after transplantation.

### **TOWARD DEVELOPMENT OF A NEW DIAGNOSTIC TEST FOR POLYCYSTIC OVARY SYNDROME**

Sehrish Rana, Fariba Assadi-Porter (Mentor), Biochemistry

Polycystic ovary syndrome (PCOS) is a complex disease that has both genetic and environmental links. It is characterized by anovulation, increased androgen levels, and polycystic ovaries. One in every 10 women is affected by polycystic ovary syndrome. By comparing metabolic differences between PCOS and control groups samples, we have attempted to identify the pathways involved in the pathophysiology of PCOS. Blood, urine, and saliva samples from rhesus monkeys, rats and humans were analyzed by NMR-spectroscopy to gain information regarding metabolites altered by PCOS. All samples were prepared in a similar manner. Half ml of sample was used with minimum protein content; samples were chemically modified, and then analyzed through NMR spectroscopy. The information gained from NMR spectra was used to determine the metabolic and hormonal alterations that conspire to produce PCOS. With our research we hope to provide the first diagnostic test for early onset of this syndrome.

### **NON-ECONOMIC FACTORS AFFECTING THE CONDITIONS ATTACHED TO IMF LOANS**

Brenda Lazarus, Katherine Cramer Walsh (Mentor), Political Science

Previous research suggests that certain non-economic factors impact the loan selection process of the International Monetary Fund (IMF). The purpose of this study is to determine if these factors also impact the number and type of conditions attached to IMF loans. This research is significant because the IMF claims that its goal is to promote economic growth and development throughout the world and denies that its actions are influenced by world politics. However, if research shows that this institution is adjusting conditions based on political factors, this would indicate that the IMF is biased and is taking political issues into consideration.

### **SIMULATION IN HEALTHCARE**

Gaura Saini, Sam Seider, Eric Bauman (Mentor), Anesthesiology

Technology continues to play an increasingly integrated role in education, particularly in the area of the clinical sciences. Much of this technology is found in the realm of simulation and video games. Currently, many advances are being made in the simulation field that will only further enhance the instruction of medicine. Being on the verge of such a breakthrough, this project seeks to develop a system of inventory which will categorize existing healthcare simulation games and offer a template for future games to be cataloged. It is this system of organization that will enable these useful games to be accessed easily and used appropriately. To this end, the project not only seeks to identify

existing types of simulators and games, and their application, but also to vet an expectable nomenclature for future evaluation and cataloguing of games and simulations found within the health sciences.

## **INDIVIDUAL DIFFERENCES IN PAIN REGULATION ABILITY**

Ashley Jordan, Regina Lapate (Mentor), Psychology

Pain disorders are debilitating and disruptive to one's daily routine. This study is designed to assess an individual's ability to regulate their emotional responses to pain. Results will be obtained by exposing participants to brief bursts of painful heat. Participants will be instructed to use mental imagery to enhance, maintain, or suppress their emotional responses. Following each burst, participants will be prompted to make numerical ratings assessing their perception of the intensity and unpleasantness of the stimulus. Psychophysiological measurements used to obtain results include: electromyography; heart rate; respiration; and skin conductance response. The participants' results will be analyzed in conjunction with their differences in emotion regulation ability and working memory capacity. Broader implications of this research include further dispelling the mysteries of clinical pain syndromes.

## **DETERMINING EFFECTIVE CYP1B1 INHIBITORS WITH LUMINESCENCE ASSAYS: APPLICATION TO OBESITY STUDIES**

Steven Gilbert, Colin Jefcoate (Mentor),  
Molecular and Cellular Pharmacology

A link between Cyp1b1 and obesity showed that Cyp1b1 deficiency in C57B6 mice suppresses the obesity response due to a high fat diet. A luminescence assay in conjunction with a mouse study is able to determine Cyp1b1 activity in living cells when expressed by a known inducer, 2,3,7,8-tetrachlorodibenzo-p-dioxin. The assay effectively measures Cyp1b1 inhibitors ability to decrease cyp450 function by a luminogenic cyp450 substrate that produces luminescence proportional to Cyp1b1 activity. When concentrations (0.1uM, 1uM, and 10uM) of inhibitor, alpha-naphthoflavone, were mixed with 10 T-cells a linear trend showed luminescence emission decreasing.

## **SOUND LOCALIZATION IN BINAURAL ANIMALS**

Anna Knezic, Tom Yin (Mentor), Physiology

The vestibulo-ocular reflex (VOR) is a well-known reflex in which images are stabilized on the retina during movements of the head by producing an eye movement in the opposite direction of head movement. Therefore, the image on the center of the visual field remains intact and without it vision would be

severely compromised during head movements. There is evidence that cats exhibit a similar analogous reflex, which has been called the vestibulo-auricular reflex (VAR). In the VAR, the external ears (or pinnae) compensate for head movements by counter-rotating on the head during head movements in order to maintain their position toward a target. The cats were presented with visual and acoustic targets while monitoring head, eye, and pinnae movements. The ipsilateral pinna reached the target while the head was still in motion and maintained a fixed position in space by counter-rotating on the head, with a velocity equal and opposite to head movements. My project examines whether the VAR occurs during vertical head movements

## **CHARACTERIZING TRANSCRIPTIONAL NETWORKS**

Jeff Vierstra, Timothy Donohue (Mentor), Bacteriology

Characterizing transcriptional networks is fundamental in understanding how biological processes are modulated. They are composed of groups of genes whose expression is controlled by a shared set of regulatory elements, such as transcription factors (TFs). TFs bind specific DNA motifs and interact with cellular transcriptional machinery either promoting or repressing expression of downstream genes. Identifying the presence and spatial configuration of TF binding sites in regulatory regions of co-regulated genes is essential for the reconstruction of regulatory networks. This task can be aided by high-throughput computational analysis. As of recent, many computational algorithms have been proposed. However, they all search de novo for motifs, and fail to integrate existing knowledge on the structure of regulatory regions. We propose to extend the current algorithms by integrating knowledge about the general structure of promoter regions in prokaryotes, and thus reducing the search space required for motif discovery. We anticipate that this will significantly improve the success rate for the discovery of biologically relevant motifs in prokaryotes.

## **KINEMATICS AND DISTRIBUTION OF NEUTRAL HYDROGEN IN SEXTANS A AND B**

Rachel Worth, Eric Wilcots (Mentor), Astronomy

We present the results of a high-resolution VLA study of the neutral hydrogen in Sextans A and B, dwarf irregular galaxies on the outskirts of the Local Group. The HI kinematics in both galaxies are similar to those of other dwarfs where the gas has been significantly shaped by stellar winds. Several distinct HI holes are identified in each, which maybe be due to massive stars pushing gas out from around them. Some velocity profiles of the gas exhibit double peaks, possibly indicating that some regions have multiple components to their kinematics. We also derive a rotation curve for Sextans B, and compare the results in both galaxies to previous findings in other wavelengths.

## **AN EFFECTIVE CAP AND TRADE SYSTEM**

Eric Lee, Adam Kahn, Ann Patnode, Dan Kaplan, Nathan Terhaar,  
Shannon Elliott (Mentor), Business

Our objective is to create a cap and trade system to reduce carbon emissions while helping to be a driving force in technological advances in the green industry. A cap and trade system is an attempt to reduce carbon dioxide and other greenhouse gases in a cost-effective manner. It makes the producers of energy internalize the cost of carbon emission through an economic incentive public policy. Our system will be both new and innovative.

## **BUSINESS CAREER BUILDER**

Katie Lorenz, Michael Nelson, Jonathan Budzien, Megan Wisniewski,  
Justin Mayer (Mentor), Supply Chain Management

Our objective is to construct a course that educates students of opportunities both within the Wisconsin School of Business and post-graduation. Through our experiences and the surveying of our peers we have found that there is a deficiency in pre-business advising. Through surveys, focus groups, and research analysis of other prestigious business schools, we will develop a course structured upon the needs of pre-business students. It is our mission to not only develop and present our syllabus and course plan to the deans of the business school but also to have it become a course. We hope that upon completion of this course, students will feel comfortable not only choosing a major but having a better grasp of their post-college plans.

## **A PREDICTIVE QUANTITATIVE THEORY FOR GENE FUNCTIONS IN PLANT GROWTH THROUGH QUANTIFYING NATURAL VARIATION AND DYNAMICAL SYSTEMS IN INFORMATION GEOMETRY**

Larry Rolen, Amir Assadi (Mentor), Mathematics

Comparing and contrasting plant development can provide important insights into a better understanding of developmental processes in agriculture, biotechnology, and biomedical research, and a predictive theory of function of genes in development has potential for broad applications. How can we predict which group of genes are responsible for growth in an organ? How can we discover the molecular biology processes that underlie gene expression and protein interactions? The greatest bottleneck outside biology to answer these and other questions is lack of a principled approach to quantify natural variation in morphologies that result from perturbations of gene-protein networks under various circumstances. A systematic understanding of such variations will greatly enhance progress towards solution such problems. This project seeks to apply rigorous

mathematical analysis to the investigation of massive image data sets from plant development and growth morphology. In particular, we have preliminary results that indicate an appropriate setting to quantify natural variation in the Riemannian geometry of hyperbolic space. In this space, we analyze dynamics of leaf and root growth in the model plant *Arabidopsis*. The ultimate goal is to develop techniques to predict and recognize emerging patterns in plant leaf shape and root system growth rate, which would allow us to infer quantitatively the dynamics of underlying genetic and environmental factors.

## **FUNCTIONAL COMPLEMENTATION OF A BACTERIAL HOST-ASSOCIATION FACTOR WITH HOMOLOGS IN DIVERSE SPECIES**

Regina Whitemarsh, Heidi Goodrich-Blair (Mentor), Bacteriology

The mutualistic bacterium *Xenorhabdus nematophila* requires the membrane protein NilB to colonize its nematode host *Steinernema carpocapsae*. To identify functional regions of NilB, I assessed the ability of NilB homologs from four bacterial species to complement the colonization defect of a nilB mutant. Two tested homologs partially complemented a colonization defect in a nilB mutant. NilC is an accessory protein that increases NilB levels. To determine if NilC also influences NilB homolog levels I inserted a FLAG epitope into each homolog to allow for detection of protein levels via Western blot. I also determined if NilC is necessary for NilB homolog function in colonization. The data show that some, but not all NilB homologs function in colonization and require NilC.

## **NANOPARTICLE COATINGS: A SOLUTION TO THE LEACHING PROBLEM**

Mary Walton, Jessica Sanfilippo (Mentor),  
Civil and Environmental Engineering

Slag, a by-product of steel production, can be used as a concrete aggregate. This formulation diminishes need to landfill the waste, but creates an environmental concern: leaching of sulfur compounds. I am working on the development of a nanoparticle coating for slag. A film of a metal oxide, e.g. TiO<sub>2</sub>, acts as a shield and contains the harmful ions in the aggregate. Qualitative and quantitative tests are essential to evaluate the effectiveness of the coating. Inductively Coupled Plasma spectroscopy was used to quantitatively evaluate leached ions to determine the coating effectiveness. The TiO<sub>2</sub> coating was shown to be the most effective. In order to ensure a coating method that will protect against the environmental threat of leaching, we continue to refine our coatings.

## **NUMERICAL SIMULATION OF SELF-RELAXATION BEHAVIOR IN THE PEGASUS EXPERIMENT**

Tom Bird, Carl Sovinec (Mentor), Engineering Physics

Magnetic confinement of ionized gas, or plasma, heated to temperatures where nuclear fusion occurs is a promising method of power generation. The most refined magnetic confinement device, the Tokamak, is approaching the required performance levels. As the next generation of Tokamaks are designed and built, advanced predicative capabilities are necessary. Recent advances in numerical simulation have produced powerful computational tools which aid our theoretical understanding of plasma dynamics. The NIMROD code is a proven tool for studying the macroscopic behavior of magnetically confined plasmas, where wavelengths are comparable to the device size. NIMROD simulations of non-linear, self-relaxation behavior observed during startup of the Pegasus Toroidal Experiment are presented. Optimization of present device operation and scaling to future devices are discussed.

## **NEUROTRANSMISSION REGULATED AROUSAL**

Maria Khalil, Craig Berridge (Mentor), Psychology

The appropriate regulation of arousal is critical for behavior and, ultimately, survival. This project examines one possible neural pathway potentially involved in the induction of alert waking/arousal. Recent studies indicate that the neurotransmitter, norepinephrine, promotes arousal via actions within the lateral hypothalamus (LH). This project utilizes immunohistochemical procedures to determine whether norepinephrine-induced arousal involves activation of LH neurons that produce the neuropeptide, hypocretin (hypocretin neurons). These studies utilize immunohistochemical procedures to visualize, Fos, a marker of neuronal activity in hypocretin neurons. Measures include counting the number of Fos-positive cells, hypocretin cells and cells positive for both Fos and hypocretin. These studies will provide new insight into the neurocircuitry underlying arousal.

## **THE HIV/AIDS KNOWLEDGE VACCINE PROJECT**

Anna Moreland, David O'Connor (Mentor),  
Pathology and Laboratory Medicine

The purpose of the HIV/AIDS Knowledge Vaccine Project (KVP), an outreach program at the O'Connor laboratory for HIV/AIDS vaccine research at UW-Madison, is to serve as a forum for disseminating the best vaccine against HIV that we have available: prevention knowledge. A 2008-09 Wisconsin Idea Undergraduate Fellowship supports KVP, in partnership with the AIDS Vaccine Advocacy Coalition in New York, in developing a series of monthly,

online, radioshow-style discussions on current issues in HIV/AIDS featuring professionals in the field. These discussions are soon to be published on iTunes U in an effort to allow people in Wisconsin and around the world to readily access information on—and seek answers to questions about—the great public health crisis of our generation.

## **THE ROLE OF VITAMIN A IN CONGENITAL DIAPHRAGMATIC HERNIA**

Anneka Wiersma, Margaret Clagett-Dame (Mentor), Biochemistry

Congenital diaphragmatic hernia (CDH) is a life-threatening birth defect that may be linked to vitamin A deficiency. A model of late embryonic vitamin A deficiency (late VAD) developed in our group produces 100% penetrance of CDH in rat fetuses made deficient after embryonic day 10.5 (E10.5) of development. By examining the diaphragms of rat fetuses whose mothers were made VAD and were dosed with vitamin A at progressively later days during pregnancy, we determined that vitamin A is required between E12.5 and E13.5 to prevent CDH. We will also determine whether four genes may be involved in the development of CDH by comparing the levels of protein expression of each gene in late VAD rat embryos to those in vitamin A sufficient rat embryos.

## **PSYCHOPHYSIOLOGICAL CORRELATES OF INDIVIDUAL DIFFERENCES IN PAIN REGULATION**

Ashley Jordan, Regina Lapate (Mentor), Psychology

Clinical pain syndromes are debilitating and disruptive to one's daily routine. This study is designed to assess an individual's ability to regulate their emotional responses to pain. Results will be obtained by exposing participants to brief bursts of painful heat. Participants will be instructed to use mental imagery to enhance, maintain, or suppress their emotional responses. Following each burst, participants will be prompted to make numerical ratings assessing their perception of the intensity and unpleasantness of the stimulus. Psychophysiological measurements used to obtain results include: electromyography, heart rate, respiration, and skin conductance response. The participant's results will be analyzed in conjunction with their differences in emotion regulation and working memory capacity. Broader implications of this research include further dispelling the mysteries of clinical pain syndromes.

## **IDENTIFICATION OF SALMONELLA FUN GENES INVOLVED IN SURVIVAL IN WATER**

Steven Molinarolo, Jeri Barak (Mentor), Plant Pathology

The recent outbreak of Salmonella in peanut butter products has rekindled public interest into this largely unstudied environmental niche for Salmonella, plants and plant products. Salmonella's virulence has been thoroughly studied, but the mechanism of how this bacteria spreads outside a warm-blooded host is unknown. This experiment was conducted to identify uncharacterized genes with a role in survival of Salmonella in water. Approximately 1,200 uncharacterized *Salmonella enterica* genes will be tested. A mutant of each gene is being tested individually looking for a decrease in survival after 48 hours in distilled water. The importance of this project is to identify specific mutants with reduced survivability in Salmonella to better understand the molecular mechanisms used in this environment, water. This knowledge has the potential to help explain how Salmonella contaminates field crops via water.

## **PREDICTING TIME-SERIES DYNAMICS USING NEURAL NETWORKS**

Adam Maus, J. Clinton Sprott (Mentor), Physics

Artificial neural networks are mathematical models that emulate biological neural systems. They have been used in classification, pattern recognition, and time-series analysis. In time-series analysis, neural networks can be used for forecasting, and also to determine how many and which past values are required to predict the future. Determination of this 'lag space' sheds light on the nature of the dynamics and permits development of minimal models capable of replicating the dynamics. Application of these models to real world data such as the weather, ecosystem growth and decay, or the stock market may provide us with more accurate models and additional knowledge about the system being studied.

## **CREATING AND MAINTAINING POSITIVE PERSONAL AND PROFESSIONAL RELATIONSHIPS IN A FAMILY BUSINESS**

Mallory Madden, Debra Houden (Mentor), General Business

This study will address the dynamics of the relationship between non-family and family member employees in a family business through the utilization of personal interviews and a case study of The Star Prairie Trout Farm. I will address frequently occurring personal and professional problems within these relationships and their hypothesized solutions. The inclusion of non-family employees in a family business provides fresh perspectives, expands the business into the community, and is vital to business growth. However, it is pre-

dicted that unless the relationships among non-family and family employees remain amicable, the positive effects of including non-family employees may be reversed. Moreover, because relationships within a family are complex before factoring in a business, this study hopes to provide insight into utilizing the family business to strengthen family bonds.

## **THE EFFECTS OF DEMINERALIZED BONE MATRIX ON HUMAN MESENCHYMAL STEM CELL OSTEOGENESIS**

Zach Pflum, Wan-Ju Li (Mentor), Orthopedics

A method of regenerating damaged bone tissue, the application of demineralized bone matrix (DBM) to induce and conduct osteogenesis in damaged bone has proven successful. The mechanism by which DBM facilitates human mesenchymal stem cell (hMSC) osteogenesis is not well understood. Further understanding of the osteogenic properties and processes of DBM in an *in vitro* model may allow for the optimization of treatments. Examination of the following variables is essential to understand the osteoconductive characteristics of DBM: The impact of DBM soluble factors; the dose-dependent effect of DBM; and the influence of culture time on osteogenesis. We anticipate the concentrations of soluble factors of DBM (Bone morphogenetic proteins and growth factors) over the entire culture period will modulate the osteogenesis of hMSCs.

## **POSTPARTUM DEPRESSION AND INFANT ATTENTIONAL CAPACITIES AT 12 MONTHS OF AGE**

Nicole Butterbaugh, Roseanne Clark (Mentor),  
School of Medicine and Public Health

Major depression in the postpartum period occurs in 10–15% of women. Postpartum depression is associated with lower attentional capacities in toddlers compared to toddlers of non-depressed mothers. The current study examines the possible connection between postpartum depression and the development of attentional capacities. Depressed mothers either have an intrusive or withdrawn interaction style, which increases the likelihood that infants will develop an insecure attachment. Those same negative parenting styles are also associated with later attention problems in childhood. It is hypothesized that the infants in this study will be more likely to have an insecure attachment with their mothers, and that there will be a positive correlation between insecure attachment and low attentional capacities in these infants.

## **RECONSTRUCTING PALEOFIRE REGIMES IN A HAWAIIAN MONTANE CLOUD FOREST**

Haeyoon Chang, Shelley Crausbay (Mentor), Botany

The goal of the research is to reconstruct the fire regime of the Hawaiian tropical montane cloud forest limit near Lake Waijū-Anapanapa. The sediments collected from the lake were sliced into a half centimeter and analyzed to count the charcoal particles present in the sediment. A deposit of charcoal particles represent that there has been fire in the past. Reconstruction of the fire regime is compared to climate at that period of time in order to predict the impact of future climate change on the fire regime at the cloud forest limit.

## **THE EFFECTIVENESS OF AN 8-WEEK LINGUAL STRENGTHENING PROTOCOL ON IMPROVING SWALLOWING FUNCTION**

Croix Fossum, Jacqueline Hind (Mentor), Medicine

Dysphagia (difficulty swallowing) is a condition that affects up to one in five Americans over the age of 55 and can lead to life threatening complications such as pneumonia. Increases in hyoid bone displacement and Upper Esophageal Sphincter (UES) opening are indicators of improved swallowing function. Previous research has shown that lingual strengthening programs have improved swallowing in both normal and stroke cohorts. The current research is investigating the differences in hyoid displacement and UES opening before and after an 8-week exercise protocol. Videofluoroscopy has been used in the analysis of swallows of normal and stroke patients. A software program has been developed to track the displacement of the hyoid bone and UES opening. It is expected subjects will increase hyoid displacement and UES opening after completing the exercise protocol.

## **PERSISTENCE OF INFLUENZA VACCINE SEROPROTECTION IN LUNG TRANSPLANT PATIENTS**

Kalynn Rohde, Mary Hayney (Mentor), Pharmacy

The CDC set strict recommendations for when lung transplant patients should receive the influenza vaccine in order to avoid waning of antibody concentrations. We hypothesized that lung transplant patients are able to maintain seroprotective antibody levels for a full year after receiving the influenza vaccination. For five consecutive years, sera were collected from lung transplant patients, healthy controls, and patients waiting for lung transplants. For each season an 11 month post-vaccination serum was drawn. The sera were analyzed using a hemagglutination inhibition assay, which determined the number of

individuals from each group that were able to maintain seroprotective levels. Results show that high percentages of lung transplant patients are able to maintain seroprotective levels 11 months after vaccination.

## **SATELLITE IMAGE COMPRESSION**

Aaron Swander, Bormin Huang (Mentor),  
Space Science and Engineering Center

The purpose of this research is to develop a compression program for satellite data. This research seeks to discover a novel method to encode data for more efficient transmission. Initially, differences between neighboring pixels were evaluated to locate edges in the image. Afterward, an adjacent pixel on the same side of the edge was selected to predict the current pixel's value. The prediction errors of the image were assigned different numbers of bits depending on their occurrence frequencies. More frequent values were assigned fewer bits, whereas less frequent values received more bits. As a result, compression occurs since fewer bits were necessary to represent an image. This generic compression method is not limited to satellite images, but applies to other images as well.

## **FACING THE ARAB-ISRAELI CONFLICT IN THE VOICES OF ART AND JOURNALISM**

Jennifer Bonavia, Jack Williams (Mentor), Geography

In this paper I argue that A.B. Yehoshua, one of the most prominent intellectuals and novelists in Israel, responds to the Arab-Israeli conflict with different voices in his non-fiction and his fiction. I examine how Yehoshua's novel *The Lover* (1977) complicates his approach to Arab-Israeli identity in his collection of essays *Between Right and Right* (1980) and at times even contradicts the positions that he defends in his essays. I investigate Arab identity in *The Lover* on socio-economic, educational, and psychological levels. To illuminate the difficult encounter between Jews and Arabs in the novel, I draw from the theories of Georg Hegel, Albert Memmi, Albert Camus, and Jean-Paul Sartre. This paper will shed light on the possibilities of artistic responses to political conflict vis-à-vis non-fictional responses.

## **DNA SEQUENCING**

Leanne Demery, Bormin Huang (Mentor),  
Space Science and Engineering Center

DNA sequencing is the process of determining the frequency and specific places of the nucleotide bases in DNA. It is important for determining and relating different genomes of various organisms. We are trying to design a sequencing algorithm to predict its performance and compare to others. We are focusing on

using DNA data compression and DNA microarray image compression to make our algorithm. We are designing a computer code to decrease the file size of the DNA chain or image. We use computer programs such as MATLAB, which has its own language, to create functions and matrices that consist of our code.

### **MEDICINE INVOLVEMENT OF OAZ1 IN THYROID HORMONE MEDIATED CARDIAC HYPERTROPHY**

Carly Kuehn, Eugene Kaji (Mentor), School of Medicine and Public Health

The transcription factor thyroid hormone receptor (TR) is a known transcription factor of myosin heavy chain (MHC), a protein upregulated in physiologic cardiac hypertrophy. To understand the complex regulation of MHC, the laboratory previously conducted a yeast 2 hybrid screen to find other proteins that potentially aide TR in regulating MHC. One positive interaction was ornithine decarboxylase antizyme 1 (OAZ1). OAZ1 is known for regulating polyamine synthesis in the heart, however, OAZ1's role with transcription factors was unknown. This study pursued a deeper understanding of the interaction of TR and OAZ1 through luciferase assays. The results indicate that OAZ1 appears to upregulate the thyroid hormone response element (TRE) portion of MHC in the presence of TR and thyroid hormone.

### **MOLECULAR MECHANISM OF ABDOMINAL AORTIC ANEURYSMS: INVESTIGATION OF AGE AND TGF- IN MMP-9 REGULATION**

Greg Banker, Bo Liu (Mentor), Surgery

The progressive nature of abdominal aortic aneurysms (AAA) makes them one of the most lethal cardiovascular diseases. Macrophage infiltration is a prominent pathological characteristic of AAA, contributing to tissue destruction by producing matrix metalloproteinase-9 (MMP-9), an enzyme that degrades critical matrix proteins of the aortic wall. Our preliminary data suggest that advanced glycation end products (AGE) induced MMP-9 expression in macrophages upon binding to their receptor, RAGE. Furthermore, we observed that transforming growth factor beta (TGF-) potently antagonized the effect of AGE on MMP-9 production. We will use pharmacological, molecular and genetic tools to delineate the cross-talk between TGF- and AGE signaling in regulation of MMP-9. We believe such study will further our understanding of AAA pathogenesis and provide a novel approach to AAA treatment.

### **EFFECTS OF COMPONENT CHANGES IN TITANIUM DIOXIDE AND ZINC OXIDE BASED DYE SENSITIZED SOLAR CELLS**

David Lubin, Yukihiro Hara (Mentor), Materials Science

The need for a new type of low cost solar cell is paramount in a time when demand for affordable, renewable energy is at its greatest. Dye Sensitized Solar Cells (DSSCs) technology is a nascent contender with relatively low cost but currently low efficiency comparing with Si-based solar cells. A need for manipulation of matrix upon which the cell is based (TiO<sub>2</sub> or ZnO) is vital for this efficiency to increase above the current levels. This research is centered upon varying the thickness of film deposition and different morphology of electrode materials. It is expected that one or more of these changes will increase efficiency. This would make for an unprecedented level of performance and offer inexpensive renewable energy.

### **MECHANISMS OF LAEA REGULATION OF ASPERGILLUS TOXINS**

Jeyanthi Bhaheetharan, Nancy Keller (Mentor),  
Medical Microbiology and Immunology

Secondary metabolites are biosynthesized compounds that can have both toxic (mycotoxins) and beneficial (penicillin) impacts on plants and animals. Recently, a global regulator of secondary metabolism, LaeA, was discovered in the model organism *Aspergillus nidulans*. LaeA's role in regulating secondary metabolites is conserved among *Aspergillus* species, including the opportunistic human pathogen *A. fumigatus*. In a mouse model for invasive *aspergillosis*, LaeA is a pathogenicity factor of *A. fumigatus*. To find genes involved in secondary metabolite regulation and/or LaeA function, we conducted a multi-copy suppressor screen of a LaeA null mutant as well as a yeast two-hybrid screen in *A. fumigatus*.

### **DISTINGUISHING BETWEEN AFRICAN AMERICAN ENGLISH AND STANDARD AMERICAN ENGLISH**

Tarica Jackson, Jan Edwards (Mentor),  
Communicative Disorders/Psychology

The purpose of this experiment is to determine if children, ages 4–7, can distinguish the difference between African American English (AAE) and Standard American English (SAE). Children who are not able to perceive the difference between the two may later fall behind in school. Children will watch two different colored monsters read a story, and they will pick which monster speaks in AAE and which monster speaks in SAE. If children are not able to distinguish

the difference, more research will be conducted to find out why they are unable to. This will lead to further research in the development of techniques that children will be able to utilize in identifying differences in dialect which will create a more accessible learning environment.

### **THE MOLECULAR MECHANISM OF CRHSP-28 AND MEMBRANE PHOSPHOLIPID INTERACTION**

Lee Linstroth, Guy Groblewski (Mentor), Nutritional Sciences

Ca<sup>2+</sup>-stimulated secretion of digestive enzymes from pancreatic acinar cells is essential for nutrient assimilation and metabolism. The mechanism(s) by which Ca<sup>2+</sup> modulates digestive enzyme secretion is of central importance because aberrant alterations in cellular Ca<sup>2+</sup> causes the premature activation of digestive enzymes, which leads to the inflammatory disease, pancreatitis. CRHSP-28 is a Ca<sup>2+</sup> sensitive protein that regulates acinar cell secretion by an unknown mechanism. We are using recombinant CRHSP-28 to study the behavior of this protein and to learn about possible regulatory mechanisms. Our studies show that CRHSP-28 interacts strongly with phosphatidyl serine and a number of other poly-phosphoinositides that are typical of those found in cell membranes. Additional experiments suggest that CRHSP-28 is capable of forming large aggregates or polymeric structures in cells. The significance of these results with relation to exocytosis is under investigation.

### **EXPLORING THE EFFECTS OF PLATINUM ON BACTERIAL PHYSIOLOGY**

Charles Burns, Douglas Weibel (Mentor), Biochemistry

This poster describes the study of the molecular effects of platinum on bacterial physiology. I studied the molecular connection between platinum and the Z-ring, the protein filament that determines the mid-cell and the site of septation during replication. My hypothesis was that the observed filamentation of bacteria in the presence of platinum is due to the activation of *sulA* transcription. In this study, *Escherichia coli* strain MG1655 containing a fusion of *ftsZ* to green fluorescent protein (GFP) was grown in the presence of cisplatin. Cell morphology was observed as well as effects on the Z-ring. The results from this study will improve our understanding of the toxicity of platinum in bacteria and will bolster our general understanding of bacterial physiology.

### **ALLELE FREQUENCIES OF CG1 AND GL15 IN ZEA MAYS L. IN RESPONSE TO DIVERGENT RECURRENT SELECTION**

Jessica Rutkoski, William Tracy (Mentor), Agronomy

Common rust (*Puccinia sorghi*) is a pathogen that causes substantial yield loss in sweet corn (*Zea mays L.*). Resistance genes in maize previously exploited to prevent rust infection are no longer effective against certain races of *Puccinia sorghi* in the Midwest. Plants that transition from juvenility to the adult phase earlier during development are generally more resistant to rust. This development transition is called vegetative phase change (VPC). VPC is regulated by microRNAs including miRNA156, known as the *corngrass1* locus and miRNA172, known as the *glossy15* locus in maize. In this research, I test the hypothesis that natural variation at *cg1* and *gl15* are important in determining variation in the timing of (VPC). This will be accomplished by searching for shifts in allele frequency at these loci in populations originating from the same source population and divergently selected for eight generations for early and late (VPC). SNP alleles will be determined by sequencing and then evaluated between the original population and the early and late populations produced by eight cycles of selection. Response of alleles to selection will be determined by searching for allele divergence between the early and late VPC selection programs.

### **MHR JOB OPTIONS DEVELOPMENT: CREATING ECONOMIC SECURITY FOR WOMEN AND FAMILIES**

Jennifer Nilsestuen, Loren Kuzuhara (Mentor), Business

Job Options Development was a collaborative project among Madison's YWCA Employment and Training Annex, Professor Loren Kuzuhara, and Jen Nilsestuen to develop a system that provides structured, efficient, and consistent career skills training and support for the clients of Madison's YWCA. Clients will gain an advantage in the job market, which will stimulate economic and community development in the Madison area. To ensure consistency in the Job Options program, a curriculum was established and a series of six career skills workshops were created. A basic human resources booklet was also developed to inform the YWCA and its clients about employee rights and educate them about the hiring processes from an employer's point of view. Local employers were asked to participate in the initiative by hiring graduates of the program. Ultimately, the project will help the YWCA educate, train, and serve more people with limited resources, which will lead to steady, consistent incomes for their clients. By moving families out of poverty, this project supports the development of both the community and the economy.

## **NON-ECONOMIC FACTORS AFFECTING THE CONDITIONS ATTACHED TO IMF LOANS**

Kyle Swinsky, Heather Abercrombie (Mentor), Psychiatry

Previous research has suggested that certain non-economic factors impact the loan selection process of the International Monetary Fund (IMF). The purpose of this study is to determine how two factors impact the number and type of conditions attached to IMF loans: 1) close ties with the IMF's top donor countries; and, 2) the type of government present in the country requesting a loan. This research is significant because the IMF claims that its goal is to promote economic growth and development throughout the world and denies that its actions are influenced by world politics. However, if research shows that this institution is adjusting conditions based on political factors, this would indicate that the IMF is biased and is taking political issues into consideration.

## **IDENTIFYING SUPPRESSORS OF DMI1 MUTANTS IN MEDICAGO TRUNCATULA**

Jeffrey Kusiak, Arijit Mukherjee (Mentor),  
Great Lakes Bioenergy Research Center

Legumes form symbiotic associations with nitrogen-fixing soil bacteria called rhizobia. This symbiotic relationship provides the plant with nitrogen, essential to its growth. The DMI1 gene of *Medicago truncatula*, required for legume nodulation, controls the early steps of this symbiosis. The *dmi1* mutants cannot express the early nodulation gene ENOD11 and are also unable to form nodules. Our project aims to identify suppressors of the mutant allele B129 (*dmi1-2*). Our screening strategy is to identify suppressors by their ability to restore MtENOD11 expression using a GUS assay. Any suppressors found will be verified in the next generation for its ability to restore ENOD11 expression or nodulation and eventually be cloned. The results will give us a greater understanding of the genetics involved in the early nodulation process.

## **INTEGRATING THE NURSING PERSPECTIVE INTO THE MEDICAL HOME MODEL**

Eve Dibble, Ana Schaper (Mentor), Nursing

The objective is to create a family-centered pediatric Medical Home model, a new primary care delivery concept. Foster's (1997) method of Conceptual Triangulation was used to synthesize conceptual results of research across the disciplines of medicine and nursing. The results indicated shared concepts across these disciplines including: whole-person orientation, coordinated and integrated care, the importance of communication and family participation. Unique concepts from the medical perspective are: physician driven practice;

focus on quality; and safety and care in the community. Unique concepts from the nursing perspective are: health team driven practice; shared decision making, and family presence and skill development. The model developed integrates shared and unique concepts for best patient care centering on the relationship between a primary care team and a parent-child unit.

## **BIOMECHANICAL PROPERTIES OF THE MECHANOSENSING MACHINERY IN SKELETAL MUSCLE**

John Frey, Troy Hornberger (Mentor), Comparative Biosciences

Mechanical signals play a central role in the regulation of skeletal muscle mass; however, the basic mechanisms of the mechanotransduction process are far from understood. The purpose of this study was to characterize the biomechanical properties of the mechano-sensing machinery. In the initial experiments, C2C12 skeletal muscle myoblasts were subjected to progressively higher magnitudes of strain, strain rate, and strain time integral (STI), and the signaling responses of various molecules implicated in the regulation of skeletal muscle mass were evaluated. The results identified three distinct response patterns. Additional studies were then performed to determine if the distinct signaling responses were elicited by strain, strain rate or the STI. The results demonstrated that the activation of signaling to P-p70(389) was dependent on both the magnitude of strain and STI. These studies demonstrate that the mechano-sensing machinery in skeletal muscle is capable of distinguishing between specific types of mechanical information.

## **THE WISCONSIN SCHOLARS LONGITUDINAL STUDY**

Maha Baalbaki, Sara Goldrick-Rab (Mentor), Educational Policy Studies

Education is an important key to economic success. Unfortunately, for many education does not come at an affordable price. For students of poorer socioeconomic background, the overwhelming expense of a college education brings forth many economic, social, etc. setbacks. In order to lighten their difficulties, many students seek federal financial aid, such as need-based grants. The Wisconsin Scholars Longitudinal Study, of which I am a team member, seeks to estimate the causal effects financial aid has on a student's college performance. Through the use of longitudinal surveys and interviews, we will test the hypothesis that there is a positive effect of financial aid on indicators of student success such as GPA, degree completion, etc. Such findings will call the attention of many educational policy makers who are debating whether or not to increase financial aid.

## **DOES LIVING TOGETHER PREDICT RELATIONSHIP SATISFACTION IN YOUNG DATING COUPLES?**

Kayla Montgomery, Sarah Wier, Lauren Papp (Mentor),  
Human Development and Family Studies

Many studies have looked at the association between premarital cohabitation and subsequent satisfaction among married couples. However, little research has focused on dating cohabiting couples and their current relationship satisfaction. This project uses a sample of young adult dating couples to investigate the relationship between cohabitation and perceived negative qualities of a partner, overall relationship satisfaction, relationship adjustment, and commitment. We hypothesized that living together would correlate positively with perceived negative qualities and commitment, but negatively correlate with relationship satisfaction and overall adjustment. Our sample included 101 dating couples who completed questionnaires during a lab visit at the UW Couples Lab. By comparing cohabiting and non-cohabiting couples, we hope to provide information on a relevant topic and use our research to provide suggestions for dating couples today.

## **LOCALIZATION OF ANGIOTENSIN II RECEPTORS IN THE RAT ADRENAL GLAND**

Courtney Premer, Mark Brownfield (Mentor), Comparative Biosciences

This study explores the distribution of Angiotensin (AT) receptor subtypes, AT1a, AT1b, and AT2, in selected regions of the rat adrenal gland. Angiotensin is functionally correlated with hormone release. Specifically, the subcapsular glomerulosa is responsible for aldosterone and deoxycorticosteroid secretion (sodium balance) and the medulla is responsible for epinephrine and norepinephrine (autonomic stress response). These areas of the adrenal gland were sectioned and then stained with antibodies to each AT receptor and visualized by light microscopic immunocytochemistry. Further, receptors were immunogold labeled and subsequently inspected under an electron microscope. Results illustrate the specific areas that Angiotensin II effects the rat adrenal gland. Upon finding the locations, this knowledge will be crucial in pharmacologically aiding patients with hypertension and stress disorders.

## **EXPERIENCE AND FOUNDING OUTCOMES IN THE AVIATION INDUSTRY**

Raechel Garry, Phillip Kim (Mentor), Management

The aviation project is to investigate the potential relationship between the experience of founding team members in the aviation industry and their intended business goals. Our method is to examine the companies' application files

to the Department of Transportation. These files and documents contain information about the business plans and operating goals of companies and also the background information of the management team members. Our expected result is the positive relationship between experience and the applicants' goals. This principle could also apply to other business industries.

## **FORGOTTEN TREASURES: TRACING THE HISTORICAL ROOTS OF ETHNOGRAPHIC MATERIAL CURATED AT UW-MADISON**

Stephanie Thompson, Danielle Benden (Mentor), Anthropology

Over the years the UW-Madison Department of Anthropology has accumulated a tremendous amount of ethnographic objects from around the world. These were often donated, borrowed, or collected by professors. A review of current object records reveal limited or even absent information about these collections. Acknowledging this lack of crucial information (e.g. origin of object, approximate date obtained, cultural significance), I have attempted to supplement available data through advanced research. It is possible to gain greater intellectual control over these once forgotten ethnographic collections by improving the existing documentation through contact with previous collection owners and library and literature searches. Compilation of enhanced data enriches our understanding of these objects' life history and facilitates future research for both students and faculty.

## **RADAR ANALYSIS OF HIGH-ALTITUDE MICRO-METEORIODS**

Jacob Oberman, Stanley Briczinski (Mentor), Physics

A meteoroid is the visible reflection from any non-terrestrial particle entering the Earth's atmosphere. We have used the Poker Flat Advanced Modular Incoherent Scatter Radar to detect and analyze micro meteoroids in the upper atmosphere. Some meteoroids appear to be destroyed instantaneously while others ablate (burn out) over a longer period of time. Those meteors that spontaneously vaporize may play a significant role in the composition of the upper atmosphere. We present a comparison between the observed parameters of terminal meteoroids and the general population in an attempt to determine what distinguishes terminal meteoroids from the rest of the sporadic events observed. We discuss the possible implications that the presence of terminal meteoroids have for the aeronomy of the meteor zone.

## **DEVELOPMENT OF AN AUTOMATED RIVER DISCHARGE IMAGING SYSTEM**

Adam Bechle, Chin-Hsien Wu (Mentor),  
Civil and Environmental Engineering

Discharge is one of the most important characteristics of a river, an important factor in determining the ecology, contaminant transport, and flood frequency of the river. Conventional discharge measurement techniques using in situ current meters can be costly to perform and even dangerous during high flow conditions. Thus, we developed a remote sensing technique, which uses images of a river to non-intrusively calculate the discharge in a safe and reliable fashion. Using a system of calibrated cameras, artificial tracing particles and turbulent flow patterns on the river surface are tracked over time to obtain the river's surface velocity, which is then converted to a discharge value. The result of this research will provide an automated and flexible method for sustainably measuring river discharge, ARDIS.

## **IDENTIFICATION OF A NOVEL CONSTRAINED PEPTIDE LIGAND AGAINST THE FC-RIIB RECEPTOR**

Sixun Chen, Laura Kiessling (Mentor), Chemistry

B cells undergo activation when the B cell antigen receptor (BCR) is engaged by antigens. Co-receptors, such as the inhibitory Fc-RIIB receptor that binds to IgG, can modulate BCR signalling. The identification of a novel constrained peptide ligand against Fc-RIIB will be a useful probe of B-cell co-receptor signalling. Fc-RIIB protein was collected from transfected CHO-K1 cells and purified using Ni-NTA resin and HiTrap columns. A combinatorial phage library of cyclic peptide 7-mers was used in panning experiments against the target, Fc-RIIB. Putative peptides were identified to bind to Fc-RIIB and have the consensus sequence, SLPLTGQ. The consensus peptide generated via SPPS (Solid-Phase Peptide Synthesis) will form the basis for further binding studies against Fc-RIIB.

## **REGULATION OF EPSTEIN-BARR VIRUS INFECTION AND REPLICATION BY PROMYELOCYTIC LEUKEMIA BODIES**

Brian Lee, Shannon Kenney (Mentor), School of Medicine and Public Health

The functional nature of promyelocytic leukemia (PML) bodies, intranuclear structures epitomized by the PML protein, is a question that has yielded many insights into cellular regulation but eluded exact characterization. In particular, the interactions of these protein aggregations with nuclear-replicating viruses have been the subject of much scrutiny. PML bodies have been linked to an extensive number of pathways, including those of transcription and apoptosis,

and appear to function in an antiviral capacity. Studies by our research group and our collaborators have shown that herpesviruses such as Epstein-Barr virus (EBV) disrupt PML bodies by a variety of inhibitory mechanisms, including dispersion by the EBV regulator BZLF1. Since BZLF1 initiates the lytic cycle in latent episomic EBV, and as there is growing evidence that PML bodies are closely involved in host innate immunity, it is highly probable that PML body activity and viral life cycles are intricately coupled processes. This study will examine the hypothesis that the disruption of PML bodies by depleting PML protein increases EBV's efficiency in implementing latent infection and lytic replication. The results of this experiment will shed light on the precise role of PML bodies in mediating antiviral defense, specifically regarding EBV.

## **THE EVOLUTION OF MITRASTEMA: PHYLOGENETICS AND HORIZONTAL GENE TRANSFER IN A PARASITIC PLANT**

Thomas Kleist, Kenneth Sytsma (Mentor), Botany

Mitrostema is a highly unusual plant in that it is a holoparasite; it derives all of its water and nutrients from other host plants and does not perform photosynthesis. The drastic morphological and functional changes associated with the evolution of the holoparasitic habit correspond to substantial disparities in Mitrostema's genome compared to most other plants. As a result, phylogenetic placement of Mitrostema and other holoparasites has proved elusive. Plant holoparasites are valuable resources that provide a unique opportunity to study plant evolution without the selective pressure of a functional photosynthetic apparatus. This presentation unveils the findings of the most extensive research endeavor to date on Mitrostema. It offers new insights into the evolutionary history of the plant and identifies its closest extant relatives.

## **A FLUORESCENCE-BASED APPROACH TO BIOSYNTHETIC PROTEIN FOLDING**

David Ziehr, Silvia Cavagnero (Mentor), Chemistry

Most protein folding research has employed *in vitro* model systems; however, *in vivo* analysis is necessary to observe protein folding as it occurs, perhaps cotranslationally, in the cell. To test the hypothesis that proteins follow different folding pathways *in vitro* and *in vivo*, this work demonstrates that a model protein can be double-labeled with fluorescence donor and acceptor molecules. Future experiments will exploit these fluorescent molecules to show intramolecular distance distributions during translation. Further, this work reveals that, unlike traditional chain-releasing reagents, hydroxylamine does not produce harsh reaction conditions, yet effectively releases unmodified, soluble, and spectroscopically viable nascent chains without destroying the ribosome. This work takes initial steps to demonstrate the effect of translation on protein folding.

## **POP.COSMO ONLINE GAMING LAB**

Jonathan Elmergreen, Constance Steinkuehler (Mentor),  
Curriculum and Instruction

The Pop.Cosmo Online Gaming Lab is an after school program for boys who are at risk of not succeeding in traditional school settings. The objective of this study is to suggest how involvement with massive multiplayer online role-playing video games (MMO), such as World of Warcraft, may align with learning and cognition around key areas such as informal science, digital and print literacy, computational literacy, collective problem solving, distributed apprenticeship, and pop cosmopolitanism. In MMO games, players control a character (avatar) within the game world where they complete quests, explore landscapes, battle mythical creatures and interact with other players. As research assistants, we participate in ethnographical research which includes taking field notes and interviewing participants about their interests in school and gaming.

## **MAGNETO-FLOW INSTABILITIES IN STELLAR INTERIORS**

Daniel Lecoanet, Ellen Zweibel (Mentor), Astronomy

The stability of stellar rotation has important implications for circulation and mixing in stars. Hydrodynamic stability is usually inferred from the Richardson Criterion, which implies that if the gravitational energy is greater than the shear flow energy, the fluid in a star is dynamically stable. However, the stellar interior is a magnetized plasma, so a magnetohydrodynamic (MHD) analysis is necessary to evaluate stability. The Richardson Criterion can be shown to no longer be valid in a plasma, and we will present counter-examples. We will show how a magnetic field breaks the hydrodynamic vorticity conservation and how this results in instability. Finally, we present evidence that this instability is present over a wide range of parameters, and is a necessary part of an accurate model of stellar interiors.

## **VIOLENCE AND NON-VIOLENCE IN THE INDIAN ANTI-COLONIAL MOVEMENT**

Adam Thal, James Klausen (Mentor), Political Science

While Gandhi and the Indian anti-colonial movement are preeminently associated with non-violent resistance, this view tends to overshadow the role of violence in the movement. The research that Professor Klausen is conducting with the assistance of a fellow student and myself will culminate in an article exploring the interplay of violence and non-violence in the political philosophy that guided the Indian anti-colonial movement. The topic will be explored through the study of Gandhi and Aurobindo Ghose, a contemporary of Gandhi who often advocated violence as an anti-colonial tool. My research has focused

on Hind Swaraj, The Bhagavad-Gita, and other primary and academic sources. The ultimate goal is to promote a historically accurate view of the Indian anti-colonial movement and the men who shaped it.

## **TRANSFORMATION OF METAL NANOPARTICLES UNDER SIMULATED ENVIRONMENTAL CONDITIONS**

Ali Bramson, Joel Pedersen (Mentor), Soil Science

Nanotechnology is a rapidly growing field with applications ranging from sunscreens to ultra-light building materials to cancer treatment. As production and use of these materials increases, so does the potential for release into the environment. As a first step toward understanding the environmental fate of these materials, we developed two chemical models simulating environmental conditions. One model simulates the environment around fungi in soils; the other is based on reductive processes occurring in the sediments of lakes and ponds. After exposure to simulated environmental conditions, we analyze changes in the particles to look for any harmful transformations. This method can in principle be applied to nearly any nanomaterial of interest, making this and similar assays useful tools for investigating the transformation of nanomaterials.

## **CHANGES IN BACTERIAL COMPOSITION FOLLOWING CROSS-INOCULATION OF RUMINAL CONTENTS BETWEEN BOVINES**

Sheryl Man, Paul Weimer (Mentor), Bacteriology

The purpose of this study is to assess the ability of the ruminal microbial community to withstand cross-inoculation with a bacterial community from another cow, by monitoring changes in the bacterial community composition (BCC) with ARISA during periods shortly after the exchange. Our hypothesis is that each ruminal bacterial community is optimally adapted to its host; therefore the original bacterial community will gradually replace the 'invading' community. This study will provide evidence whether BCC can be manipulated or not, which will have great implications on cattle management strategies, such as whether to use individualized or homogenized feed.

## **EXPLORING CDC-42'S ROLE IN CELL POLARIZATION AND ASYMMETRIC CELL DIVISIONS IN *C. ELEGANS***

William Bothfeld, Jeff Hardin (Mentor), Zoology

Asymmetric cell division is a key process in producing diverse cell types. In *C. elegans*, CDC-42 and PAR proteins must polarize cells in the early embryo for asymmetric cell division to occur, but it is unknown if this mechanism is

utilized in later asymmetric cell divisions. We found that CDC-42 and its active form are expressed in polarized larval structures shown to exhibit defects when CDC-42 or PAR proteins are reduced. We will continue to explore if CDC-42 activity and the PAR proteins' distribution is polarized among late and post-embryonic cell divisions in a manner consistent with the model proposed for its function during asymmetric division in the early embryo. If this model is conserved in *C. elegans*, future research may determine if this mechanism is conserved among other metazoans.

### **LOW-LEVEL EXPOSURE TO ENVIRONMENTAL CONTAMINANTS IN WATER**

Caitlin Rau, Julia Haviland (Mentor), Zoology

Our study examines reproductive outcomes of mice treated with common agrochemicals, atrazine and nitrate. The herbicide, Atrazine, is widely used and has been implicated as an endocrine disruptor. It has been shown to disrupt reproductive development and immune function in frog and rodent species. Susceptibility to birth defects was simulated using a genetically based folate deficiency. All possible combinations of atrazine and nitrate were added to the water of the study animals. F1 offspring were examined for gross morphological defects and implantation sites in dams were compared to live born young. Initial results showed significant fetal losses in mice treated with atrazine and nitrate.

### **HOLOGRAPHIC OPTICAL TWEEZER MANAGEMENT**

Daniel Hawk, Ryan Kershner (Mentor), Mechanical Engineering

Optical tweezing is a particle manipulation method that uses a well-directed laser beam to 'trap' micro and nano-scale particles, such as living cells, nano-rods/ membranes, vesicles, bubbles, etc. The beam can be turned into a hologram by modulating its light phase. This method, called Holographic Optical Tweezing, makes it possible to simultaneously create multiple, independently controlled laser traps, which can puppeteer multiple specimens in 3-D space by means of translation and rotation. New techniques for determining trap positions need to be developed for a variety of particle types, each which have a variety of different needs. Using National Instruments' LabVIEW, a widely used computer program, a 4-D trap location management system, has been created for non-invasive, macro-based control of micro and nano particles.

### **THE ROLE OF EGFR IN THE RAPID ACTION OF 17BETA-ESTRADIOL THROUGH GPR30**

James Lehman, Ei Terasawa (Mentor), Pediatrics

Recent studies in this lab indicate that 17beta-estradiol (E2) stimulates activity of primate gonadotropin releasing hormone (GnRH) neurons and that this E2 action is mediated by the G-protein coupled receptor, GPR30, rather than nuclear estrogen receptors. However, the signal transduction mechanism of E2-induced GPR30 activation is still unclear. In this study, a possible role of the epidermal growth factor receptor (EGFR) in trans-activation of GPR30 signaling was examined. Results suggest that similar to E2, EGF stimulated GnRH neuronal activity, whereas the EGFR blocker AG1478 abrogated E2 responses in GnRH neurons, and that primate GnRH neurons expressed EGFR. These results support the notion that EGFR is involved in the mechanism of E2 action through GPR30.

### **MATCHING BETWEEN DIETARY PREFERENCES AND DIGESTIVE CAPACITY IN WISCONSIN BIRDS**

Kevin Kohl, William Karasov (Mentor), Forest and Wildlife Ecology

The adaptive modulation hypothesis states that enzyme activities should match the relative levels of substrate present in an animal's diet so as not to waste biosynthetic energy or cell membrane space with unneeded enzymes. The purpose of this study was to look at the activities of pancreatic and intestinal enzymes in six avian species where diet patterns have been extensively studied. Consistent with this hypothesis, I found that species with a higher plant material in their diets had higher carbohydrase activities. However, there were no differences in protease activities between species with different percent protein in their diets. This may occur so that species are able to break down all available protein in the diet to meet minimum requirements for amino acids.

### **GOT MILK? THE RELATIONSHIP BETWEEN VITAMIN D RECEPTOR (VDR) AND CA 2+ CELL SIGNALLING**

Megan Borchert, Yongji Wang (Mentor), Biochemistry

Calcium plays an important role in intracellular cell signaling and skeletal development in humans. The vitamin D receptor (VDR) regulates genes metabolic pathways involved in calcium absorption and immune responses. The location and activity of VDR proteins within various body tissues is not completely understood. Examination of VDR in body tissue includes establishing tissue contains VDR, localizing the protein within tissues using special staining techniques and determining VDR activity levels by measuring DNA regulation. Characterization and use of selective antibodies supports the clear identification

of VDR within tissues. Further investigation could lead to novel discoveries and a better understanding of how VDR dysfunction could lead to low calcium levels and eye malfunction.

### **IMAGES FROM THE PAST: THE PHOTO DOCUMENTATION AND RE-HOUSING PROJECT**

Jacqueline Pozza, Danielle Benden (Mentor), Anthropology

In January 2009, the Photograph Re-housing Project began in the archives of the University of Wisconsin–Madison’s Anthropology Department. Photographs, negatives, and slides provide essential information about artifacts curated within the Anthropology Collections and the people who collected them. Over the years, these had been forgotten and stored in corrosive containers. As part of an Archaeological Curation Methods course, the Photograph Re-housing Project was initiated to reorganize these materials; re-house them into acid-free binders; create a database that would not only list the locations of the items, but also display the object’s provenience information and related documentation; and to digitize them. When the project is finished, pictures of specific artifacts, sites, and people will be available within the database, aiding future research of the collections.

### **FEDERAL EARMARKS FOR HIGHER EDUCATION**

Erik Larson, Jennifer Delaney (Mentor),  
Educational Leadership and Policy Analysis

Federal earmarks, commonly referred to as “pork,” have seen a rise in occurrence over the past decade. Our colleges and universities are major recipients of these funds. How are the funds used? What impact does the political process have on the distribution of these funds from congresspeople? How does the earmark process differ from other processes of obtaining federal funding for higher education? Completed aspects of the project include a dataset compiled from various government, academic and private sources, which enable analysis of earmarks for higher education. This project seeks to give understanding of the implications that these processes have on institutions and states.

### **AN ANALYSIS OF GENETIC INTERACTIONS WITHIN THE MAP KINASE GENE FAMILY OF *A. THALIANA***

Christopher Harvey, Katie Clark (Mentor), Genetics

The mitogen activated protein kinase (MAPK) family is a highly conserved set of genes that is involved in cellular signal transduction in all eukaryotes. The plant model organism *Arabidopsis thaliana* contains 20 MAPK genes, most of

which display a high degree of sequence similarity to one another. Predictably, for most of the MAPK single knockout mutants, there exists no visible phenotype, indicating possible functional redundancy between the knocked-down gene and another gene(s) in the family. This goal of this project is to discern some of the patterns by analyzing the genetic segregation of progeny from crosses between interacting genes. To assist in analyzing these segregation ratios, another facet of this project is to determine linkage distances between several linked MAPK genes.

### **THE IMPACT OF ENVIRONMENTAL ISSUES ON CORPORATIONS IN THE UNITED STATES**

Martin Pesis, Debra Houden (Mentor), General Business

American corporations are finally taking notice of the numerous environmental issues acknowledged by organizations and activist groups across the United States. Both consumers and competitors have applied intense pressure on these corporations to maintain a high standard of environmental friendliness in their respective industries. The corporations that are taking part in the growing “green movement” are doing so for several different reasons. Some are using sustainability to reduce operating costs, some are manufacturing new products to cater to consumer demands, and a few are just doing it out of the kindness of their corporate philosophy. I have researched numerous American companies and opportunities created by becoming more environmentally friendly, as well as the future of this trend. The results will be presented.

### **PROJECT SUMMER**

Carolyn Nguyen, Erik Carter (Mentor),  
Rehabilitation Psychology and Special Education

Project Summer is focused on developing and evaluating a set of promising intervention strategies to help students with significant disabilities or emotional/behavioral disabilities connect to work and other community activities during the summer months. There is evidence that the community is not aware of the needs or capacity of these students. The project sponsored a series of community-wide conversations to increase awareness and established community connectors and employer liaisons to help match individual students to summer job opportunities. The project involves (a) comparing outcomes for students in the research and comparison groups and (b) gathering feedback from stakeholder groups like parents, teachers, students, and employers. The intervention was particularly effective for students with severe disabilities and the team is now focusing on refining the strategies to help youth with disabilities transition successfully to life after high school.

## **A TEST OF THE GESTURE AS SIMULATED ACTION HYPOTHESIS**

Anne Bartholomew, Martha Alibali (Mentor),  
Psychology/Educational Psychology

Little is known why gestures occur. The Gesture as Simulated Action (GSA) hypothesis proposes that gestures arise from the way we represent our experiences in the world. This framework contends that gestures occur when thoughts are tied to particular actions, and that experiences involving a greater action component will elicit more gestures than experiences involving a lesser action component. In this study, the GSA framework was tested by comparing the gestures speakers produced when describing images in motion to those produced when describing stationary images. Participants were asked to describe patterns either exactly as shown or rotated according to instructions provided (e.g., 45 degrees to the left). The GSA framework predicts that participants will gesture more when they imagine their mental image in motion.

## **DEVELOPMENT AND TESTING OF A NEW PROBE DESIGN TO ACCURATELY MEASURE GROUNDWATER FLUX**

Jerry Wilke, Steven Loheide (Mentor), Civil and Environmental Engineering

Monitoring groundwater flow and flux is constructive to developing sustainable communities and managing their use of water resources; however, current analysis tools often fail to accurately represent groundwater velocities necessary to improve groundwater modeling. Through the funding provided by the Hilldale Fellowship, a new probe was designed to measure groundwater flux by passively redirecting the groundwater flux about an annulus (a cylindrical ring). The probe was tested in a uniform flow field under controlled conditions, and observations collected to be further analyzed and validated through computer modeling. The methodology and observations of the study will be presented. The study of the probe is still ongoing, and future work should be directed at field-testing of the probe.

## **SURROUNDING LAND COVER EFFECTS ON AMPHIBIAN HEALTH IN MADISON AREA RETENTION PONDS**

Joel Smoot, Stanley Dodson (Mentor), Zoology

Amphibians are declining around the world at an alarming rate. As their natural habitat declines, often the most readily available water source for breeding is an artificial retention pond. We expected to see a decline in amphibian health as the lawn percentage surrounding a pond increased. To test this we measured amphibian snout-vent length and mass in addition to metamorphosis rate, and compared these values to the surrounding land cover for 13 retention

ponds. As we expected, the results show the amphibians from lawn dominated ponds are smaller than those from ponds surrounded by meadow. The implications of these findings suggest that when people are designing future retention ponds, minimizing the surrounding lawn is the best way to maximize amphibian growth and survivorship.

## **PRENEOPLASTIC LESION GROWTH IN B6.HCS7C3H 219R8 CONGENIC HEPATOCARCINOGEN-SENSITIVE MUS MUSCULUS**

Elizabeth Poli, Andrea Bilger (Mentor), Oncology

The Hcs7 locus on mouse Chromosome 1 is involved in the increased susceptibility to liver carcinogenesis in C3H mice relative to the resistant B6 strain. Early experiments have suggested that Hcs7 affects the promotion phase of hepatic tumor development. Male C3H, B6, and B6 mice carrying the C3H Hcs7 allele were treated with DEN, sacrificed at two time points, and their livers dissected. Preneoplastic lesions in the liver sections were counted and measured. A computer program was used to extrapolate the volume fraction change of the lesions between the two time points to determine if the locus promotes liver tumorigenesis. Understanding the mechanisms of liver cancer in mice can allow the identification of genes that have the same effect in human liver cancer.

## **HOW TO READ THE SEMIOTIC TEXT: TOWARD A DISCOURSE THEORY OF ROLAND BARTHES**

Terrance Sims, Amy Bellmore (Mentor), Educational Psychology

The work of the literary theorist Roland Barthes (1915–80) is generally divided into two phases by critics: the early Barthes, a scientific examination of texts through semiotics, the study of signs; and late Barthes, a series of extremely personal, novel-like texts. To construct a cohesive reading of his career, I examined the analytical forces of Barthes' early work and the transition from scientific description to the personal form of his later texts through the lens of discourse theory and pragmatics as presented by the logician H.P. Grice. This discourse-focused reading of Barthes' texts will be illuminating beyond the scope of his oeuvre; it suggests an inquest into the intersection between the cultural and the personal in the construction of meaning in texts.

**BIOCORE OUTREACH AMBASSADORS HELP K-12  
TEACHERS IMPLEMENT SUSTAINABLE,  
INQUIRY-BASED SCIENCE LESSONS**

Kaleigh Suhs, Abby Kuranz, Michelle Harris (Mentor),  
Biology Core Curriculum

We are assessing the impact of Biocore Outreach Ambassador (BOA) classroom visits on science education over the past three years in the Wisconsin Heights, Deerfield, and Waunakee school districts. The mission of the BOA is to work side-by-side with rural Wisconsin teachers to develop sustainable inquiry-based science activities aligned with state standards via classroom visits in K-12 school districts. We will measure BOA impact through teacher surveys and classroom observations. We will examine whether teachers who have worked with BOA students show an increase in inquiry based-teaching, which we define as an approach to teaching science as a process through questioning students and allowing them to explore scientific concepts through hands-on exploration.

**THE PRESENCE OF NFUA PROTEIN IS REQUIRED  
FOR SALMONELLA ENTERICA TO SYNTHESIZE THIAMINE**

Andrew Pace, Diana Downs (Mentor), Bacteriology

Iron-sulfur clusters are essential protein-bound cofactors that are critical for the survival of the cell. The nature of iron-sulfur clusters and iron-sulfur proteins have been well studied, but little is known about Fe-S cluster biosynthesis or connections between iron-sulfur cluster metabolism and other metabolic networks. The purpose of this research is to study the metabolic connections between iron-sulfur cluster synthesis and thiamine synthesis. The function of the protein NfuA has been studied *in vitro* and has been found to be involved in iron-sulfur cluster biosynthesis. A strain with an *nfuA* mutation is a thiamine auxotroph because of a defect in Fe-S cluster metabolism. I have isolated 10 strains that contain mutations that suppress the thiamine auxotrophy of an *nfuA* mutant. Identifying the genes that contain the suppressor mutations and examining why they suppress an *nfuA* mutant will help us build a model for NfuA function *in vivo*.

**DEMYSTIFYING THE RELATIONSHIP BETWEEN  
CARMEN MIRANDA AND GETULIO VARGAS**

Elizabeth Toussaint, Kathryn Sanchez (Mentor), Spanish and Portuguese

Getúlio Vargas, revolutionary dictator of Brazil from 1930–45 and popularly elected President from 1951–54, and Carmen Miranda, Brazilian singer and performer popularly known in the United States for her Hollywood roles and

Chiquita Banana publicity, both played a significant role in developing Brazilian national identity in the 1930s. Carmen Miranda biographers have commonly acknowledged that the two were often in contact and made public appearances together, however, Miranda is not mentioned in Getúlio Vargas' voluminous diary kept from 1930–45. Furthermore, Vargas' personal correspondence and national newspapers from the era do not mention or imply any contact between the two celebrities. It appears Miranda's interaction with the Vargas regime was limited to the Press and Propaganda Department. Although her popularity as a symbol of Brazilianess both at home and abroad complemented Vargas' political agenda; Miranda's career was influenced more by the capitalistic nature of the music and film industry than the policy of Getúlio Vargas.

**AN RF DISCHARGE TO STUDY IONIZED CARRIERS  
OF THE DIFFUSE INTERSTELLAR BANDS**

Michael Wood, James Lawler (Mentor), Physics

The diffuse interstellar bands (DIBs), a set of over 300 visible and infrared absorption features of unknown origin, are one of the most elusive and enduring mysteries of 20th-century astronomy. A UW–Madison project has been collecting laboratory spectra of cold, neutral polycyclic aromatic hydrocarbons (PAHs), considered prime candidate carriers of the DIBs, for comparison with observed astronomical data. To expand the project, I have constructed a radio-frequency (RF) ionizing discharge in order to collect the spectra of PAH ions. The design of the RF device and the characteristics of the discharge plasma will be presented.

**MIXING AND FLOW PATTERNS OF VISCOUS,  
VISCOELASTIC FLUIDS**

Saminu Abubakar, Robin Connelly (Mentor), Food Science

Many foods and personal care products used today are viscous, viscoelastic fluids. Studies conducted on the mixing of these fluids have concentrated on basic geometries and model systems which are different from the mixers and fluids normally encountered. The objective of this research project is the study of the mixing and flow patterns of viscous, viscoelastic fluids in a vane mixer. The approach will involve the use of high-speed digital photography to record the paths of tracers in an optically clear fluid of known rheological properties while measuring the torque generated by the mixer. The results of this research will assist in understanding the effect of normally encountered viscoelastic responses on the flow in a mixer geometry that has many applications.

## **CONSTRUCTION OF A ZOOLOGY 151/152 PEER MENTORING PROGRAM BASED ON A NOVEL EDUCATIONAL METHOD**

Shuhan He, Carlos Peralta (Mentor), Zoology

Problems with the large lecture are well documented in the literature, but little can be done due to the size of large universities like UW–Madison. An educational method was created within the biology 151/152 curriculum to ensure students are given an individualized responsibility in their education. Peer facilitators lead weekly sessions where students act as presenters for the rest of the group for a small segment of material that is randomly assigned. At the same time, the five students ask the presenter questions that forces the presenter to defend the presentation. This gives the students a place to receive feedback on their skill acquisition and, thus, their exam performance. Data is currently being tracked with 11 facilitators and about 70 students in the program.

## **PRIVATE MILITARY CORPORATIONS AND INTERNATIONAL POLITICS**

Artur Oliveira, Katherine McCoy (Mentor), Sociology

Since the attacks on September 11, 2001, the United States Government (USG) has been heavily involved in overseas military programs. To support its branches of the military, the USG has been awarding contracts to private military corporations (PMCs) for many services. Many of these multi-million dollar contracts are awarded to these PMCs so they can provide security services, repairs, intelligence services, and other assistance to the USG and US armed forces. Many questions have been raised about the future of wars and international politics and the role of PMCs in these matters, but the issue with this topic is that there is very little available information about PMCs. This lack of information stops people from understanding the roles of these companies and from making informed decisions. We have focused on transcribing case study interviews with people from inside the industry, the United Nations, and many others so that there can be more in-depth understanding about PMCs.

## **DESIGN AND TESTING OF A SOURCE CALIBRATION SYSTEM FOR THE CUORE DOUBLE BETA DECAY EXPERIMENT**

Jacqueline Houston, Karsten Heeger (Mentor), Physics

The Cryogenic Underground Observatory for Rare Events (CUORE) is an experiment designed to discover if neutrinos are their own antiparticles by observing double beta decay events. A detector housed in a cryostat is used to detect the energy signature of neutrinoless double beta decay events. In order to accurately detect the decay events, the experiment must be precisely calibrated.

This research is focused on the design and calibration of the system and controls that deliver the radioactive sources into the cryostat. This includes the design and assembly of a prototype delivery system and the development of software controls to link sensor readings and automated motion control.

## **SEMANTIC CATEGORY LEARNING THROUGH EXPLICIT AND IMPLICIT SEQUENCE LEARNING**

Annabel Li, Timothy Rogers (Mentor), Psychology

Objects with similar functions are often judged to be “of the same category,” even when they have few directly observable properties in common. One possible explanation is that such objects often occur in similar contexts: the events that precede and follow them in a sequence well learned through everyday experience overlap. In the current study, participants learned a complex sequence and were subsequently taught to name items encountered. It was hypothesized that participants would acquire names faster when items in the same position within the sequence have the same name than when they do not, but this difference turned out to be insignificant. An analysis of data comparing participants who did or did not successfully learn the sequence, however, did give support to the sequence theory.

## **COMPREHENSIVE PSYCHOANALYSIS OF FAMILY BUSINESS LEADERSHIP AND SUCCESSION PLANNING**

Michael Nemmetz, Debra Houden (Mentor), General Business

This study aims to explore how psychoanalysis can explain leadership styles of entrepreneurs and the difficulties that arise during periods of succession. I will analyze the beginning life of family business ownership through the first generation of succession while emphasizing theories of psychoanalysis such as the unconscious, repression, narcissism, symbolism, sublimation, and emotional intelligence. I will focus on how psychoanalytic interpretations can elucidate phenomena of organizational symbolism and culture while exploring the relationship between leaders and followers. This study is relevant as four out of five family businesses are still controlled by their founders, yet over half expect a leadership change by 2013. By gaining insight to the underlying beliefs, motives, and fears of the CEO, families can better prepare plans for the future of their business.

## **THE EFFECT OF DEER HERBIVORY ON GROWTH/DEFENSE TRADEOFF IN ASPENS**

Kevin Karl, Alison Bennett (Mentor), Entomology

How plants allocate their resources in the presence of insect or mammalian herbivory may limit their ability to counter future herbivory from either group of herbivores. In this study, we examined allocation to chemical defense (effective in response to insect herbivores) and regrowth (effective in response to mammalian herbivory) in four genotypes of quaking aspen (*Populus tremuloides*) following four treatments simulating different levels of deer (mammalian) herbivory: defoliation, deer saliva application, the combination of defoliation and deer saliva application, and no defoliation or saliva application. *P. tremuloides* genotypes that experienced fully simulated deer herbivory (defoliation and saliva application) had the greatest total mass and lowest average root mass. As a result, following deer herbivory, *P. tremuloides* allocate much of their resources from their root to the above ground portion of the plant for regrowth. Further chemical testing will reveal whether regrowth limits *P. tremuloides* allocation to chemical defenses against insect herbivory, which could have serious implications if deer herbivory selects for reduced chemical defense in areas of frequent insect outbreaks.

## **INVESTIGATION OF MAGNETOROTATIONAL INSTABILITY IN A HIGH-FLOWING PLASMA**

Jonathan Jara-Almonte, Cary Forest (Mentor), Physics

Accretion, the accumulation of mass onto a central object, is important for the formation of many astrophysical bodies such as stars, however the mechanism by which accretion occurs on observed time scales is unknown. The Magnetorotational Instability (MRI) is predicted by theory to be a mechanism which could lead to accretion, however the MRI has never been observed in a plasma. The Plasma Couette Experiment, under construction at the UW–Madison, aims to study MRI and dynamo effects in hot, quickly flowing, and unmagnetized plasmas by using a unique confinement mechanism. An overview of the experiment and initial temperature and density profiles, as measured by a single tip swept Langmuir probe, for the Plasma Couette Experiment will be presented.

## **PLASMA NANO-ENGINEERING POLY(METHYL METHACRYLATE) SURFACES**

Charlie Hall, Sorin Manolache (Mentor), Engineering Physics

I am researching cold plasma engineering nanotopography into poly(methyl methacrylate) surfaces using helium plasma at atmospheric pressure and charg-

ing the polymeric surfaces. Plasma is the fourth state of matter consisting of a mixture of ions, electrons, photons and excited species. Cold plasma enhanced cross-linking or modification of a polymer surface could produce nano-topographies. Etching rate is recorded to evaluate the global changes of the polymeric layers. The research of cold plasma for nano-topography is a relatively new technology that has yet to be fully explored. Once the process of altering the surface of a polymer is better understood, it can be used to nano-engineer polymers with specific functionalities and nanotopographies (i.e. absorbent, anti-scratch, etc.) requested for the design of advanced materials.

## **DISCLOSURE OF HIV/AIDS: WHY SOME PEOPLE DISCLOSE WHILE OTHERS DO NOT**

Abigail Flood, Claire Wendland (Mentor), Anthropology

The object of this project is to better understand why some people choose to disclose their HIV/AIDS status, while others choose to withhold this information. Using a set of transcribed interviews with AIDS patients, I analyzed thematic content to gain insight into why people do or do not disclose their positive status. Once the data was collected, it was compared to previously published research on disclosure. The comparison showed that this original data challenged some conclusions drawn from previously published work.

## **NATURAL SUPPORTS: PROMOTING SELF-DETERMINATION SKILLS AND OPPORTUNITIES FOR DISABLED STUDENTS**

Samantha Schomberg, Erik Carter (Mentor),  
Rehabilitation Psychology and Special Education

Paraprofessionals (or special education assistants) play a significant role in supporting students with disabilities in many schools. At the same time, self-determination—equipping students with the skills, knowledge, and attitudes needed to assume primary control and responsibility for their own lives—has emerged as critical within discussions of educational policies, services, and supports for these youth. The focus of this project is to survey paraprofessionals within randomly selected schools in Wisconsin to understand the types of self-determination skills they focus on most when supporting students with disabilities. The findings of this study will help the project to develop targeted training efforts addressing this area.

## **INVESTIGATING THE ROLE OF CYSTEINE 118 AND METHIONINE 230 IN HEME-DEPENDANT REGULATION OF IRP1**

Benjamin Schlais, Richard Eisenstein (Mentor), Nutritional Sciences

Strict regulation of iron levels in mammals is essential because both iron deficiency and overload represent major public health problems. Iron regulatory proteins (IRP) are central regulators in the translation of proteins required for iron metabolism and storage. IRP1 is itself regulated by two mechanisms. One mechanism utilizes an iron sulfur cluster and the other is heme dependant. The latter is a compensatory mechanism in which IRP1 binds heme-iron. This binding of heme causes IRP1 to be targeted for degradation. This project aims to characterize the amino acids in IRP1 that serve as ligands for heme by performing a structure/function analysis on C118 and M230.

## **CULTURAL VARIATION IN ACTION MEANING: DO AMERICANS FOCUS ON GOALS WHILE JAPANESE FOCUS ON PROCESSES?**

Christopher Knoepfler, Yuri Miyamoto (Mentor), Psychology

Actions can be described in ways that relatively favor processes or goals. For example, the act of *locking a door* may be described as *turning a key* (i.e., process-focused) or *securing the house* (i.e., goal-focused) (Vallacher & Wegner, 1989). Little is known about cultural differences in focus on goals versus processes. Cross-cultural research suggests that Westerners are more likely than Easterners to focus on focal objects. We thus hypothesized that Americans focus more on focal aspects of the action (i.e., goals) compared to the Japanese. By using both a forced-choice task (Study 1) and a free description task (Study 2), we demonstrated that Americans prefer goal-focused descriptions more than the Japanese do.

## **EXPLORING NETWORK INFORMATION DYNAMICS USING DIFFERENTIAL EQUATIONS IN THE HYPERBOLIC PLANE**

Charlie Hartman, Adam Beardsley, Mingen Feng, Alex Lanser,  
Amir Assadi (Mentor), Mathematics

A network is a mathematical concept to model interdependencies of an ensemble of objects, such as ensembles of genes, proteins, neurons, financial agents, markets or individuals in a social network such as MySpace or Facebook. The objects are called the nodes of the network. In this project, we propose a novel approach to elicit patterns of “information dynamics” in networks using methods of differential geometry in the hyperbolic space. We illustrate the ideas through concrete computations, description of geometric quantities and their visualization in the hyperbolic plane (the ‘Poincare’ model of non-Euclidean Geometry).

Specifically, we model information dynamics in a network as a geometric structure in hyperbolic geometry. Prediction of dynamics is reduced to solution of systems of differential equations in the hyperbolic plane. We propose a novel geometric approach to solve the system in such a way that its numerical approximation could be interpreted directly via information theory. As a corollary, we offer a “physical interpretation” of the approximation steps in terms of the information contents of the network in the specific context of the application.

## **MONEY AS A SOURCE OF CONFLICT IN DATING RELATIONSHIPS**

Crystal Cayemberg, Lauren Papp (Mentor),  
Human Development and Family Studies

This project examines dating relationships and explores whether money is one of the most common areas of disagreement. The idea for this research was developed given the distressed state of the economy and the prediction that the downward turn can affect dating couples. One hundred and one couples completed surveys and laboratory visits in the UW Couples Lab with Professor Lauren Papp and her research team. We expect that couples living together, as well as couples who work fewer hours per week, will list money as a topic of high disagreement more frequently than couples who do not cohabitate or who work more. The results will direct future research on dating couples’ potential areas of disagreement related to financial stress.

## **DISGUSTING SMELLS CAN INFLUENCE JUDGMENTS OF ASSOCIATED BEHAVIORS**

Madeleine George, Lisa Lindeman (Mentor) Psychology

Past research has shown that people use simple heuristics to judge others. It also has shown that unpleasant odors can influence these judgments, especially in those with high bodily awareness. We wanted to show that the influence of an unpleasant smell can specifically affect the judgments of certain behaviors. As hypothesized, participants with high bodily awareness judged others more harshly in scenarios similar to those associated with smell than neutral scenarios and more than participants with low bodily awareness. This shows that participants unknowingly transferred the disgust they felt for the smell with the presented scenarios and used this pairing to influence their judgments of others. This has implications on how people use simple cues in their environment to influence their opinions.